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Returns to education: Comparison of the USA and Germany

Author: **Lukáš Patera**

Supervisor: Mgr. Barbara Pertold-Gebicka M.A., Ph.D.

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Declaration of Authorship

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Abstract

The thesis examines returns to education in the USA and Germany and provides a side-by-side comparison of the results. An OLS regression is run based on an adjusted Mincer equation with added controlling variables and dummy variables for the highest achieved education degree rather than years of schooling. The results show that higher investment in education needed in the USA yields considerable higher returns than in Germany and also show differences in the impact of potential experience in both countries. However when looking at accumulated earnings including direct costs in form of tuition fees in the USA, the higher returns are diminished, especially in the early stages of life.

Keywords	Returns to schooling, returns to education, USA, Germany, Mincer equation, OLS regression, comparison

Author's e-mail	lukas-patera@seznam.cz
Supervisor's e-mail	barbara.pertold-gebicka@fsv.cuni.cz

Abstrakt

Tato práce zkoumá návratnost vzdělávání ve Spojených Státech Amerických a v Německu a nabízí přehledné srovnání výsledků. OLS regrese je provedena na základě upravené Mincerově rovnice s přidanými nezávislými proměnnými a s umělými proměnnými nejvyššího dosaženého vzdělání namísto počtu let vzdělávání. Výsledky ukazují, že větší investice potřebná pro vyšší vzdělání v USA přináší značně větší návratnost než v Německu a také ukazuje rozdíly vlivu potenciální pracovní zkušenosti na mzdu v obou zemích. Když se však podíváme na celkové příjmy a započteme přímé náklady ve formě školného v Amerických univerzitách, vyšší návratnost je podstatně znegována, především v prvních fázích života.

Keywords	Návratnost vzdělávání, USA, Německo, Mincerová rovnice, OLS regrese, srovnání

Author's e-mail	lukas-patera@seznam.cz
Supervisor's e-mail	barbara.pertold-gebicka@fsv.cuni.cz

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1 Introduction

During the last several decades, opportunities for young people to enroll into universities and colleges and complete their tertiary education degrees are rising steadily (Roser & Ortiz-Ospina, 2013). Having a higher education degree was some 20 or 30 years ago an enormous advantage in searching for a well paid job, compared to recent years, when this achievement is becoming more and more common, to the point where increasing number of employment positions are demanding for applicants to have completed it. This shift in education of the population has prompted researchers to analyse more in depth the real impact of a persons education on his career acomplishments, most commonly measured by the amount of wage. Such research can help students and their parents in deciding whether to pursue the completion of higher education, but can also be an indicator, along with other statistics regarding education, for governments to adjust their country's education systems and policies.

This thesis aims to provide a comparison of returns to schooling between two countries, where the financing of higher education institutions is different. In the USA part of financing these institutions lies on the students and their families through tuition fees while in Germany public universities are free of charge for all students. I run an OLS regression based on the Mincer equation. As suggested by recent literature I added several controlling variables which affect a persons wage and also used dummy variable for the highest completed degree instead of years of education as it is a more accurate representation of one's education than actual years spent in school. I then compare the results for both countries and use them to also depict the accumulated earnings throughout lives of people with different levels of education.

In chapter 2 I first explain the education systems and take a closer look at different education levels in both countries. In chapter 3 I review literature related to the returns to schooling in both countries. A large amount of research has been done on this topic in a lot of countries, using various adjustments to the mincer model. However because of the changing datasets and models it is hard to compare results side by side and that is what I try to cover in my thesis. In chapter 4 I discuss the background of my empirical model and the

description of data and variables I used for my model is then later discussed in chapter 5. In chapter 6 I first analyse how adding the controlling variables into the equation affect the resulting returns to education coefficients in both countries. Next I discuss the accumulated earnings in 6.2 and in 6.3 I give the reader a look at how the returns to education coefficients have changed throughout the years in the USA. Finally in chapter 7 I compared side-by-side all of the results from my analysis on the datasets from the same year. In the final chapter I conclude my findings.

2 Education system

2.1 USA

Children in the USA normally enter formal schooling around age 5 in the form of Elementary (also referred to as Primary) school where they remain until the age of 11. Afterwards students proceed to junior high school (also referred to as middle school) during which they already have the chance to choose from a wide range of elective classes and also options to participate in various before, or after school activities and programs made available through the school (however not paid by the school). At the age of 15 Students continue onto the high school where they stay for 4 years attending grades 9 to 12 which are called freshman, sophomore, junior and senior respectively. This model is the most common across the USA schools, however there are many variations in different states and the lenghts of each stage can vary slightly. Unlike in many other countries, students in the USA don't need to pass any final examination in order to receive a high school diploma. Instead they need to earn a certain amount of credits for successfully completed courses. The required number of credits and compulsory classes is depending greatly on the school district and the kind of diploma across all of the states, much like the primary and secondary education as a whole. The preparation for entering post-secondary education already starts throughout the high school as it is common for the colleges and universities to require certain credits and classes for admission. Also throughout the high school all of a pupil's grades received for courses are recorded and after graduation averaged to provide a student's GPA (Grade Point Average) which is one of the criterions for the selection when applying to college or university.

After finishing high school, there are two main degrees offered at the undergraduate level in the U.S. The Associate's degree which is supposed to be completed in two years and the Bachelor's degree which is supposed to be completed in 4 years. The admission requirements vary tremendously as some programs operate under open admissions and admit most or all students which sign up (need for basic requirements as high school diploma and a certain age) but some other colleges and universities have a wide range of requirements for their applicants. There are a lot of institutions in the USA which are using a holistic admissions model, which means, that for admission they evaluate not only students

academic prowess during secondary studies or results from one of the standardized exams. Applicants are evaluated as a whole person meaning that apart from academic results institutions require information about involvment in extracurricular activities (sports, music, school newspaper etc.), recommendation letters from high shool teachers, essays or personal statements about oneself and sometimes even an interview is conducted before being accepted Into university or college.

Some institutions have Associate's degree programs which are more vocationally-oriented and designed to prepare students for entering the workforce right after obtaining the degree. Other institutions are offering the chance to transfer into a four-year bachelor's degree program. In these an Associate's degree is deemed as equivalent to two years of education toward the Bachelor's degree, however for this transfer the programs need to be from the same institution or an articulation agreement between two institutions must be in place if one wants to transfer across them. The main types of Associate's degrees are: Associate of Arts degree and Associate of Sciences degree which are designed for transfering into a Bachelor program and Associate of Applied Sciences degree and Associate of Applied Arts degree which are mainly considered as terminal degrees.

Bachelor's programs are designed to be completed in four years and for succesfull graduation a cummulative minimum GPA of at least 2.0 (out of 4.0) is required. Students are taking both, general education courses (mostly in first two years) and courses in their selected major field of study (can be selected when enrolling or by the end of second year and can be changed). In some universities also minor field of study needs to be selected. The general education courses make up about one-quarter to one-half of all of students courses. In some institutions students are offered cooperative programs which are usually five years long and include two semesters of internship or work experience. As well as Associate's degree, main types of Bachelor's degree are Bachelor of Arts degree (BA) and Bachelor of Science degree (BS)

Bachelor's degree is the general minimum requirement to be accepted for Master's degree programs and while some doctoral programs will accept high-achieving students with only a Bachelor's degree, mostly students need to have earned a Master's degree to be admitted to a doctoral program. Apart from that the applicants for graduate education are reviewed in

similar way as when applying to undergraduate education, plus they also need to submit a curriculum vitae for overview of their academic and professional background.

Master's degree is typically obtained after one or two years and most programs have the option to customize taken courses based on students career objectives and interests with smaller portion of core courses than in Bachelor's program. To graduate, students need a minimum GPA of 3.0 (out of 4.0) and depending on the orientation of the program either complete a thesis or a major research project (Research-oriented) or submit a paper reflecting on their internship or field experience (Practice-oriented). Instead of these final works students may take a comprehensive exam at the end of their studies.

Doctoral degrees are final degrees in both academic and professional fields and at least four years of study are needed after a Master's degree. First one to two years students take seminars and colloquia as part of their coursework. Afterwards they need to pass comprehensive examination known as qualifying exams. Then doctoral candidates begin to work on original research and write a dissertation which is expected to contribute to knowledge of the field of study. In the end the dissertation must be defended in front of faculty memberes comitee and student's doctoral advisor. If defended succesfully, dissertation is formally signed and doctoral degree is obtained.

2.2 Germany

Compulsory school attendance in Germany starts at the age of 6 when kids most commonly enter the 4 years long grundschule (primary/elementary school). The secondary education is divided into lower and upper and includes a total of 5 different types of schools. Depending on the state, parents can either chose to which school they want to send their children, but in some cases the assignment is mandatory, based on grade averages. In grades 5 and 6 reasignment may occur between different types of schools depending on students prowess and capabilities. There are three main programs in secondary education: hauptschule, realschule and gymnasium.

Hauptschule most commonly lasts 5 years (until grade 9) and ends with final graduation examination and receiving a certificate of completion of hauptschule. While realschule programs are more academically demanding than hauptschule and also take 1 more year to

complete, students can seamlessly transfer after hauptschule graduation into realschule. Students who completed hauptschule traditionally enter upper-secondary programs in more practical fields than their counterparts which have wider range of options.

Studies at a gymnasium program spans across both lower and upper-secondary education and provides the main university-preparatory track for higher education. Upper-secondary stage lasts either from grades 11 to 12 or 13 depending on the state and is focused on specialization of students, where they can choose elective subjects. To graduate, students must pass both written and oral final examination called Abitur which is standardized across Germany. After graduation students receive a certificate of general university maturity and are entitled to study at German universities. The final Abitur grade is an important determinant of how quickly students are admitted into their preferred programs. Other option for upper-secondary studies are vocational education institutions. So called dual-system combining theoretical classroom instructions with practical training in real-life work environment guarantees high-quality vocational education for students. Companies across Germany are participating in this system and are providing training as well as a modest salary to the students. Graduates in the vocational programs are generally not eligible to enter a university program, however they may be admitted based on entrance exams or a probationary study period. Another way to enter higher education from vocational track is to obtain a university of applied sciences maturity certificate which, as the name suggests, allows students to enter universities of applied sciences and can be obtained at a variety of vocational schools.

The most common post-secondary vocational education pathway leads to the qualification of Meister/in (master craftsmen/woman). To obtain this title one must pass a final examination testing both theoretical and practical skills. Preparatory programs for these exams may last between 1-3 years and are mostly combined with part-time work. Afterwards, master craftsmen can run their own business and train apprentices.

In Germany, higher education institutions are divided into two types. Universities focused on research with academic programs and universities of applied sciences (fachhochschulen) offering more narrow range of subjects, which are more practically oriented and usually include industrial internships.

Admission into public German universities is based on the final Abitur grade. While every holder is eligible to study at university, those with higher grades are accepted faster into their preferable programs while those with worse grades need to wait for admission even for several years in some popular programs, such as medicine or law. Students who do not have the Abitur degree can also be admitted into university based on special entrance examinations or probationary period.

Bachelor's degree can be obtained at both types of universities (regular and applied sciences) and usually last 3-4 years. In comparison with the USA universities, in Germany there are less general education subjects and minor specializations but rather more specialized courses within the chosen major field of study. Bachelor's program is finished with written thesis.

Master's programs are also available at either regular or applied sciences universities and last 1-2 years. To be admited into Master's program, students usually need to have a Bachelor's degree in related field of study and sufficiently good grades. Master's program also concludes by writing a thesis.

Doctoral degrees are awarded by universities and research intitutes, only in very rare cases the universities of applied sciences are allowed to offer these programs. Studium at doctoral program can be approached by two ways. Individual programs are focusing on pure research and let the candidate independently prepare his dissertation under the supervision of advisor. Structured programs include another compulsory coursework (3-4 years) and interim assessments in adition to the dissertation.

3 Literature review

Returning to schooling is a desirable topic covered a lot in academic research. As the opportunity to acquire higher education became more available in the second half of the 20th century, so did the interest and need to point out its scientifically observable benefits. Most of the empirical studies focusing on monetary returns to schooling have at their basis the Mincer equation introduced in Mincer (1974).

3.1 Human capital and schooling

When deriving the returns to schooling equation, Mincer (1974) in his work recognized education and working experience as two biggest possible investments in human capital, which size then have big effect on the amount of wage a person can make. Becker (1983) in his work recognised that there are many different possibilities to invest in one's human capital and most of them raise observable earnings at older ages while lowering them at the time of investing. He also pointed out that investing in human capital can be done on the side of the firms. The so called resource-based-theory focused on this phenomenon and Peteraf (1993) explained that firms can gain a competitive advantage based on the superior human capital they have, as it is a non-substitutable resource. Therefore firms should look for the highest quality human capital individuals and pay them accordingly.

Nowadays in most developed countries young people feel pressure of expectation of having the best education possible. The biggest incentive for most young people however remains the expectation of higher future earnings. Therefore the decision of whether continue to obtain a higher level education depends mostly on theirs and their parents perception of future income when taking into account the indirect (and in some countries even the direct) costs of studying, this is confirmed by recent empirical studies such as Jensen (2010). Measuring the effect of schooling on people's earnings can help with these decisions and ultimately have an effect on the whole economies of many countries.

3.2 Empirical research

Grogger and Eide (1995) added major dummies, ability measures, family background variables, and race dummies into the basic mincer equation to analyse what was responsible

for rise in education wage premia in the second half of 20th century. They also used education attainment dummies rather than years of education. Their results suggested that the rise of college wage premium was mostly thanks to skills acquired during college rather than innate ability. And that there is a great dispersion of wage premiums by different majors. Averett and Burton (1996) use structural probit to simulate decision whether to go to college or not. Family background and ability variables are used, and results are compared for males and females separately. Strong correlation between college wage premium and decision to attend college is found for males however not for females. Card (1999) presents, in his work, review of models, assumptions and estimating equations used in returns to schooling literature. He mainly focuses on works that had used: instrumental variables based on institutional features of the school, family background and twin studies. His work brings several conclusions: Evidence from, then latest, studies of identical twins show small upward bias (10%) in the simple OLS estimates; IV estimates of returns to education based on family background are systematically higher than corresponding OLS estimates; Returns to education vary with school quality and parental education; IV estimates based on interventions in the school system tend to be 20% or more higher than the OLS estimates. Heckman, Lochner and Todd (2006) tested assumptions which are used to justify interpretation of the coefficient on years of schooling (or school attendance) in mincer model as a rate of return. In their estimation of marginal internal rates of return they account for direct costs (monetary and psychic) as well as indirect costs, then they incorporate income taxes and length of working life which is also dependent on schooling level. Nordin and Rooth (2014) compared how ability influences returns to schooling in the USA and Sweden. They focused on one cohort of white males divided into groups based on their cognitive-test scores. They also used potential experience as a proxy of work experience. In their work they found a significant and positive relationship between returns to schooling and ability in Sweden, but not in the USA and suggested the reason being the lower price of higher education in Sweden. Webber (2016) combined data from National Longitudinal Survey of Youth (79 and 97), American Community Survey and National Survey of College Graduates to estimate present discounted value of attending college. His analysis accounted for students' major, both cognitive and non-cognitive ability as well as probability of successful graduation. His results suggest that college education is a sound investment for

most individuals, although depending largely on students' major and cost of college, how early in life individuals reach "break-even" monetary level with only high-school graduates.

Many studies do not have different results for different types of higher education degrees. Most of them have either only one kind of degree or they use total years of schooling instead of highest achieved education attainment. I present individual results for Associate's, Bachelor's, Master's and Doctoral degrees in my thesis. Almost all studies are distinguishing between returns for men and for women either by completely separated regressions or by including a dummy variable for sex. Some studies include other control variables either for social aspects such as marital status, region and race or for controlling different career aspects for example firm size, industry or college/university major.

A great number of the studies are focusing on isolating the effect of education on monetary returns and present the most unbiased result possible. Most common methods to achieve unbiasedness are by controlling for innate ability in the form of scores in cognitive-tests, by incorporating instrumental variables in the regression or by analysing dataset consisting entirely of twins. However, most of the studies are only presenting the amounts of benefits in returns to schooling without paying much attention to the costs of completing a higher education degree which I try to incorporate in my results in chapter 7.1.

Due to a large number of variations in models and dataset restrictions, results in previous literature lack the possibility to clearly compare returns to education in countries where higher education is heavily subsidized and those where it is not. My thesis should provide this clear comparison of results executed on the same model and somewhat comparable datasets.

4 Empirical model background

The goal of my thesis is to answer the following questions:

- What are the financial returns to different higher education degrees?
- What are the differences in returns to schooling between the USA and Germany?
- How early in life do the financial benefits of completing a higher education degree outweighs both direct and indirect costs of studying?
- How gender, potential experience, marital status and race affect the hourly wage?

4.1 Mincer equation

Most of the studies on returns to schooling in the past had used in their empirical work some form of earning equation based on the equation introduced in Mincer (1974). Because his work is the buldingstone of my thesis I will now introduce it along with assumptions and problems which were pointed out by other author's works.

Mincer's goal was to create a production function linking skills of an individual in a labour market (human capital) and wage. He then proceeded to express unobservable human capital as observable variables years of schooling and years of experience:

$$\ln(wage) = \beta_0 + \beta_1 * Schooling + \beta_2 * exp + \beta_3 * exp^2 + \varepsilon$$

β_0 is the initial earnings capacity

β_1 is the rate of return to a year of education

β_2 and β_3 represent rate of return to additional year of work experience

Schooling represents years of schooling

Exp represents years of work experience

Exp^2 represents years of work experience squared allowing the wage equation to be quadratic

ε represents unmeasured differences between individuals innate ability

4.2 Assumptions

First assumption of the mincer model is that all of the benefits people get from investing in their human capital by studying are captured by earnings and are not taking into consideration other non-monetary employee's benefits which are present in various forms and values in many jobs. If one was to include these, in kind payments, into the model, the results could potentially differ drastically, because while someone's benefits may have negligible value such as discounts for sport activities or meals, some benefits can be of considerable worth, such as company car or electronics. And of course in some companies these benefits are completely absent. Therefore Björklund & Kjellström (2002) suggested in their work that for the most precise results these non-monetary benefits should be accounted for. Unfortunately in the data I used for my thesis there is not any information on the value of non-monetary employee's benefits, therefore I can't include it in my model.

In Mincer's model, there are not taken into account any costs of education. Although not through the model, in my thesis I take into account both the opportunity costs of schooling – the unearned wages in time of attending a higher education institution and in the case of the USA the direct costs of attending fees. By calculating the costs in the expected earning paths in section 6.4 I show to what extent the costs are offsetting the returns to higher education.

Next assumption is based on the fact that the value of returns to experience earned through on-the-job training is not dependent on the education. According to Lemieux (2006) this can be said for the older data used by Mincer but was not observed in data from the end of 20th century. Results from these suggested that the returns to education were higher for workers with more years of experience than for those with less years of experience. Possible solutions are to either include interaction term between experience and schooling or to run the regression on different cohorts to analyze returns separately for different age groups. These would require a more detailed analysis beyond the span of my empirical work.

The model also assumes that students do not work while they are attending school and that the economy is in a constant state of stable productivity and wages.

While these assumptions do not completely reflect the real world conditions, it is very hard to collect such precise data to adjust the equation accordingly. For the purpose of my thesis of comparing returns in two different countries, where I hold these assumptions the same

for both, those are reasonably sufficient to make as they were used by many researchers before.

4.3 Ability bias

Probably the most addressed problem in the Mincer equation is that it doesn't include any information about the innate ability. The omission of this index could cause an upward bias in the resulting returns to schooling as one's ability may well influence the decision to attend college and also is a big contributor to human capital. This means it either causes correlation between the level of schooling and the error term (making the schooling variable endogenous) or has a big impact on a person's wage (because his human capital is considerably larger or smaller than others with the same education and experience) or both of these. Researchers use mainly three approaches to prevent the ability bias. First is by expanding the model with dependent variable of ability, measured by various test scores, second is by the study of identical twins with the assumption that twins have genetically the same innate ability, therefore the only difference in human capital is determined by the amount of education and experience. And lastly by using an instrumental variable for schooling and thus canceling the correlation with error term. Unfortunately my datasets do not provide enough information in order for me to use any of these approaches. However there is evidence suggesting only small upward bias from studies of identical twins by Card (1999) and even the absence of bias altogether by Ashenfelter & Krueger (1994).

5 Data

5.1 USA

The empirical analysis of returns to schooling in the USA is based on data from American Community Survey from the years 2019 (for the most recent results) and 2017 (for comparison in section 7) which collects information on more than 3 million individuals each year. The dataset includes several demographic information as well as socioeconomic data of every individual.

Because of the large number of observations, I am able to apply restrictions on most of the variables and thus eliminate a lot of irregularities in observed data. For my analysis I consider only individuals who are not, at the time of survey, attending a school. Instead of years of schooling I use the highest completed degree as it is, according to many other studies (Card & Krueger (1992), Lemieux (2006)), more relevant when studying the returns to schooling. Unfortunately, the dataset does not include rates of wage per hour however it does include net salary earnings in the previous year as well as hours worked per week and weeks worked during the year, therefore I am able to calculate the desired variable. Only people who have worked 52 weeks, 40 hours a week and have obtained at least a high school degree are taken into account in my analysis. I also removed individuals with less than 7.25 dollars per hour salary which is the federal minimum wage rate in the United States (unchanged from the year 2009) and individuals with higher wage than the 99^{th} percentile in the dataset, therefore excluding major outliers which could bias the final results as these extremely high earning individuals, in my opinion, achieved success based on unique qualities or external factors which are not observable in our dataset. Next I removed individuals aged below 18 (usual high school graduation age) and above 66 (retirement age in the USA – gradually increasing from 65 to 67 starting in the year 2000 until 2023). As a proxy of work experience I was forced to use potential experience, subtracting the number of years typically needed to complete corresponding degree from age, setting the minimal value of this variable to 0, because actual working experience is not available in the dataset. This is a common way of dealing with such lack of data used in many other empirical works (e.g.: Cameron & Taber (2004), Murphy & Welch (1990)). Because the dataset lack the information about the age at

which each person obtained the highest attained education I used the most common years which are needed to complete each degree (discussed in the chapter 2). Finished high school at 18 years old, Associate's degree at 20 years old, Bachelor's degree at 22 years old, Master's degree at 24 years old and doctoral degree at 28 years old. In the end the dataset used for this analysis consists of 384 193 observations.

5.2 Germany

The data used for analysis of returns to schooling in Germany are from International Social Survey Programme which is conducting annual cross-national surveys on various topics relevant to social sciences. Each year information regarding different topics is gathered in multiple countries, but some socioeconomic data including education and income is present in each year regardless of the topic. Altough there exist more suitable datasets, with more observations and relevant variables, because of availability and my time constraints this dataset was for my thesis the best obtainable choice.

Because the dataset in Germany is significantly smaller than the one I used for the USA (only 1701 observations in 2017 and 1689 in 2016), in order to apply similarly hard restrictions and still end up with statistically significant results I was forced to combine data from two years. Dataset provided only monthly income after all tax and insurance deductions and (average) hours worked weekly. To get pre-deduction wages I used a simplified progression tax and insurance system practiced in Germany[1].Because the amount of tax is based on yearly and not monthly income, for the lack of information I assumed that everyone has worked 12 months in the year prior to the data collection. After increasing the yearly income to pre-tax and pre-insurance value I calculated the gross wage per hour by dividing the gross year income by 48 times hours per week reported by each individual. Only people who reported they worked between 35 and 45 hours per week are considered in my analysis and I also

[1] For net yearly income from 0€ to 14 999€ total tax and insurance deduction was 20%; from 15 000€ to 19 999€ total tax and insurance deduction was 28%; 20 000€ to 24 999€ – 33%; 25 000€ to 29 999€ – 36%; 30 000€ to 34 999€ – 39%; 35 000€ to 44 999€ – 41%; and for 45 000€ and more it was 44%.
Values were derived from internet wage calculator found at https://www.bbx.de/grossnet-wage-calculator-germany/ and checked by other similar sources.

remove observations with less than 8.5 euros wage per hour – the minimum wage in Germany in 2016 and individuals with more than 65 euros per hour excluding 1% of the highest earning individuals as in the USA dataset. Again as a proxy for missing information on work experience I used the potential experience substitute. Because the dataset lack the information about the age at which each person obtained the highest attained education I used the most common years which are needed to complete each degree (discussed in the chapter 2). Finished high school at 19 years old, Meister's degree at 21 years old, Bachelor's degree at 22 years old, Master's degree at 24 years old and doctoral degree at 28 years old. In the end the dataset used for the analysis consists of 879 observations.

6 Results

First, I will analyse how adding controlling variables to the basic Mincer model affects the coefficients of returns to schooling for different education levels. Then, based on the resulting coefficients, I will create the average expected total net earnings paths for each level of achieved education and compare them.

6.1 Basic Mincer model

At first, I will analyse the basic equation, similar to original Mincer model:

$$Log(wage) = \beta_0 + \sum_{i=1}^{4}(\beta_i * Edu_i) + \beta_5 * pot.exp + \beta_6 * pot.exp^2 \quad (1)$$

i=1…4 where

- i_1= Associate's degree in USA or Meister's degree in Germany
- i_2= Bachelor's degree
- i_3= Master's degree
- i_4= doctoral degree

As stated before, I used dummy variables for the highest completed level of education rather than years of schooling. This is because generally, the degree a person holds is a proof of acquired skill or mental capability which ultimately has an effect on the position and salary one can achieve. Whereas the actual years of studying does not necessarily prove anything and can be misleading as generally the more years a person studies the more skills he can acquire, but ultimately if a longer period is needed to obtain a degree, then it could be seen as a worse testament to one's capabilities.

The base completed level of education for comparison is high school degree. Coefficients β_i then tells us by how much percent more of a wage per hour a person with a given degree is expected to make than a person with only a high school degree.

6.2 USA

In the first column (Model 1) in Table 6.1 we see results of regression (1) executed on the most recent data in the USA in 2019. The coefficients of the highest completed levels of education are as expected – positive, meaning that every higher education degree has a higher wage yield than high school degree. Coefficients for potential experience and potential experience squared are also with the expected sign indicating that with more experience people have higher wages but the older people are, the less increase of wage is expected with another year of experience, eventually old age having stronger impact than experience and another year decreasing expected rewards.

6.2.1 Gender variable

First, I add the dummy variable female into the model because it has the most significant impact on wages of all the chosen controlling variables. By adding this variable into the model the adjusted R-squared grew by around 3.5 percent from 23.94 to 27.49. In Model 2 females are expected to earn on average 20.3 percent lower wage than males, In table 6.1 it is clear that by adding other controlling variables the magnitude of variable female is not prone to much change (maximum 0.8 percent lower in final model) indicating that there is not much collinearity between variable female and other added variables.

Adding female dummy variables had some effect on returns to different higher education levels. All of the coefficients have grown with the biggest change observed in returns to Master's degree (from 66.7 pc to 71.4 pc). This change can be explained by the fact that in the final dataset, males have a larger representation in groups without a higher education degree than women which on the other hand have larger representation in groups with a higher education degree most notably in those with Master's degree.

6.2.2 Race variable

I now add the dummy variable race to account for differences between the wages of people of different races. In this model african americans are expected to earn on average 12.2 percent less wages than whites. On the other hand, asians are expected to earn on average 6.9 percent more than whites. The rest of races (mixed races, hinuits, indians etc.) have on average 6.5 percent lower wages than whites.

The coefficients of returns to higher education degrees fell by a couple of percent, least notably the coefficient of returns to associates degree (only 0.25 percent), in comparison with the previous model, indicating that majority of asians have higher degrees, while majority of people belonging to different race than white or asian have only high school or Associate's degrees. Adjusted R-squared rose from 27.49 percent to 28.18 percent.

6.2.3 Marital status variable

Last variable a decided to control for is the single variable depicting the difference between wages of married people and those who are not in a marital relationship. According to this model, people who are not married, holding all other variables constant, are expected to have lower wages by 10.4 percent than those who are. As in the previous model, the returns to schooling have dropped again most notably for those with doctoral degree (by 3.2 percent) and we also see less of a race "discrimination" where all values of coefficient of variables for race got closer to 0.

Table 6.1: Regression results of Model 1 to Model 4 for USA

Coefficient	Model 1	Model 2	Model 3	Model 4
Adjusted R^2	0.239	0.275	0.282	0.290
Intercept	2.515	2.591	2.608	2.701
	(0.002)	(0.002)	(0.003)	(0.003)
Associate's degree	0.153	0.176	0.174	0.169
	(0.002)	(0.002)	(0.002)	(0.002)
Bachelor's degree	0.490	0.520	0.506	0.494
	(0.002)	(0.002)	(0.002)	(0.002)
Master's degree	0.667	0.714	0.698	0.676
	(0.003)	(0.003)	(0.003)	(0.003)
Doctoral degree	0.920	0.945	0.918	0.887
	(0.006)	(0.006)	(0.006)	(0.006)
Potential experience	0.030	0.030	0.030	0.026
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Potential experience squared	-0.0005	-0.0004	-0.0004	-0.0004
	(0.000005)	(0.000005)	(0.000005)	(0.000005)
Female		-0.203	-0.199	-0.196
		(0.001)	(0.001)	(0.001)
Black			-0.122	-0.101
			(0.002)	(0.002)
Asian			0.069	0.064
			(0.003)	(0.003)
Other			-0.065	-0.057
			(0.002)	(0.003)
Single				-0.104
				(0.002)

All coefficients are significant on the 99% level.

6.3 Germany

In the first column (Model 1) in table 6.2, we can see results of regression (1) executed on the most recent data of the year 2017 in Germany. Again every coefficient of returns to higher education degree is higher than the one before just as expected. Coefficients for experience have also the expected sign – non-squared positive and squared negative, meaning diminishing returns to each subsequent year of potential experience.

6.3.1 Gender variable

After adding the female variable into the model the adjusted R-squared have grown by more than 3% from 25.55% to 28.87%. In Model 2 females are expected to earn on average 18.04% lower wage than males.

Adding female dummy variables had some effect on returns to different higher education levels. Every coefficient with the exception of the one for returns to Master's degree have fallen with the biggest change observed in returns to Meister's degree (from 25.6% to 21.1%). These changes are probably due to the fact that there is a bigger portion of all males with higher degrees than the portion of women with higher degrees, most notably with the Meister's degree. Exception being in the Master's degree where the opposite can be said and females having a bigger portion with only high school education.

6.3.2 Living without a partner variable

Final variable tells us the difference between wages of people living without a partner in one household and those living with one. The resulting coefficient suggests that people living alone have lower wages by 12.9%. As in the previous model, the returns to schooling have dropped again most notably for those with doctoral degrees (by 1.5 %) indicating that people with higher degrees live more in a shared household than people with high school degrees. Also the gender inequality in income fell a little bit (less than 1%) probably due to the fact that there is a higher percentage of males living with a partner than females living with one.

Table 6.2: Regression results of Model 1 to Model 3 for Germany

Coefficient	Model 1	Model 2	Model 3
Adjusted R2	0.256	0.289	0.303
Intercept	2.467	2.552	2.631
	(0.055)	(0.055)	(0.058)
Meister degree	0.256	0.211	0.206
	(0.047)	(0.047)	(0.046)
Bachelor's degree	0.409	0.395	0.386
	(0.075)	(0.073)	(0.073)
Master's degree	0.486	0.49	0.484
	(0.034)	(0.033)	(0.033)
Doctoral degree	0.838	0.834	0.818
	(0.094)	(0.092)	(0.091)
Potential experience	0.0248	0.023	0.02
	(0.005)	(0.005)	(0.005)
Potential experience squared	-0.0003	-0.0003	-0.0003
	(0.0001)	(0.0001)	(0.0001)
Female		-0.18	-0.174
		(0.028)	(0.028)
Single			-0.129
			(0.03)

All coefficients are significant on the 99% level.

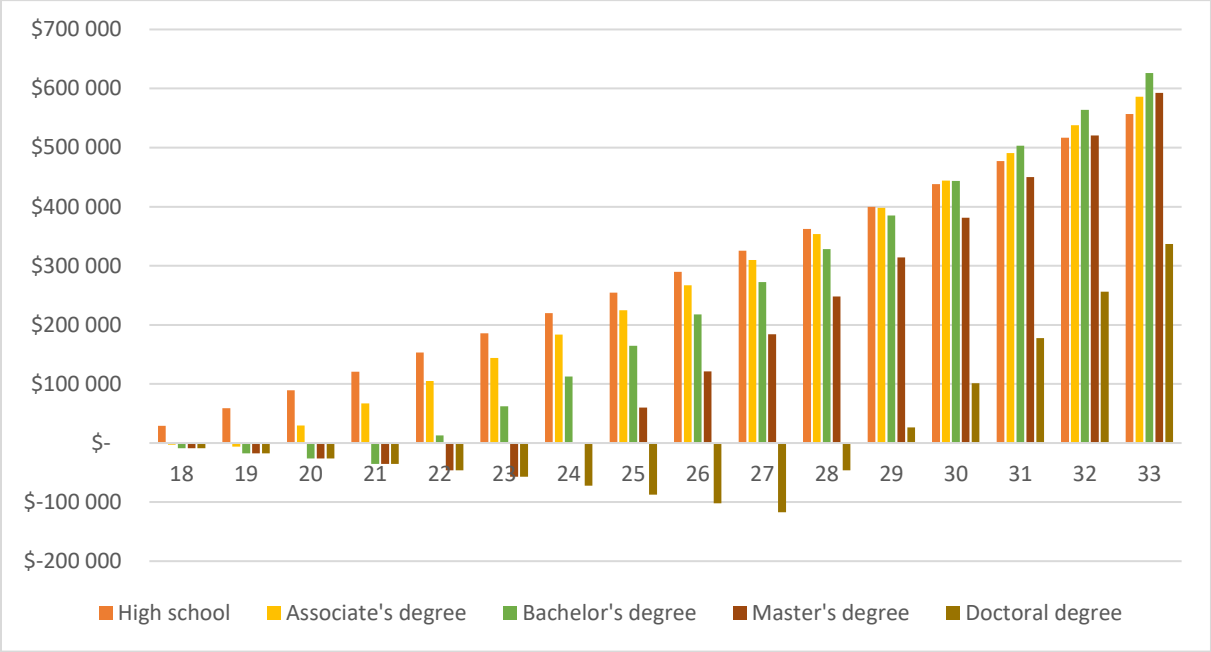
6.4 Accumulated earnings

In this section I will provide a comparison of the average expected net earnings between different degree holders based on the results in the previous chapter. First for the USA (for this section I used results from regression on the data from the year 2017) and then for Germany. The corresponding coefficients for highest degree and for potential experience are used to compute the average expected wage per hour for each degree in every year of age. Since the dependent variable I used in my model is wage per hour I need to convert it to yearly net earnings by multiplying it by 2080(40 hours a week for 52 week – same as my specification in the dataset) for the USA and by 1920 for Germany. Next the costs of attending a college needs to be subtracted over the usual years needed to achieve the degree in USA. The costs I used for this section are taken from the National Center for Education Statistics website. I chose the average tuition fees for in-state students at public institutions in the academic year 2016-2017 as I think these are the best at representing the

average student in the USA. In figures 6.1 to 6.3 we can see the average expected total net earnings for white married men in every year of age based on his highest completed degree in the USA and in figures 6.4 to 6.6 the same for men living with a partner in Germany.

6.4.1 USA

Figure 6.1: Accumulated earnings in the early stage of life for USA



In figure 6.1 we can see that persons without a higher education degree have the highest net earnings for most of their early life because they start working right after high school and have no direct college costs. When they reach the age of 30, both the Associate's degree holders and Bachelor's degree holders already manage to accumulate more money from wages and by the age of 32 only doctoral graduates have less total life earnings then them. The negative effect of holding no degree caught up to them completely at the age of 38 (Figure 6.2) when finally, these people have the least total net earnings and from this point the gap starts to rapidly increase in comparison to any degree holders.

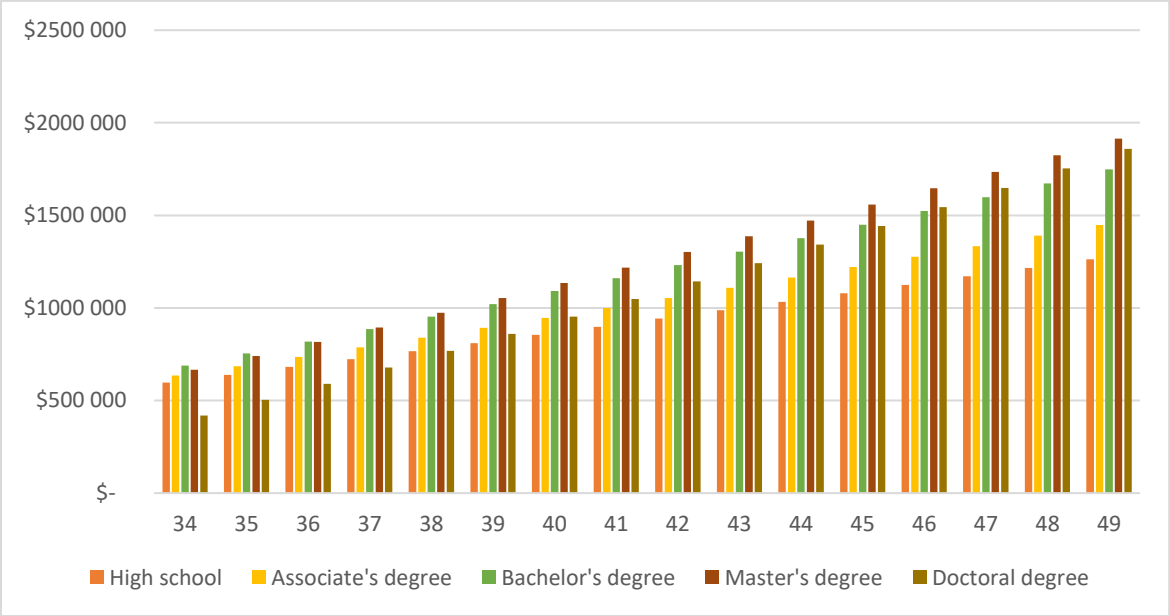
Associate's degree holders have similar earning path, having slightly less for most of the early life and climbing above no degree holders by the age of 30, but by the age of 33 both

those who have Bachelor's and Master's degree are already above with their net earnings, only managing to stay above the doctoral degree holders by two years longer than those without a degree to the age of 40.

Bachelor's degree holders have the highest net earnings in comparison to other groups from age of 31 when they already overcome both less educated counterparts until the age of 37 when Master's degree holders start to accumulate more total net earnings and by the age of 46 the doctoral graduates overcome them as well.

In Figure 6.2 the prevalance of Master's degree holders during the middle part of life is illustrated, having the highest net wage earnings from the age of 37 to the age of 53 (figure 6.3) at the end only failing short to doctoral graduates.

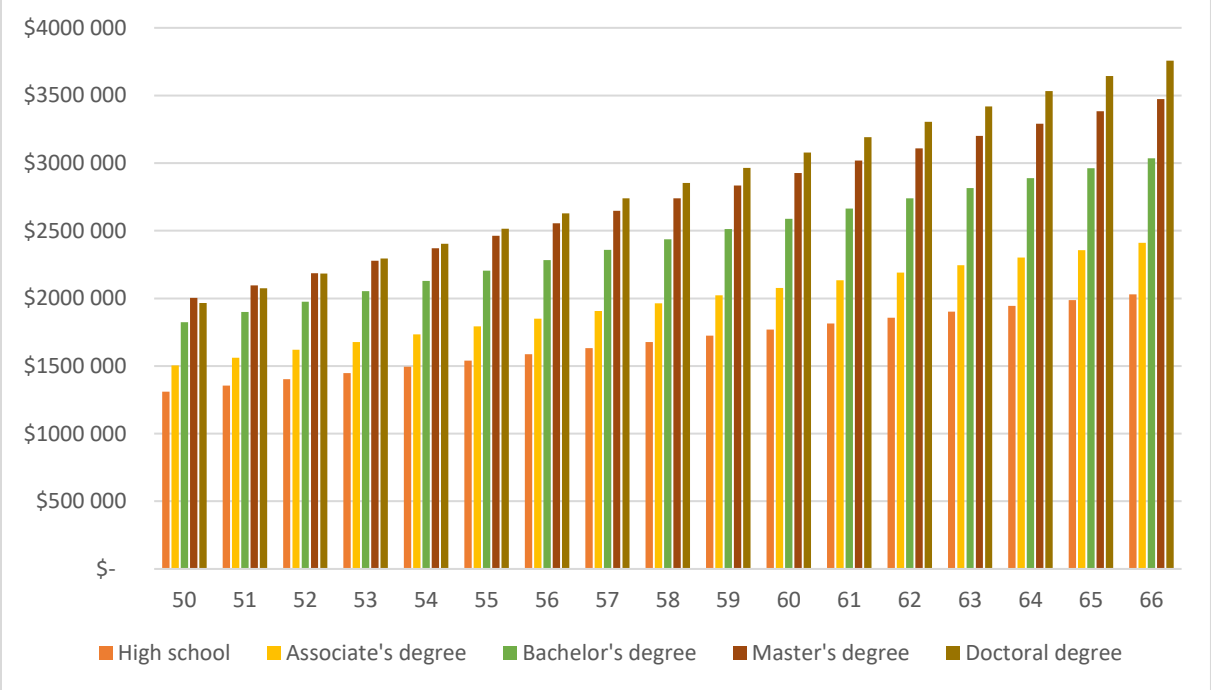
Figure 6.2: Accumulated earnings in the middle stage of life for USA



People with the highest level of education are on average expected to amass the most wage net earnings during their working life even despite spending most of early life in school, losing forgone earnings from salaries as well as facing the most substantial direct costs of studying. Because of this they start to accumulate more net earnings than non university, Bachelor's and Master's graduates only by the age of 40, 46 and 53 respectively, leaving the

monetary returns to education much more later in life then the rest of the degrees, however ultimately with the highest rate.

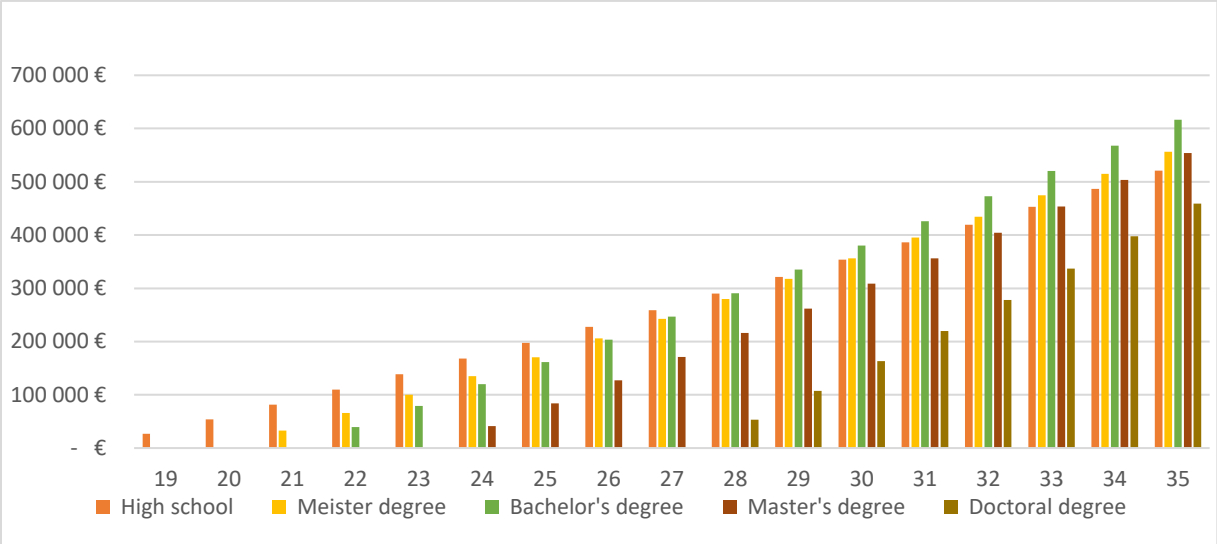
Figure 6.3: Accumulated earning in the late stage of life for USA



6.4.2 Germany

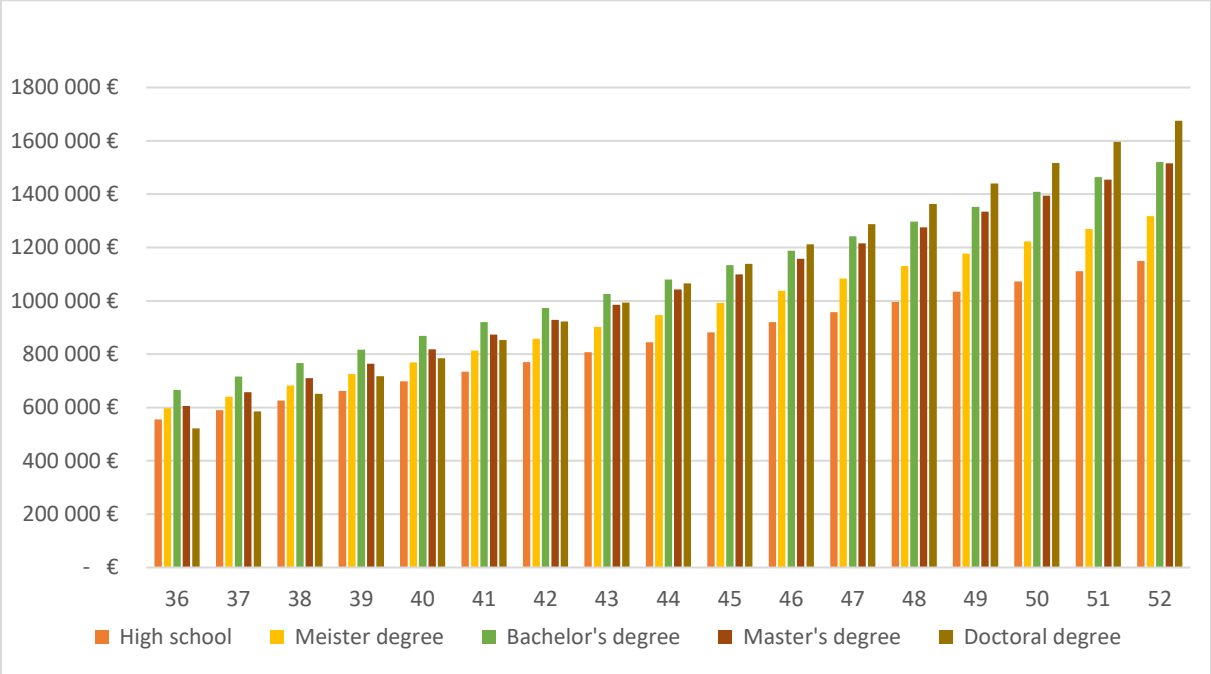
In figure 6.4 we can see that people with a high school degree have the highest net earnings until the age of 28 because they start working at a younger age than their counterparts. At the age of 28 the Bachelor's degree holders are the fastest to earn more overall in wages than them, next at the age of 30 also people with Meister's degree managed to accumulate more in wages and by the age of 33 only doctoral graduates have less total life earnings. By the age of 38 (Figure 6.5) people without higher education are expected to have accumulated the lowest amount of net wages in their life and over the rest of working life the difference starts to increase rapidly.

Figure 6.4: Accumulated earning in the early stage of life for Germany



Total net earnings of Meister's degree holders are overcomed by those of Bachelor's degree holders at the age of 27 whilst still not matching earnings of high school graduates (which they do at the age of 30). The next higher degree holders to accumulate more net earnings are those with Master's degree – at age of 36 and finally doctoral graduates managed to earn more by the age of 40.

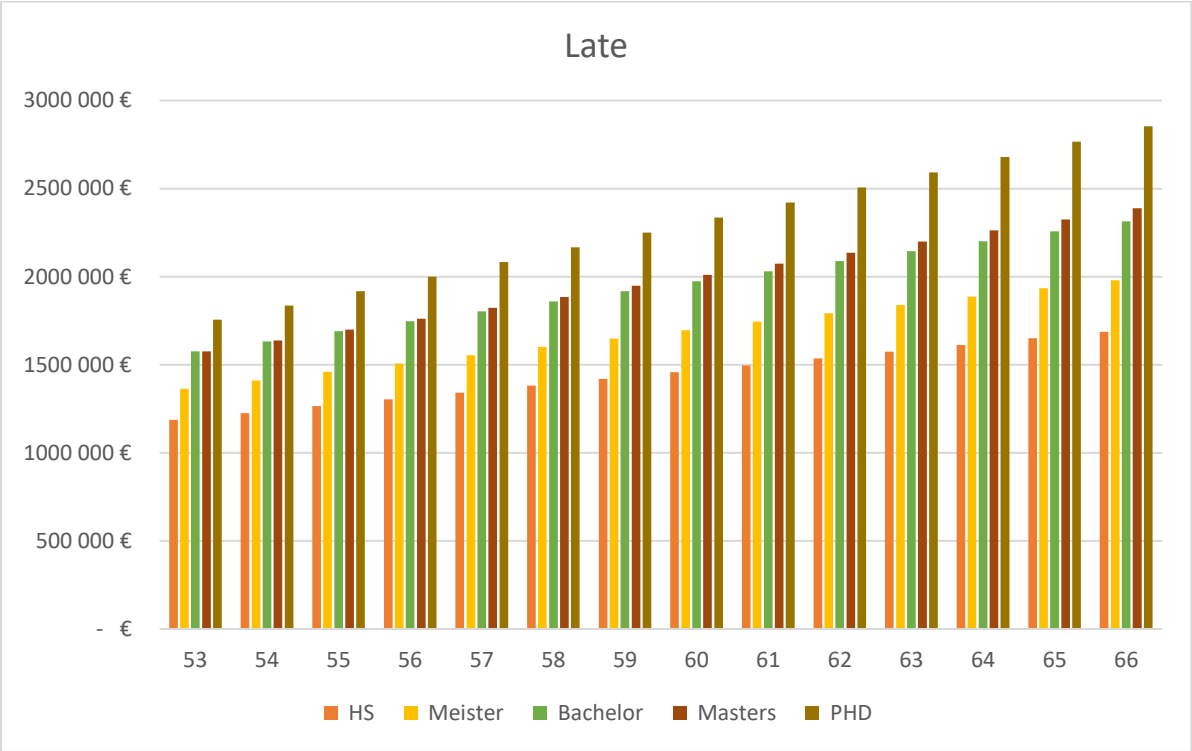
Figure 6.5: Accumulated earnings in the middle stage of life for Germany



Bachelor's degree holders have the highest net earnings in comparison to other groups from age of 28 when they already overcome both less educated counterparts until the age of 45 when first the doctoral degree holders start to accumulate more total net earnings and only by the age of 53 the Master's graduates overcome them as well.

Those with Master's degree are expected to accumulate more earnings than high school graduates and Meister's graduates at 36 years of age and more than Bachelor's graduates only at the age of 54 (figure 6.6) while doctoral degree holders overcome them already when they are 43.

Figure 6.6: Accumulated earnings in the late stage of life for Germany

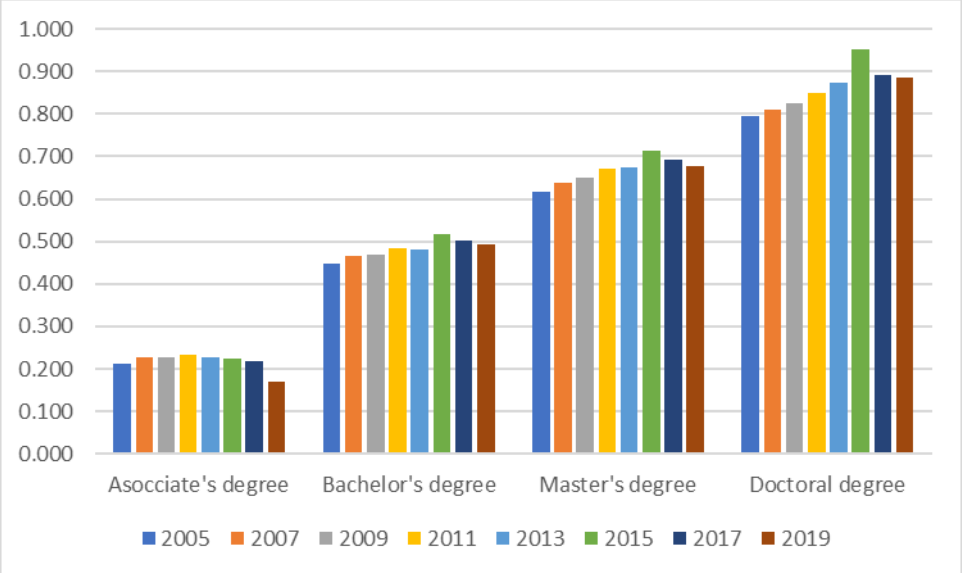


As expected, ultimately those who achieve the highest level of education are expected to amass the most wage net earnings throughout their working life. Because they need the most amount of time in order to complete their degree, the monetary returns start to have bigger values than lower degrees only later in life. Doctoral degree graduates therefore accumulate more net earnings from salaries than high school, Meister's and Master's graduates by the age of 38, 40 and 43 respectively and more than Bachelor's graduates when they are 45 years old.

6.5 Evolution of coefficients in time

In figure 6.7 the progression of returns to education with time in the USA can be seen for each level of higher degree. For the three highest degrees a clear pattern can be seen. Returns to Bachelor's, Master's and doctoral degrees are steadily rising through years 2005-2015 and after reaching peak in 2015, the returns slightly fall off, however not below the level of previous years. The biggest rise over time can be seen in returns to doctoral degree holders who were expected to earn on average 79.5% more than people with only secondary education in 2005 and the most recent data indicating almost 10 percentage points rise to 88.7% with the highest value being 95.1% in 2015. Returns to a Master's degree followed a similar path with smaller differences, starting at 61.6% in 2005 and rising by 6 percentage points to 67.6% in the most recent data, peaking in 2015 at 71.3%. Same pattern but with smallest differences is observable for coefficient of returns to a Bachelor's degree rising by less than 5 percentage points from 44.9% in 2005 to 49.4% in 2019 with highest value reaching at 51.8% in 2015. Returns to Associate's degree were not prone to much change between years 2005-2017 staying in range from 21.3% - 23.3% however the most recent data in 2019 saw, relatively to the rest of the values, a big drop down to only 16.9%

Figure 6.7: Returns to completed degree through time for USA



7 Comparison

Table 7.1: Regression results of final models for both countries

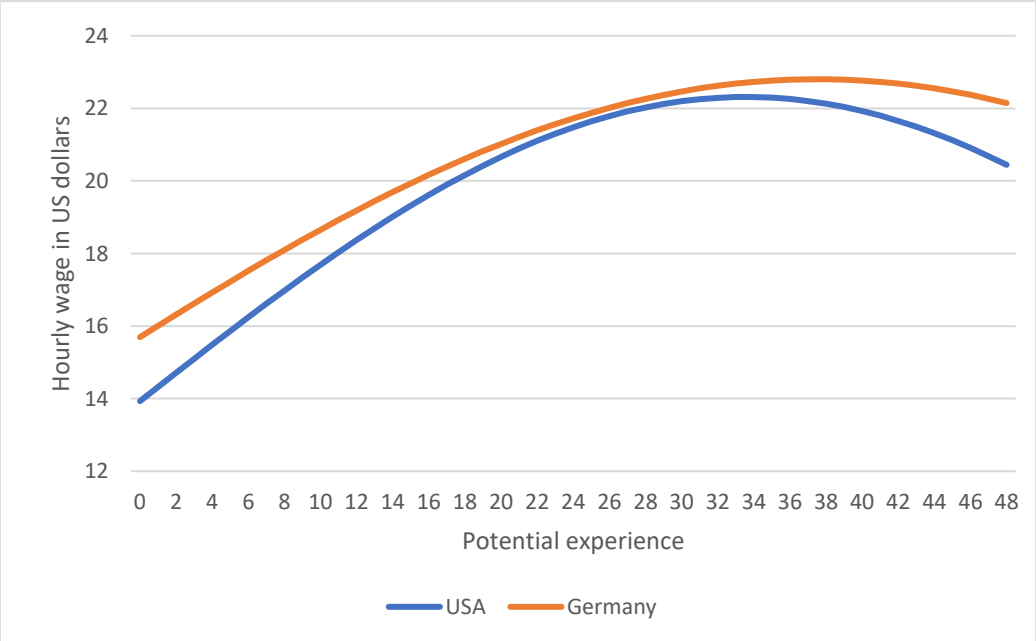
Coefficient	USA	Germany	Germany (split universities)
Adjusted R^2	0.323	0.303	0.304
Intercept	2.634	2.631	2.622
	(0.003)	(0.058)	(0.058)
Associate's/Meister degree	0.217	0.206	0.204
	(0.002)	(0.046)	(0.046)
Bachelor's degree	0.503	0.386	0.459
	(0.002)	(0.073)	(0.092)
Bachelor's applied sciences degree			0.283
			(0.111)
Master's degree	0.691	0.484	0.52
	(0.003)	(0.033)	(0.039)
Master's applied sciences degree			0.42
			(0.049)
Doctoral degree	0.892	0.818	0.819
	(0.005)	(0.091)	(0.091)
Potential experience	0.028	0.02	0.021
	(0.0003)	(0.005)	(0.005)
Potential experience squared	-0.0004	-0.0003	-0.0003
	(0.000005)	(0.0001)	(0.0001)
Female	-0.197	-0.174	-0.18
	(0.002)	(0.028)	(0.028)
Single	-0.098	-0.129	-0.13
	0.002	(0.03)	(0.03)

All coefficients are significant on the 99% level

In table 7.1 we can see regression results for both countries in comparison – column 1 and 2. The intercept which represents white male with high school diploma, zero potential experience and living with a partner in one household is quite similar for both countries. Hourly gross wage for such a person is according to my model expected to be 13,93$ in the USA and 13,88 € in Germany. A little difference shows after accounting for average exchange ratio during 2017: 1 EUR=1.13USD. Standard 160 hour/month then gives us a monthly gross income of 2228.8 $ in the USA and 2509.5 $ in Germany. The first obtainable post-secondary degrees, although somewhat different in way of studying, have very similar financial yields – 20.6% higher wage is expected for Meister‘s degree holders in Germany while 21.7% more

than high school graduates are expected to earn Associate's degree holders in the USA. Considerable differences in returns to highest attended degree are beginning to show in returns to Bachelor's degree which is expected to be 38.6% in Germany while in the USA it is 50.3%. Biggest discrepancy is according to my model between Master's graduates in both countries. While in the USA people with a Master's degree are expected to earn on average 69.1% more, in Germany this value sits, by more than 20 percentage points lower, at only 48.4%. Lower, but nonetheless sizable difference is observable in the results for doctoral degree holders with returns in the USA averaging 89.2% while in Germany it is only 81.8%. These results are in accordance with the fact that people in the USA have to invest not a small amount of money in order to attend colleges and universities while in Germany public universities are free of tuition fees and because of the higher investment, my expectation was that the returns should also be higher. Even if we, in the German data (column 3), distinguish between degrees from university of applied science, where there is more practical focus, and academic university, more focused on research and theory, the expected returns from the clearly more yielding one do not reach the levels of returns from universities in the USA. Although the difference between Bachelor's degrees is now only around 4%, the difference in Master's degrees is still very significant – more than 15%.

Figure 7.2: Potential experience effect on hourly wage for both countries



The effect of potential working experience are best illustrated in the figure above. In the USA the returns to years of working experience are rising faster than in Germany in the beginning of a working career. This can be caused by the fact that the educational system in Germany has a far greater focus on practical studies rather than only academic and therefore most of the students are entering the workforce already with some initial working experience. This means that the first years of experience from employment dont have such an effect as in the USA where it is common for fresh graduates to have close to zero practical knowledge of the job they are about to start. On the other hand, returns to an additional year of experience are more diminishing in the USA as employees reach peak wages after 34 years of potential working experience (at 22.31$ per hour for white male with high school degree living with partner) and afterwards the disadvantages of getting older outweighs the advantages of more amassed experience. In Germany, this peak is achieved only after 37 years (at 22.8$ per hour) and afterwards the descent is less steep than in the USA.

7.1 Break-even age

In this section I will present a side by side comparison of the age at which the expected total net earnings of each degree holder surpass the earnings of each lower degree holder in the USA and in Germany.

In the first part of table 7.1 we see that in both countries the break-even age at which Meister's degree holders in Germany and Associate's degree holders in USA surpass high school graduates is 30 years.

Bachelor's degree graduates reach break-even ages in comparison with both high school (by 2 years) and Meister's/Associate's (by 4 years) graduates faster in Germany than in USA – at 28 and 27 years of age respectively.

People with Master's degrees on he other hand reach break-even ages faster in the USA. By only one year when put against high school graduates (32 in USA and 33 in Germany), by 3 years when put against Meister's/Associate's degree holders (33 in USA and 36 in Germany) and the biggest difference between both countries is seen in the third part of table 7.1

where the Master's graduates reach break-even age against Bachelor's degree holders at 37 years of age in the USA and in Germany it is by 17 more at 54 years of age.

Finally the owners of the highest degree reach break-even ages at the same rate in both countries when put against both high school graduates and Meister's/Associate's graduates. One year is the difference with regards to Bachelor's degree – 45 years old in Germany and 46 years old in the USA. And a big difference is seen in the last part of table 7.1. The break-even age when comparing doctoral graduates and Master's graduates is 43 years in Germany and 53 years in the USA.

Table 7.1: Overview of break-even ages for both countries

	USA	Germany
Break-even age with high school		
Meister's/Associate's degree	30	30
Bachelor's degree	30	28
Master's degree	32	33
Doctoral degree	38	38
Break-even age with meister/associate		
Bachelor's degree	31	27
Master's degree	33	36
Doctoral degree	40	40
Break-even age with bachelor		
Master's degree	37	54
Doctoral degree	46	45
Break-even age with master		
Doctoral degree	53	43

8 Conclusion

The focus of my thesis was to analyse returns to higher education in the USA and Germany when taking into account other factors influencing wages on recent data and to provide comparison of the results, and also if and at what magnitude are the direct costs of higher education in the USA compensated by higher returns than in the case of free public education of Germany. For the analysis I used an adjusted Mincer regression model on the data from years 2016 and 2017 for Germany and 2017 and 2019 for the USA.

The results are indicating that the explanatory variables I added all have significant effect and increased the adjusted R-squared from 0.239 to 0.29 in the case of the USA and from 0.256 to 0.303 in the case of Germany. Adding these variables had mixed effects on the coefficients of schooling in the USA and negative effects in Germany. These results are in accordance with the expectations that individual characteristics are partly responsible for the differences in earnings between people with different education levels.

Thanks to the availability of data I was able to present the evolution of returns to schooling coefficients in time for the USA. The results showed very similar patterns for Bachelor's, Master's and Doctoral degree holders which were increasing from the year 2005 to year 2015 and then to 2019 slightly falling off with the span of changes increasing with higher education levels. For Associate's graduates the evolution was by far the most consistent with the span of changes only 2% apart from the last year 2019 when they fell by nearly 5%.

I compared the resulting coefficients of returns to higher education degrees in both countries. The only non-university degrees (Meister's in Germany and Associate's in USA) had the most similar returns to schooling (20.6% in Germany and 21.7% in USA) however for more advanced degrees the differences were rather large. The biggest difference is between the Master's degree holders (48.4 % in Germany and 69.1% in the USA). Also a big difference was between Bachelor's degrees (38.6% in Germany and 50.3% in USA) and a bit lower difference between Doctoral graduates (81.8% in Germany and 89.2% in the USA). The biggest differences observed in Bachelor's and Master's returns to education can partly be explained by the division in German education at these levels, on universities focused on practical and others focused on academic knowledge (university of applied

sciences/research university). The results from regression in which these types of universities are recognised indeed show significant divergence in the financial returns. Applied sciences Bachelor‘s graduates have returns of only 28.3% in contrast to research university Bachelor‘s graduates returns of 45.9%. And for Master’s level the applied sciences have returns of 42% to research returns of 52%. However, even the higher returns of graduates from research universities do not reach the levels of returns of their counterparts in the USA. Clearly overall, the higher investment in the form of direct costs in the USA yields higher returns to schooling than in the free public education case of Germany with the exception being non-university higher degrees which is almost the same.

In the end I provided an overview of the break-even ages at which people reach overall the same amount of net wages (taking cost into account in the case of the USA) as people with lower educational degrees. Master’s degree holders are the only group who reach break-even ages faster in the USA than in Germany. On the other hand the other university degrees provide break-even ages earlier in life in Germany than in the USA although the difference is only a couple of years in most cases (exception is break-even age for doctorate graduates in comparison to Master‘s where a big difference is due to low returns for Master‘s graduates in Germany rather than difference in returns to doctorate degree). For the Associate’s and meister degree the result is, as expected due to similar returns in the previous chapter and also lowest direct cost in the USA, that in both countries the break-even age with high school graduates is the same at 30 years old.

Overall the results of my thesis indicate that higher education direct costs in the USA which may seem quite substantial to a young person are compensated by a higher expected returns, than observed in the free public schooling system of Germany. Although for the case of Bachelor‘s and doctoral degrees the difference in returns is not as impactful as to ensure higher financial advantage over people with less education in the USA than in Germany. For the Master’s graduates the returns are so much higher in the USA than in Germany that they more than enough compensate for the direct costs and even ensure bigger financial advantages over the less educated. As for the non-university degrees, the financial advantages over the high school graduates are very similar in both countries.

However I would recommend more thorough analysis and more evidence from other countries before being confident in making conclusions whether it is more profitable for students and employees in subsidiary education systems or not.

Bibliography

Angrist, J.D & Krueger, A.B., 1991. Does Compulsory School Attendance Affect Schooling and Earnings? The Quarterly Journal of Economics, 106(4), pp.979-1014.

Ashenfelter, O., Harmon, C. & Oosterbeek, H., 2000. A review of estimates of the schooling/earnings relationship, with tests for publication bias. NBER working paper series 7459

Ashenfelter, O. & Krueger, A.B., 1994. Estimates of the Economic Return to Schooling from a New Sample of Twins. The American Economic Review, 84(5), pp.1157–1173.

Averett, S.L. & Burton, M.L., 1996. College Attendance and the College Wage Premium: Differences by Gender. Economics of Education Review, 15(1), pp.37-49.

Barrow, L. & Rouse, C.E., 2005. Do Returns to Schooling Differ by Race and Ethnicity? The American Economic Review, 95(2), pp. 83-87

Becker, G.S., 1983. Human capital: A theoretical and empirical analysis with special reference to education, Chicago: IL: University of Chicago Press.

Bhuller, M., Mogstad, M. & Salvanes, K.G., 2014. Life Cycle earnings, Education Premiums and Internal Rates of Return. Discussion Paper Series in Economics 24/2014, Norwegian School of Economics, Department of Economics, pp.993-1030

Björklund, A. & Kjellström, C., 2002. Estimating the return to investments in education: How useful is the standard Mincer equation? Economics of Education Review, 21(3), pp.195–210.

Boarini, R. & Strauss, H., 2007. The Private Internal Rates of Return to Tertiary Education: New Estimates for 21 OECD Countries. OECD Economics Department Working Papers 591, OECD Publishing.

Cameron, S.V. & Taber, Ch., 2004. Estimation of Educational Borrowing Constraints Using Returns to Schooling. Journal of Political Economy, 112(1), pp.132-182

Card, D., 1999. The causal effect of education on earnings. In Handbook of Labor Economics. pp. 1801–1863.

Card, D. & Krueger, A.B., 1992. Does School Quality Matter? Returns to Education and the Characteristics of Public Schools in the United States. The Journal of Political Economy, 100(1), pp.1–40.

Fuente, A. de la & Jimeno, J.F., 2005. The Private and Fiscal Returns to Schooling and the Effect of Public Policies on Private Incentives to Invest in Education: A General Framework and Some Results for the EU. CES working paper series 1392

Grogger, J. & Eide, E., 1995. Changes in College Skills and the Rise in the College Wage Premium. Journal of Human Resources, 30(2), pp.280-310

Heckman, J.J., Lochner, L.J. & Todd, P.E., 2005. Earnings Functions, Rates of Returns and Treatment Effects: The Mince Equation and Beyond. IZA Discussion Papers 1700, Institute of Labor Economics (IZA).

Jensen, R., 2010. The (Perceived) Returns to Education and the Demand for Schooling. Quarterly Journal of Economics, 125(2), pp.515–548.

Lemieux, T., 2006. The "Mincer Equation" Thirty Years After Schooling, Experience, and Earnings. In Jacob Mincer A Pioneer of Modern Labor Economics. Boston: Kluwer Academic Publishers, pp. 127–145.

Loo, B., 2018. Education in the United States of America. Published online at wenr.wes.org. Available at: https://wenr.wes.org/2018/06/education-in-the-united-states-of-america [Accessed July 21, 2021].

Mincer, J., 1974. Schooling, Experience, and Earnings, New York: National Bureau of Economic Research.

Murphy, K.M. & Welch, F., 1990. Empirical Age-Earnings Profiles. Journal of Labor Economics, 8(2), pp.202-229

Nordin, M. & Rooth, D.-O., 2014. Increasing Returns to Schooling by Ability? A Comparison between the USA and Sweden. The Manchester School, 82(S2), pp.1-20.

OECD, 2017. Education at a Glance 2017: OECD indicators, Paris: OECD Publishing. Available at: https://www.oecd-ilibrary.org/education/education-at-a-glance-2017_eag-2017-en [Accessed May 15, 2021].

OECD, 2019. Education at a Glance 2019: OECD indicators, Paris: OECD Publishing. Available at: https://www.oecd-ilibrary.org/education/education-at-a-glance-2019_f8d7880d-en [Accessed May 15, 2021].

Peteraf, M.A., 1993. The Connerstone of Competitive Advantage : A Resource-Based View. Strategic Management Journal, 14(3), pp.179–191.

Polachek, S., 2007. Earnings Over the Lifecycle: The Mincer Earnings Function and Its Applications. IZA Discussion Papers 3181, Institute of Labor Economics (IZA).

Reisel, L., 2013. Is more always better? Early career returns to education in the United States and Norway. Research in Social Stratification and Mobility 31/2013, pp.49-68

Roser, M. & Ortiz-Ospina, E., 2013. Tertiary Education. Published online at OurWorldInData.org. Available at: https://ourworldindata.org/tertiary-education [Accessed July 25, 2021].

Strauss, H., de la Maisonneuve, Ch., 2007. The Wage Premium on Tertiary Education: New Estimates for 21 OECD Countries. OECD Economics Department Working Papers 589.

Trines, S., 2021. Education in Germany. Published online at wenr.wes.org. Available at: https://wenr.wes.org/2021/01/education-in-germany-2 [Accessed July 22, 2021].

Webber, D.A., 2016. Are college costs worth it? How ability, major, and debt affect the returns to schooling. Economics of Education Review 53/2016, pp.296-310