

Dissecting the Comparatively Low Education Premium in Sweden – an Empirical Approach

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Abstract:

Previous studies show that Sweden has the lowest rate of return to tertiary education in the OECD, significantly lower than its Nordic neighbors. Common factors suggested by conventional theory in explaining differences in the education premium are related to relative supply and demand of skilled labor, productivity, labor market features and fiscal policy. We investigate whether these factors can explain the comparatively low education premium in Sweden by performing pooled OLS (POLS) with time fixed effects and elaborating by Blinder-Oaxaca decomposition, on a panel data set containing 27 countries. At best we are able to explain around 60 % of the difference between Sweden and the rest of the sample, and the size of the public sector along with the tax level are shown to contribute most to the explained difference. The relatively large degree of unexplained difference may in part be due to omitted variables which are suggested by conventional theory, of which some were not possible to include because of inadequate data. It might also reflect that the observed gap in the education premium stems from unexplained variation not attributed to level differences in the factors, but instead differences in coefficients.

Keywords: Returns to Tertiary Education, Mincer Earnings Function, Blinder-Oaxaca Decomposition, Sweden

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1 Introduction

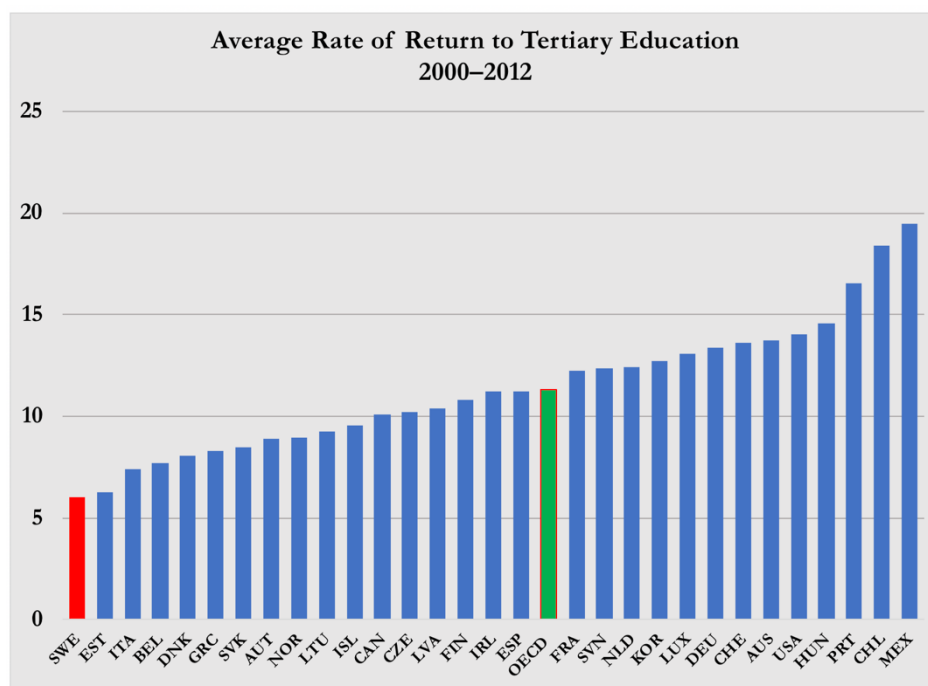
“A man educated at the expense of much labor and time... may be compared to one... expensive machine... The work which he learns to perform... over and above the usual wages of common labor, will replace the whole expense of his education” (Smith 1776, cited in Psacharopoulos and Patrinos, 2008).

Individuals face a choice of pursuing tertiary education or starting employment which does not require higher education, thereby enabling more years of active labor. Higher educated workers must therefore be compensated by higher yearly earnings in order to recoup their initial investment in education. The education premium, i.e. the return to tertiary education, is the factor most directly related to decisions of individuals contemplating tertiary education, even if non-monetary incentives probably contribute as well.

Sweden has the lowest rate of return to tertiary education in all of OECD, illustrated below in Figure 1, and it has declined in recent years (Montenegro and Patrinos, 2014). The most common and straightforward explanation for the level of the education premium in a certain country beyond relative productivity is relative supply and relative demand of skilled labor, which is why low and middle income economies in general show a higher education premium than high-income economies. However there are many countries classified as high-income economies within the OECD region exhibiting premiums considerably higher than Sweden, even its Nordic neighbors, as seen in Figure 1. Understanding what factors affect the education premium, is of interest firstly to policymakers as they might be able to have an impact on the level of the premium and thereby governing the long term effects of the education premium on societal and economic structure. In a world of high international labor mobility, likely to continue developing in the same direction, it is also of individual interest to students pursuing higher education to know where they might be more or less compensated for their degree when seeking employment, and where to pursue the education itself as well.

Figure 1: Average returns to tertiary education, estimated using Mincerian wage equations, during the period 2000–2012 with Sweden highlighted and a reference bar for the mean (11.32 %).

Graphics: The authors. Data source: Montenegro and Patrinos, 2014.



Our intention is to investigate whether factors suggested by conventional theory on what contributes to the level of the education premium can be useful in determining why Sweden exhibits the lowest in the entire OECD region. The literature review lays the foundation for identifying factors, mainly related to relative supply and demand of skilled labor, productivity, labor market features and fiscal policy, which according to the current state of knowledge may explain the level of the education premium. We compile panel data for 27 OECD countries during the time period 2000–2012 and perform pooled OLS (POLS) with time fixed effects sequentially adding control variables corresponding to the categories of interest. If our model estimation suggests that the factors could indeed help explain the gap in the education premium, a Blinder-Oaxaca decomposition is carried out in order to better understand the relative importance of factors. It is also an attempt to examine any potential unexplained variation affecting the comparably low Swedish premium.

Our results show we are able to explain around 60 % of the gap which indicates that factors suggested by conventional theory can be useful in understanding the situation. The highest marginal contribution stems from controlling for the public sector size as well as the tax level. Importantly though, the unexplained difference also yields an interesting insight that alternative

approaches and factors, as well as further examination of Sweden-specific coefficients relating the factors to the Swedish education premium, might be required in order to better understand differences in rates of return to tertiary education among OECD countries and the Swedish disparity in particular.

The thesis is structured in the following way: Firstly we highlight important previous literature related to our subject, which is later used for selecting relevant control variables in our study. Thereafter we explain our research focus and specific research question followed by our data and empirical strategy used in order to try and answer it. Lastly we present our results and discuss the implications of them.

2 Literature Review

2.1 Historical Background

Estimates of the return to investments in education have been made since the latter part of 1950. Schooling induces higher labor productivity and hence economic growth as well as poverty reduction. The measure of returns is traditionally estimated as the proportional labor market earnings increase which each additional year of completed schooling adds subtracting its incremental costs. There are five consistent conclusions found in a vast amount of different surveys. First of all, returns to education for individuals are in general positive and the average cross-economy rate of return is 10 % per year. However the returns seem to be higher in low and middle income economies, compared to levels in high-income economies. Globally the highest rate of return to schooling are found at the primary level, and somewhat lower for secondary and tertiary education. Further women experience a higher rate of return to education compared to men, and finally there has been an increase in demand for skilled labor as the rate of returns have only modestly declined even though there has been an increase in supply (Montenegro and Patrinos, 2014).

2.2 Productivity Enhancement Theory and Signaling

Kjelland (2008) states that an individual contemplating the pursuit of higher education will do so if the net present value of additional future earnings is higher than the economic, psychic and alternative costs of attaining the education. He further describes two different established theories

explaining why an individual with higher education can expect higher earnings, which constitutes the education premium. The first one is human capital theory which states that an education results in higher labor productivity for the individual receiving it, and as workers are paid the equivalent of their marginal product they will therefore have higher earnings. The second and competing theory is signaling, which states that education serves as a screening device, separating the more productive individuals from the less productive, but the education itself does not increase productivity. Which of the competing theories is correct has no effect on individual choice of education as only future earnings are considered, no matter where they stem from. On the other hand it is of importance to society since assuming signaling theory is correct, the expenditure on education is of lower value if the education does not lead to increased productivity.

Van der Velden and Bijlsma (2016) find evidence in favor of human capital theory in a cross-country analysis of 22 OECD countries. According to them the college wage premium is explained in large part by a combination of higher skill level, the ability to use the skills in the jobs and job requirements well matched to the skill level. This effect on the college wage premium is clearly larger in the private sector, compared to workers employed in the public sector. Signaling is also showed to have an effect on the premium. In countries where educational credentials strongly signal skill the college wage premium is higher and hence the analysis favors both of the two competing theories, productivity enhancement and signaling. Another finding possibly in favor of the productivity enhancement, comprised in the human capital theory, is presented by Lemieux (2006). He finds that the return to education differs across wage distributions and that the highest returns are found in the higher percentiles of (log) wages. This possibly reveals a complementarity between skills unrelated to work experience and a higher education premium, given that there is a positive relationship between ability and labor income.

Testing if a signaling effect exists or disentangling the premium to estimate to what extent the rate of return constitutes productivity enhancement effects as compared to signaling effects is a common approach in the literature since the two different effects lead to very different policy implications. For example given the productivity enhancement theory, years of schooling is directly linked to economic growth whereas signaling instead could facilitate labor market matching (Fang, 2006).

2.3 Relative Supply and Demand

In the United States there is a consensus that fluctuations in the college wage premium can be explained by the changes in relative supply and demand of skilled labor (Katz and Murphy, 1992). Van der Velden and Bijlsma (2016) further state that relative supply of high-skilled labor is showed to have a strong effect on the college wage premium, negatively affecting it. As for the underlying factors affecting demand Kreuger (1993) points at technological change as the main reason for an increased demand of high-skilled labor and therefore higher education premium. The U.S. showed a decelerating premium in the 1990s which in part is attributed to a sharp increase in college enrollment in the mid 1980s and hence an increase in the supply of high-skilled labor (Fortin, 2006). Her analysis of the effect of relative supply on the college premium is inconclusive for states which are characterised by a high share of enrollment in private education and/or high labor mobility, but in other cases there is evidence in favor of this linkage. Domeij and Ljungqvist (2006) compare the changes in skill premia, measured as relative wages between college and high school graduates, in Sweden and the U.S. between 1970–2002. They find that, when differentiating between private and public sector employment, the relative supply of skilled and unskilled labor can explain the dramatic decrease in the Swedish skill premium during the period. By making this distinction, their analysis suggests that an expansion of the Swedish public sector caused by a disproportional hiring of low-skilled labor has resulted in the decrease of the Swedish skill premium.

2.4 Labor Market Dynamics and Government Policies

A phenomenon subject to much recent research is overeducation, referring to when an individual has a higher educational level than is required for the job he or she holds (Levels et al., 2014). Estimates of graduate overeducation vary both by gender and with the methods used to calculate it, but it is believed to lie between 21 % and 46 % in Australia (Kler, 2005). Levels et al. (2014) show that the wage effect of overeducation is half of the wage effect of required education, which supports the intuition that overeducation negatively affects the education premium. They further find that the educational mismatch can be partly explained by heterogenous skills among workers and measuring only one skill, the effect of numeracy skills on wages, they are able to explain 25 % of the wage effect of overeducation. Finally collective wage bargaining is found to be negatively correlated to the impact of skill on wages, meaning that for countries with high degrees of collective wage bargaining a smaller share of wage differences can be explained by skill related factors. OECD (2017) also states that collective bargaining coverage affects the wage dynamics in

the labor market. The same is found by Aidt and Tzannatos (2002), examining economic effects globally of unions and collective bargaining based on over 1,000 primary and secondary studies. One of their most robust finding suggests that the presence of unions compress wages, lowering the rate of return to education.

Constructing estimates for rates of returns to schooling, using Mincerian wage equations, de la Fuente (2003) concludes that numerous government policies seem to highly influence the levels of the private education premium. In fact subsidies specifically aimed at education increase the private rate of return whereas taxes and social benefits lower the rate of return. Further it is found that these counteracting effects result in a net subsidy to education in most European Union countries. Fortin (2006) states that education policies may affect the college premium but their ability to do so is contingent on two factors, that price effect is an important factor in the labor market and that policies lead to a shift large enough to substantially change the supply.

3 Research Focus

3.1 Research Question

The comparatively low education premium in Sweden is what we strive to understand. It is substantially lower than the OECD average but also lower than the other Nordic countries. As we have not found any recent research dedicated to Sweden with a similar approach, we consider it particularly meaningful to use the current state of knowledge to try to understand the observed disparity. The specific research question and its subquestion which the thesis will intend to answer are formulated as follows:

Can factors suggested by conventional theories explain the disparity between the Swedish rate of return to tertiary education and the higher returns in the rest of the OECD region?

If so, what factors appear to be the most important affecting the observed gap?

3.2 Limitation of Scope

We will restrict our study to OECD members, Lithuania being the exception but currently about to become a member, mainly due to availability of extensive, comparable data. In addition to allowing comparable data this also yields a set of rather comparable countries as they have a much

more similar institutional context, compared to other countries in for example Africa and the Caribbean. This facilitates analysis, as there would otherwise be a greater need for controlling for cross-country differences which can affect the education premium level, in order to produce fruitful comparisons. We narrow the selection of countries further, by focusing on economies in Europe, North America and Australia, which allows for additional increased structural similarity. Two different sets of countries are used based on income definition as described in Section 5 below, to mitigate still existing differences that could distort our results. Since the data on the dependent variable extends from 2000–2012 this naturally sets the time span of interest for our study.

The role of signaling effects and its possible ability to explain variation in the rate of return to education is not explicitly considered or treated in this thesis. This is mainly because signaling is by its nature challenging to include for the purpose of inference, since quantitative ex ante data is not readily available and only ex post data should fail to capture the effect of signaling. Another reason for this limitation is that numerous studies on the subject struggle to prove a considerable effect of the signaling component (Harmon et al., 2000). In addition effects of signaling is not of interest to policymakers as they rather expect to see, and are motivated by, results of increased productivity from investments in education.

Conventionally, the education premium is broken down into two parts: social and private rate of return. However this should not be viewed as a binary classification since the social rate of return is derived from the private return. The profitability rate from the standpoint of the state (i.e. the social rate) is mainly used in the decision making of allocating public funds to educational investments. On the other hand, the main objective of estimating private returns to schooling is to explain individual behavior and incentives associated with his/her choice of education (Psacharopoulos, 1995). In this thesis we will focus entirely on the private rate of returns. Lastly we focus solely on the monetary education premium and do not take psychic costs into account.

4 Data

4.1 Data Overview

Table 1: Panel data variables, where the dependent variable is highlighted in grey.

Panel Data Variables		
Name	Description	Data Source
Education Premium	Return to tertiary education, Mincerian earnings equation.	Montenegro and Patrinos, 2014
Share Tertiary Degrees	Share of population (25–64 years) with a tertiary degree.	OECD, Adult education level
ln(GDP per Capita)	The natural logarithm of GDP per capita in USD, constant prices 2016 PPP.	OECD, Level of GDP per capita and productivity
GDP per Hour	GDP divided by total hours worked by all individuals engaged in production. USD constant prices 2010 PPP.	OECD, GDP per hour worked
Collective Bargaining Coverage	Share of workers covered by collective agreements expressed in percentages.	OECD, Collective bargaining coverage
Unemployment	Share of workforce with advanced education (minimum bachelor's degree) who are unemployed.	World Bank, Unemployment with advanced education
Tax	Tax paid by employee as a share of total labor cost, measured on married couple with two children where one earns 100 % of average earnings and the other 67 %.	OECD, Average tax wedge
Social Expenditure	Public social expenditure as a share of GDP.	OECD, Social expenditure (SOCX)
S.T.E.M.	Science, technology, engineering and math graduates as a share of tertiary graduates.	OECD, Graduates by field of education
Public Sector Size	Employment in general government as a percentage of total employment	OECD, Public employment and pay

The data used in this thesis was retrieved from the World Bank and OECD databases, as illustrated above in Table 1. All variables were then combined to create the panel data set used for analysis throughout the thesis. The data set includes 201 observations ranging over the period 2000–2012 from 27 countries, namely:

Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Iceland, Italy, Lithuania, Luxembourg, Latvia, Netherlands, Norway, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United States

where 78 % of the countries have 7 or more observations.

4.2 Data Adjustments

Our panel data is relatively short, meaning that the number of entities is greater than the number of time periods (Cameron, 2007). We have tried to mimic a balanced panel data by inferring the missing observations. This to avoid listwise deletion weakening the statistical power of our tests.

4.2.1 Interpolation

The initial data set shows a high number of missing values, leading to a low number of observations and several omitted variables when running regressions, thereby disabling meaningful statistical analysis. In order to handle missing values, to increase the number of observations included, adjacent values for the control variables are used for interpolation. In cases where one single data point is missing, meaning there is a value for a specific control variable in the year before and after the missing value, the average of the two adjacent data points is calculated. When there are several missing values for a specific control variable and a specific country, meaning more than one single data point is missing in between adjacent values, using the average value for these is deemed inappropriate. Instead they are linearly interpolated, resulting in a gradual increase or decrease. Consistently this rule of action is used for all control variables exhibiting missing values but showing adjacent values for a specific country, enabling our calculations to be performed and increasing the number of observations. The method described results in the previous missing values being replaced in a linear form and each missing value takes on a value more similar to the adjacent value closest to it.

4.2.2 Extrapolation

Having imputed using interpolation, extrapolation is considered to handle and potentially inferring missing values outside the range of observations. In order to be consistent and avoid the risk of overfitting the data associated with non-linear fitting, only linear extrapolation is used. The method is solely applied when fitting a linear trend yields a high R^2 and it makes intuitive sense, resulting in mitigation of the missing values illustrated below in Table 2.

Table 2: Specification which observations have been linearly extrapolated.

Linear Extrapolation		
Country	Year(s)	Variable
Austria	2011–2012	Collective Bargaining Coverage
Belgium	2009–2012	Collective Bargaining Coverage
Denmark	2011–2012	Collective Bargaining Coverage
France	2010–2012	S.T.E.M.
Italy	2004–2006	Public Sector Size
Norway	2004	Share Tertiary Degrees
Norway	2010–2012	Collective Bargaining Coverage
Slovakia	2012	Collective Bargaining Coverage
Slovenia	2005–2006	Public Sector Size
Spain	2004–2006	Public Sector Size
Sweden	2012	Collective Bargaining Coverage
Sweden	2004–2006	Public Sector Size

4.3 Dependent Variable

Data on our dependent variable, the tertiary education premium, comes from the World Bank report “Comparable Estimates of Returns to Schooling Around the World” (Montenegro and Patrinos, 2014) documenting recent figures on the education premium in an extensive manner. In order to use comparable and consistent premium figures for the purpose of the thesis, the data collected for the dependent variable comes exclusively from this relatively exhaustive data source. Their study considers the time period 1970–2013, but it should be noted that only 25 % of the observations are from before 2000. Data availability also affects the geographical source of observations, where the Latin America and Caribbean region have the highest representation, 36 %, as opposed to North America which has the lowest with only 2 % of observations. Tertiary education showed the highest rate of return, 15.2 % on average, which is the measure we use, compared to 10.6 % for primary and 7.2 % for secondary education.

They estimate the education premium by creating an extensive database containing national household surveys retrieved from the World Bank International Income Distribution Database (I2D2). After standardizing variable definitions in order to present comparable results, their database consists of 139 economies and 819 economy-year points. As their specification of the rate of return to education becomes more complex, allowing for differences in educational attainment and gender specification, the number of observations drop. They estimate the private rate of return to education by calculating the mean of semi-logged earnings functions. This is also known as the Mincerian method and is currently the conventional method used in order to estimate marginal rates of return to schooling. Below, in Table 3, the estimated levels of private rates of

return to tertiary education used in this thesis are illustrated. Then follows a specification of the Mincerian method and how it has been employed by Montenegro and Patrinos (2014) in order to calculate the returns.

Table 3: Descriptive statistics on the dependent variable for all countries in the sample.

Rate of Return to Tertiary Education (Average 2000–2012)			
Portugal	16.52	Latvia	10.40
Hungary	14.59	Czech Republic	10.20
United States	14.03	Canada	10.10
Australia	13.74	Iceland	9.53
Switzerland	13.60	Lithuania	9.27
Germany	13.38	Norway	8.97
Luxembourg	13.08	Austria	8.92
Netherlands	12.46	Slovakia	8.71
Slovenia	12.34	Greece	8.29
France	12.24	Denmark	8.08
Spain	11.24	Belgium	7.73
Ireland	11.23	Italy	7.43
Finland	10.80	Estonia	6.27
Sample Mean	10.56	Sweden	6.03

As mentioned earlier the standard method, in order to estimate returns to education, applied in current research is the Mincerian method (Mincer, 1974) using log earnings equations of the type:

$$\ln(w_i) = a + \beta_1 S_i + \beta_2 X_i + \beta_3 X_i^2 + \mu_i \quad (1)^1$$

where S_i equals years of schooling, X_i equals potential years of labor market experience and μ_i is a random disturbance term. The potential years of labor market experience is calculated as $age_i - S_i - 6$, where 6 is the assumed age when starting school. The coefficient β_i can consequently be interpreted as the average private rate of return to an additional year of education. Investigating this marginal labor wage effect on the basis of different educational attainment the continuous variable S_i can be replaced by a series of dummy variables, each representing different levels of education:

¹ Equation retrieved from Montenegro and Patrinos (2014).

$$\ln(w_i) = \alpha + \beta_p Dp_i + \beta_s Ds_i + \beta_t Dt_i + \beta_l X_i + \beta_2 X_i^2 + \mu_i \quad (2)^2$$

where β_t is the return coefficient of tertiary education and therefore of interest in the context of this thesis, in order to separate the returns to tertiary education. Derived from this extended Mincerian Equation (2), the private rate of return to tertiary education can be calculated using the equation:

$$r_t = (\beta_t - \beta_s) / (S_t - S_s) \quad (3)^3$$

where t denotes tertiary education and s denotes secondary education. This yields the marginal wage effect of an additional year of tertiary education holding secondary education as the counterfactual and taking into account costs directly derived from the education. These costs include direct costs paid by the recipient of education like tuition fees and course material, but most importantly foregone earnings caused by the absence of labor income during the period of education. Private benefits equal the post tax wage exceeding that of the control group.

4.4 Control Variables

Relative supply of skilled labor is closely related to the education premium (Katz and Murphy, 1992). We believe a good estimate of the supply of skilled labor is the share of the population which holds a tertiary degree. The variable *Share Tertiary Degree* is defined as the percentage of the population which have completed tertiary education, i.e. holds a tertiary degree. The age span included is 25–64 years old and it is measured as a percentage of same age population, that is the share of individuals between 25 and 64 years old which have a tertiary degree.

According to Montenegro and Patrinos (2014) the education premium is in general higher in low- and middle-income economies, compared to high-income economies. The income level of a country should therefore have a negative effect on the education premium and this is the reason for including GDP per capita as a control variable in our regressions. The variable *ln(GDP per capita)* is defined as GDP per capita in USD in constant prices 2016 and adjusted for purchasing power parity (PPP). By taking the natural logarithm of the variable, its coefficient can be interpreted as a percentage change.

² Ibid.

³ Ibid.

In microeconomics it is widely accepted that workers are paid their marginal product which motivates the inclusion of GDP per hour as a control variable, as it is a productivity measure of output per hour of labor and a higher productivity (presumably in part an effect of tertiary education) would according to theory yield a higher education premium. A productivity measure specific to skilled labor would suit our purpose better but due to data unavailability this variable is chosen instead. The variable *GDP per hour* is defined as GDP divided by the total number of hours worked by all individuals who participate in production and is measured in USD, constant prices 2010 and PPP.

There is a shortage of S.T.E.M. graduates (Science, Technology, Engineering and Math) and an increasing demand for this type of skilled labor (Bell, 2013). Excess demand puts an upward pressure on wages and hence the education premium associated with these fields, and therefore a measure of S.T.E.M. graduates as a share of total tertiary graduates is included as a control variable. This variable could potentially also be seen as a proxy for technological change, and thereby be related to productivity, which according to Kreuger (1993) increases demand for high-skilled labor, and hence the education premium as well. To estimate the amount of S.T.E.M. graduates the following four degrees, categorized by OECD, are considered:

Computing (ISC 48), Mathematics and Statistics (ISC 46), Science and Engineering and Manufacturing and Construction.

In order to get the proportion of S.T.E.M. graduates as a measure of total graduates, which constitutes the variable *S.T.E.M.*, the calculated number of S.T.E.M. graduates was divided by the number of total tertiary graduates within all fields for any given country and year.

In countries with high collective wage bargaining, less of wage effects can be attributed to skill (van der Velden and Allen, 2014). Relative earnings between workers with higher education and those without are related to minimum wage laws and other labor market structures such as collective bargaining coverage (OECD, 2017). Collective bargaining coverage is believed to affect wage dynamics and there should be a negative correlation to the premium, as the presence of unions are found to compress the wage distribution between skilled and unskilled labor (Aidt and Tzannatos, 2002). The variable *Collective Bargaining Coverage* is defined as workers covered by collective agreements divided by the total number of workers in the labor force.

Unemployment among skilled labor is believed to capture the dynamics of relative supply and demand, as unemployment indicates an excess supply of skilled labor in the labor market. The variable *Unemployment* is defined as the share who are unemployed, in the part of the labor force where individuals hold a bachelor's degree, or higher completed level of education.

As the data we use for the dependent variable, the education premium, is measured after tax we also include the tax wedge as it explicitly contributes to a lower premium. The variable *Tax* is defined as the tax paid by a married couple with two children where one parent receives 100 % of average earnings and the other 67 % of average earnings, as a share of the total labor cost for the employer inflicted on him/her by having these individuals employed.

Expenditure on social benefits are negatively correlated to the education premium (de la Fuente and Ciccone, 2003). In order to control for differences between countries in this aspect we include the control variable *Social Expenditure*, which is defined as public social expenditure as a share of GDP.

There is a connection between the size of the public sector and the skill premium and the large decline in the skill premium in Sweden between 1970 and 1990 may be attributed to the public sector growth at that time (Domeij and Ljungqvist, 2006). Also van der Velden and Bijlsma (2016) find evidence that a lower skill premium prevails in the public sector compared to the private sector. Therefore we include the control variable *Public Sector Size*, which is defined as employment in general government as a percentage of total employment.

Optimally we would have been able to include control variables accounting for overeducation and the level of minimum wage but due to inadequate data on overeducation and several European countries not having a statutory minimum wage this could not be achieved.

Table 4: Descriptive statistics on all control variables for Sweden, rest of the sample and a selection of individual countries.

Control Variable Descriptive Statistics								
	Sweden	Not Sweden	Denmark	Norway	U.S. ⁴	France	Germany	Spain
Share of Population Holding a Tertiary Degree⁵								
Mean	32.87	27.12	33.07	35.35	39.07	27.57	25.86	29.83
StdDev	2.12	7.30	1.33	2.53	2.58	2.13	1.55	1.82
Coeff of Variation	0.06	0.27	0.04	0.07	0.07	0.08	0.06	0.06
Count	9	192	9	9	3	9	8	9
GDP per Capita⁶								
Mean	39678.97	35054.41	39692.94	55893.97	42986.41	34184.36	38343.58	31023.10
StdDev	3981.28	14638.56	4261.09	7228.35	6039.70	2918.13	3762.63	2427.96
Coeff of Variation	0.10	0.42	0.11	0.13	0.14	0.09	0.10	0.08
Count	9	192	9	9	3	9	8	9
Collective Bargaining Coverage⁷								
Mean	90.67	63.09	82.60	68.85	13.30	97.47	61.26	77.13
StdDev	2.37	27.11	1.56	1.10	0.82	0.73	2.23	1.73
Coeff of Variation	0.03	0.43	0.02	0.02	0.06	0.01	0.04	0.02
Count	9	187	9	9	3	9	8	9
Unemployment in the Advanced Sector⁸								
Mean	3.83	4.92	3.89	1.87	N/A	5.51	3.99	10.32
StdDev	0.41	3.04	0.99	0.54	N/A	0.61	1.21	3.26
Coeff of Variation	0.11	0.62	0.25	0.29	N/A	0.11	0.30	0.32
Count	9	189	9	9	N/A	9	8	9
Tax Wedge⁹								
Mean	40.99	34.80	32.89	33.36	25.72	45.03	43.46	36.10
StdDev	2.45	8.06	0.76	0.29	1.03	0.34	1.34	0.94
Coeff of Variation	0.06	0.23	0.02	0.01	0.04	0.01	0.03	0.03
Count	9	185	9	9	3	9	8	9
Public Social Expenditure¹⁰								
Mean	26.57	21.51	26.74	20.92	16.42	29.37	25.18	23.06
StdDev	0.86	4.56	1.93	1.23	2.63	1.27	0.98	2.77
Coeff of Variation	0.03	0.21	0.07	0.06	0.16	0.04	0.04	0.12
Count	9	185	9	9	3	9	8	9
Share of Graduates with a S.T.E.M. Degree¹¹								
Mean	30.05	27.14	23.80	20.55	19.27	32.94	37.19	29.35
StdDev	2.72	6.74	1.30	1.16	0.89	0.63	1.20	0.60
Coeff of Variation	0.09	0.25	0.05	0.06	0.05	0.02	0.03	0.02
Count	9	155	9	9	3	9	8	9
Share of Labor Force Employed in the Public Sector¹²								
Mean	29.68	18.07	29.26	29.38	16.91	21.65	11.16	13.94
StdDev	0.95	5.19	1.00	0.52	N/A	0.28	0.24	1.49
Coeff of Variation	0.03	0.29	0.03	0.02	N/A	0.01	0.02	0.11
Count	9	124	6	6	1	6	6	9

In Table 4 above we observe that Sweden shows a higher average value than the aggregate rest of the sample for all control variables except *Unemployment*. The largest disparity is found in *Public Sector Size* and *Collective Bargaining Coverage*, in which Sweden on average exceeds that of other countries by more than 60 % and 40 % respectively. *Unemployment and Collective Bargaining Coverage* show the largest variance for the aggregate sample, excluding Sweden.

⁴ OECD has no data for the U.S. for the particular measure of unemployment in the advanced sector.

⁵ OECD, Adult education level.

⁶ OECD, Level of GDP per capita and productivity.

⁷ OECD, Collective bargaining coverage.

⁸ World Bank, Unemployment with advanced education.

⁹ OECD, Average tax wedge.

¹⁰ OECD, Social expenditure (SOCX).

¹¹ OECD, Graduates by field of education.

¹² OECD, Public employment and pay.

The selected countries in Table 4, show similar levels in *GDP per capita*, Norway standing out with a higher level, and all countries have an above average level except for France and Spain. Descriptive statistics for all individual countries are found in Appendix A. The U.S. stands out, having a substantially lower degree of *Collective Bargaining Coverage*. France, followed by Sweden, has the highest level and only Germany is below the full sample average. Spain has a level of *Unemployment* almost 90 % higher than France which shows the second highest level, which deviates from the rather compressed levels of the other countries. Considering *Tax* there is a substantial difference between France, showing the highest level, and U.S.A., showing the lowest level and the remaining countries are quite evenly distributed in between. All countries have *Social Expenditure* above 20 % but below 30 %, U.S. being the exception with a lower level. Regarding *S.T.E.M.* Germany has the highest level, almost twice that of the U.S. which has the lowest. The distribution of *Public Sector Size* is relatively dispersed, though notably almost identical for Sweden, Denmark and Norway.

5 Method

5.1 Regressions

The Mincerian earnings function still serves as a conventional method when estimating rates of returns to schooling. Hence the assumption that a linear relationship exists between wages, years of schooling and work experience continue to constitute a basic theoretical framework in recent literature and empirical studies (Heckman et al., 2006). In line with prevalent practice we therefore assume a linear relationship between the rate of return to tertiary education and our set of quantitative control variables. We use pooled OLS (POLS) and add control variables progressively. Effectively this means that when moving right, column wise, in the resulting regression tables the array of covariates is sequentially expanded.

We start by checking the mean difference in the education premium between Sweden and the rest of the sample by only including the dummy variable *Sweden* as follows:

$$Y_{it} = \beta_0 + \text{Sweden}_i + \varepsilon_{it} \quad (4)$$

where β_0 is the intercept, $Sweden_{it}$ is a dummy variable taking on the value of 1 if the observation is from Sweden and 0 if else and ε_{it} is the error term. By having the dummy variable as the only independent variable, a base case is presented where the difference in mean of the dependent variable between Sweden and the rest of the sample is established.

Then we proceed by controlling for differences related solely to time. This is done by introducing a set of dummy variables with one dummy variable for each year in the sample, excluding the last year. The reason is to avoid falsely interpreting relationships between variables which are due to aggregate trends rather than specific effects. Thus time fixed effects have been introduced to the basic POLS model. The second regression therefore is illustrated as follows:

$$Y_{it} = \beta_0 + Sweden_i + T_{i1} + \dots + T_{i12} + \varepsilon_{it} \quad (5)$$

where T_{i1} is time 1 (=2000) for country i , T_{i2} is time 2 (=2001) for country i and so forth until T_{i12} which is time 12 (=2011) for country i . Time 13 (=2012) is omitted to avoid perfect multicollinearity.

The various control variables are divided in different categories and one category is added in each additional regression run in order to isolate the conditional marginal contribution of those particular features of interest and facilitate interpretation of the results. The first category refers to fundamental economic concepts and aims to control for differences in the supply of skilled labor and the income level between the countries, by including *Share Tertiary Degree* and *GDP per capita* to the model. The second category is called productivity and aims to control for differences in productivity among the countries by including *GDP per hour*. The third category handles labor market features and includes *Collective Bargaining Coverage* and *Unemployment*, with the latter considered as a measure of excess supply of skilled labor. Lastly the fourth category covers fiscal policy and introduces the control variables *Social Expenditure* and *Tax*. Generally the equation can be expressed as follows:

$$Y_{it} = \beta_0 + Sweden_i + T_{i2} + \dots + T_{i12} + \beta X_i + \varepsilon_{it} \quad (6)$$

where X_i is a vector capturing all of the control variables employed in the various regressions.

Public Sector Size is included in an additional regression. The reason why it is added separately in the end is that the inclusion causes a major fall in observations. To allow interpretation of its contribution, only the observations for which *Public Sector Size* is available are first used for a regression including the variables previously introduced, followed by a regression including the variable *Public Sector Size* as well.

Lastly, in order to prevent any distortion made by countries which do not have a similar income level as Sweden, which might affect the results, an alternative adjusted sample only including high-income countries¹³ is also tested. The method described above is repeated on the sample when all countries which were not defined as high-income countries during a majority of the period are excluded. This results in the exclusion of Estonia, Latvia, Slovenia, Slovak Republic, Hungary and Lithuania. Their exclusion also allows for the inclusion of the productivity variable *S.T.E.M.* as there is then no large drop in observations which was previously a problem. To ensure that the sample adjustment does not affect our other findings, *S.T.E.M.* is only included in an additional last regression after having repeated our method exactly to reveal any potential differences due to the change in sample. This is illustrated in Table 9, in Part 6.2.2, showing the regressions using the adjusted sample. The specification including the full sample will be referred to as *Specification 1* whereas the specification restricted to the high-income sample will be referred to as *Specification 2*.

5.2 Blinder-Oaxaca Decomposition

To study mean outcome differences between two groups the counterfactual decomposition technique known as Blinder-Oaxaca decomposition is widely used (Jann, 2008). In order to perform the decomposition, first two group-specific regressions need to be executed. That is, our linear regression model is divided into two groups, as illustrated below:¹⁴

$$Y_i = \begin{cases} \beta^{Sweden} X_i^{Sweden} + \varepsilon_i^{Sweden} \\ \beta^{Not Sweden} X_i^{Not Sweden} + \varepsilon_i^{Not Sweden} \end{cases} \quad (7)$$

where the outcome variable is the premium, X_i is a vector containing the control variables and β contains the slope parameters and the intercept.

¹³ Country Classification for aid and repayment terms by OECD, based on World Bank's threshold.

¹⁴ Based on equation in O'Donnell et al. (2007).

Denoting the sample not containing Sweden A and the sample consisting of Sweden B , the mean outcome difference in the premium can be expressed accordingly:¹⁵

$$R = E(Y_A) - E(Y_B) \quad (8)$$

where the mean difference (R) can be decomposed into the components:

$$R = Q + U \quad (9)$$

where Q is the “explained part” caused by inter group level differences in the predictors (or control variables) and U is the “unexplained part” caused by differences in the coefficients and unobserved variables. Hence U captures the effects of partial correlations relating the independent variables to the dependent, not observed in a single regression model. This is called a “twofold” decomposition where the first part describes the change in the Swedish premium if Sweden had had the same characteristics (or endowment) as the rest of the sample and the second part describes the change in the Swedish premium when applying the mean A coefficients.

More detailed Q and U can be written as:

$$Q = \{E(X_A) - E(X_B)\}' \beta^* \quad (10)$$

and

$$U = E(X_A)' (\beta_A - \beta^*) + E(X_B)' (\beta^* - \beta_B) \quad (11)$$

where β^* is an unknown nondiscriminatory reference coefficient that needs to be estimated. Without making an assumption about the direction of the discrimination affecting the premium level, not derived from differences in X 's, β^* is estimated by a pooled regression over both groups as advocated by Neumark (1988).¹⁶

In addition to decomposing the mean outcome difference into the explained and unexplained part, the contributions of each of the control variables to both parts of the differential will be examined

¹⁵ Equations (8)–(13) are based on Jann (2008).

¹⁶ A robustness check is performed in Appendix B, changing the estimation of the reference coefficient to equal β_A under the assumption that discrimination is instead directed only towards Sweden (Jann, 2008). Using this alternative assumption yields very similar results.

by a further detailed decomposition of the components Q and U . These components are simply sums of the individual contributions of each control variable as expressed below by Equation (12) and (13).

$$Q = \{E(X_{1A}) - E(X_{1B})\}' \beta_1^* + \{E(X_{2A}) - E(X_{2B})\}' \beta_2^* + \cdots + \{E(X_{nA}) - E(X_{nB})\}' \beta_n^* \quad (12)$$

$$U = E(X_{1A})' (\beta_{1A} - \beta_1^*) + E(X_{1B})' (\beta_1^* - \beta_{1B}) + E(X_{2A})' (\beta_{2A} - \beta_2^*) + E(X_{2B})' (\beta_2^* - \beta_{2B}) + \cdots + E(X_{nA})' (\beta_{nA} - \beta_n^*) + E(X_{nB})' (\beta_n^* - \beta_{nB}) \quad (13)$$

5.3 Endogeneity, Multicollinearity and Heteroskedasticity

Including country-specific fixed effects to control for omitted variable bias (OVB) is simply not viable since conditional on country fixed effects, the Sweden dummy variable could not be used to observe the difference in education premium across the countries. Given our research question and data used, no assumptions for the error term can be made. The zero conditional mean assumption (Wooldridge, 2012) is likely to be violated meaning that the existence of omitted-variable bias in the estimators is probable. This since a model perfectly describing variation in the education premium is not feasible nor the purpose of this thesis. The potential existence of OVB is likely to affect the accuracy of our interpretations of the coefficients. With that in mind, an as large as possible set of relevant control variables have been included in the model. However since the purpose of this paper is not to explain causal effects about the education premium, the endogeneity problem is not crucial in order to draw fruitful conclusions based on our findings, since the coefficients nevertheless can be motivated as partial correlations.

In addition a large bivariate correlation between the two GDP metrics are detected (0.9178 in *Specification 1* and 0.8667 in *Specification 2*), illustrated below in Table 5, as well as a variance inflation factor (VIF) of approximately 25 for each of the metrics for both specifications. This causes a likely multicollinearity problem making it non-viable to interpret a linear relationship between any of these two assumed independent variables with the dependent variable. Therefore an exclusion of one of the variables is required in order to sustain a linear model. Since we have another independent variable controlling for productivity, *GDP per hour* is omitted from the regression model.

Table 5: Average Pearson Correlation between $\ln(\text{GDP per Capita})$ and GDP per Hour over both specifications

	GDP per Hour	$\ln(\text{GDP per Capita})$
GDP per Hour	1.000	
$\ln(\text{GDP per Capita})$	0.8923	1.000

Furthermore since we have multiple control variables controlling for the same category of interest the potential problem of multicollinearity must be considered. A simple analysis of the variance inflation factors for both our set of samples (the full sample as well as the high-income sample) is performed. This in order to detect whether the variance of the OLS estimators is “too large” magnifying the size of the confidence intervals. The variance inflation factor alone is not sufficient to determine whether a multicollinearity problem exists in our model. Though it might be an indicator if a potential alarming correlation prevails between our control variables, obstructing a meaningful interpretation. Considering a small average VIF of approximately 2.55 for the full sample and the highest individual factor around 4, well below the conventional rule of thumb risk level of 10, the multicollinearity problem is possibly not alarming, but indeed not ruled out. The average VIF of the high-income sample is 2.54 with no factor above 4. Important to have in mind is that a small sample size, which should be considered the case for both our samples, also affects the variance of the estimated coefficients. In addition a high variance in an estimator could also stem from a misspecified model including independent variables with no partial effect on the dependent variable (Wooldridge, 2012).

We use a Breusch-Pagan/Cook-Weisberg test for heteroskedasticity in order to investigate whether this might be a problem in our dataset. The null hypothesis is constant variance in the error terms, i.e. homoskedasticity, and the resulting p-value for the test is 0.1220 (as seen in Table 6) for the full sample resulting in failure to reject the null hypothesis. The p-value for the sample only including high-income countries is 0.1415 (as seen in Table 7) also resulting in failure to reject. However a failure to reject the null hypothesis does not mean that we can conclude that the alternative hypothesis is correct. In light of this we decide to use robust standard errors¹⁷ for all regressions, in order to reduce the potential problem heteroskedasticity might cause and since it is common practice in empirical work.

¹⁷ An alternative would be to use clustered standard errors, but we choose not to as it is a more advanced method and not covered by course material at the undergraduate level.

Table 6: Including Full Sample

Breusch-Pagan / Cook-Weisberg Heteroskedasticity Test**Ho: Constant variance**

Chi2(1)	2.39
Prob > Chi2	0.1220
Results	Cannot Reject Ho

Table 7: Restricted to High-Income Countries

Breusch-Pagan / Cook-Weisberg Heteroskedasticity Test**Ho: Constant variance**

Chi2(1)	2.16
Prob > Chi2	0.1415
Results	Cannot Reject Ho

6 Results

6.1 Bivariate Correlations

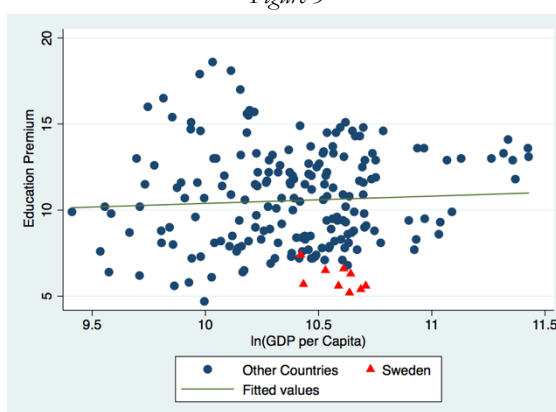
Presented below in Figures 2–10 are scatter plots containing the dependent variable and every control variable respectively, excluding the dummy variables. The observations belonging to Sweden are separated and each corresponding data point is highlighted as a red triangle. The full sample of 27 countries is presented. Consistently the education premium is set on the y-axis whereas the various independent variables are set on the x-axis. This in order to graphically illustrate the bivariate correlations in order to see if they are consistent with previous literature as well as to see if Sweden appears as an outlier.

6.1.1 Fundamental Economic Theory

Figure 2



Figure 3



6.1.2 Productivity

Figure 4

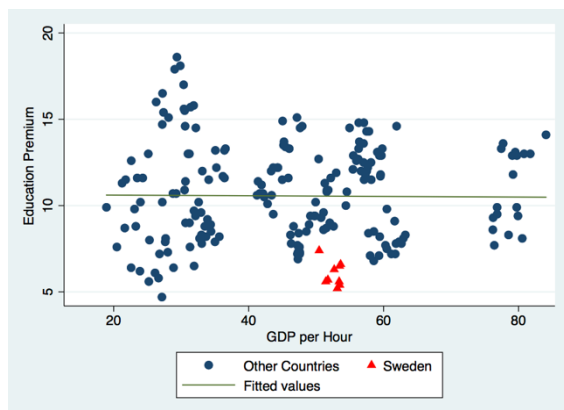
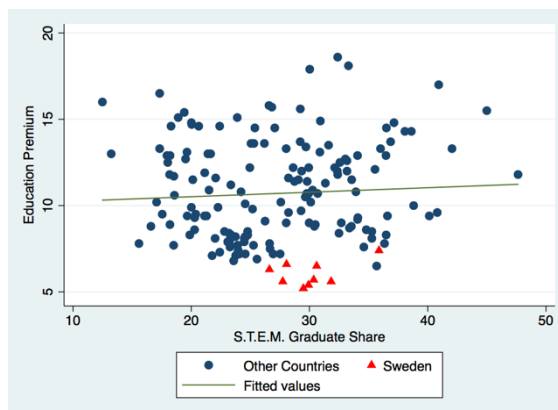


Figure 5



6.1.3 Labor Market Features

Figure 6

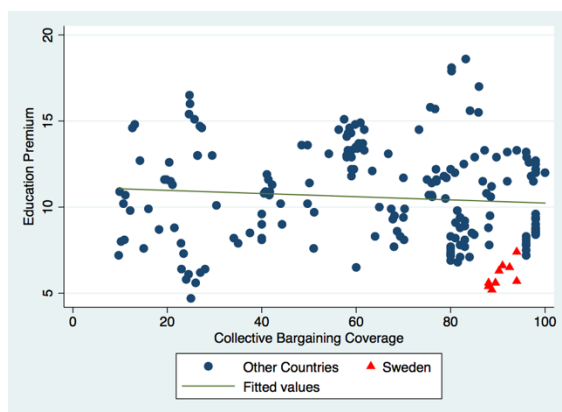
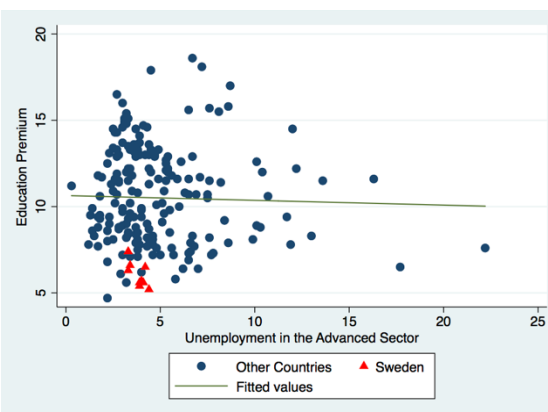


Figure 7



6.1.4 Fiscal Policy

Figure 8

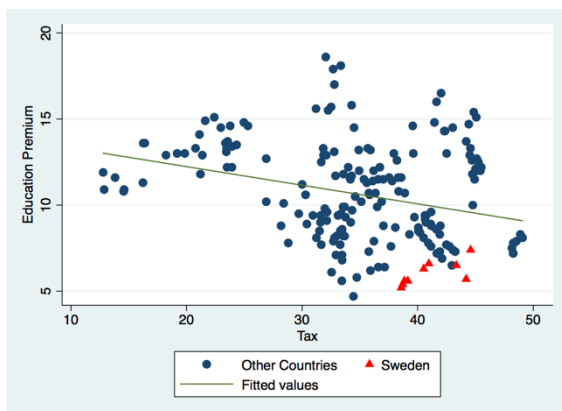


Figure 9

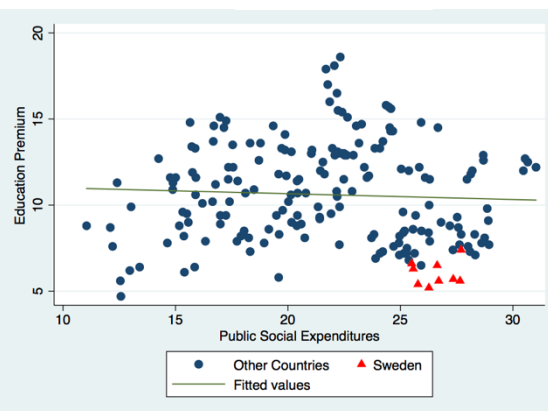
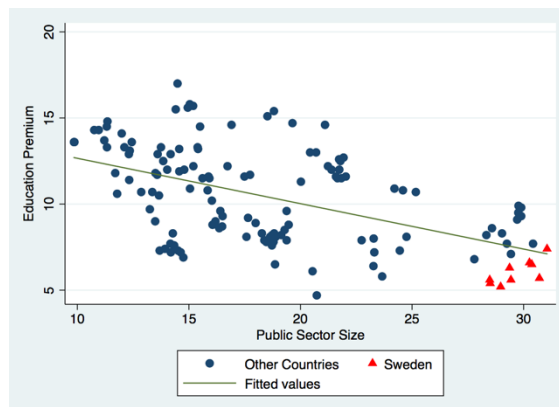


Figure 10



Starting with Figure 2, the share of population having a tertiary degree shows a relatively clear negative correlation with the education premium, as expected based on previous literature. In fact the Pearson Correlation is -0.1803 . However Figure 3 depicts a positive correlation between *GDP per Capita* and the education premium, and the bivariate correlation found is 0.0907 . It should be noted that the negative relationship found in previous studies is true when comparing high-income countries with low and middle income countries. As our paper is restricted to, almost exclusively, high-income countries the expected negative relationship does not seem to prevail when premium differences between countries with similar levels of GDP per capita are of interest. The productivity metrics *GDP per hour* in Figure 4 shows basically zero correlation with the premium, possibly revealing that it is an inaccurate measure of labor productivity given the productivity enhancement theory, or alternatively that aggregate productivity does not coincide with relative productivity between skilled and unskilled labor. In Figure 5, *S.T.E.M.* shows a minor positive correlation (0.0587) with Sweden positioned in an intermediate position. Oppositely in Figure 6, including *Collective Bargaining Coverage*, a minor negative relationship is shown (-0.0851). Further Figure 7 shows basically no correlation (-0.0285), meaning that the expected negative correlation cannot be demonstrated, indicating that *Unemployment* might be too simple to successfully describe the desired dynamics of relative supply and demand in the labor market limited to highly educated workers. This since the variance in observations with regard to this control variable is fairly small. As for fiscal policy metrics, Figure 8 having the tax wedge on the x-axis shows a clear negative correlation (-0.2939). Figure 9 shows a considerable variance in observations for public social expenditure, but the expected negative correlation is small (-0.0525). Lastly, the strongest correlation (-0.533) is found in Figure 10, where *Public Sector Size* is on the x-axis.

6.2 Regressions

6.2.1 Specification 1

Table 8: Specification 1 Regressions ¹⁸

VARIABLES	Marginal Rate of Return to Tertiary Education						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sweden	-4.737*** (0.303)	-4.702*** (0.340)	-4.431*** (0.379)	-4.133*** (0.424)	-4.136*** (0.471)	-4.195*** (0.571)	-1.722** (0.688)
Share Tertiary Degrees			-0.101** (0.0433)	-0.126*** (0.0439)	-0.0915** (0.0424)	-0.0571 (0.0499)	0.0452 (0.0515)
ln(GDP per Capita)			1.686*** (0.533)	1.828*** (0.559)	-1.992* (1.078)	-1.621 (1.306)	-3.367*** (1.218)
Collective Bargaining Coverage				-0.00867 (0.00758)	-0.00569 (0.0126)	-0.00355 (0.0187)	-0.0131 (0.0164)
Unemployment				-0.0771 (0.0649)	-0.158** (0.0636)	-0.132 (0.0816)	-0.225*** (0.0695)
Tax					-0.217*** (0.0459)	-0.159*** (0.0529)	-0.155*** (0.0481)
Social Expenditure					0.320*** (0.0960)	0.240* (0.129)	0.347*** (0.108)
Public Sector Size							-0.264*** (0.0437)
Constant	10.77*** (0.203)	10.81*** (0.530)	-3.897 (5.075)	-3.699 (5.381)	35.99*** (10.75)	30.58** (13.15)	49.38*** (12.37)
FE Time	No	Yes	Yes	Yes	Yes	Yes	Yes
Observations	201	201	201	193	186	126	126
R ²	0.114	0.122	0.177	0.193	0.306	0.266	0.412

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Considering regressions (1)–(5), in Table 8, to assess the various categories of factors' marginal contribution explaining the mean difference in the premium between Sweden and the rest of the sample, we observe that the intercept of *Sweden* does not change substantially. However it does consistently decrease (in absolute numbers), except for when controlling for fiscal policy, meaning that the included categories of control variables are indeed able to explain some of the difference. The reason why including fiscal policy shows no marginal contribution, but the largest increase in the model fit (as measured by R^2), should be that *Social Expenditure* has a large positive coefficient and Sweden has an above average level of this factor, offsetting the contribution of *Tax* which does to some extent explain the premium gap. The most prominent, though small, intercept shift

¹⁸ The mean premium difference of 4.737 percentage points is assumed unchanged in regressions (1)–(5).

is the increase (less negative) of approximately 7 % in the fourth regression when controlling for labor market features. Comparing the first (1) and fifth (5) regression we are ultimately able to explain in the proximity of 13 % of the difference in the education premium measured by the intercept of the variable *Sweden*. Considering *Public Sector Size*, which marginal contribution can be seen by comparing the additional regressions six (6) and seven (7), its inclusion shows a noticeable effect and the intercept of *Sweden* increases by approximately 59 %.

The actual mean difference of the premium in the sample considered in regressions (6)–(7) is 4.615 percentage points, meaning we are able to explain approximately 63 %.¹⁹ Examining regression (7) in Table 8, containing the most extensive specification with all control variables included, we note that the coefficient of *ln(GDP per Capita)* is approximately -3.37 and statistically significant. This means that a one percentage increase in Swedish GDP induces a 3.37 percentage decrease in the premium holding the other controls fixed. Then if Sweden would have had the same income as the U.S. for instance (≈ 8.3 % higher, as seen in Table 4) this would be associated with a considerable premium decrease of approximately 28 %. Further the variables *Share Tertiary Degree* and *Collective Bargaining Coverage* are not statistically significant at a 5 % significance level. A rather large negative coefficient (-0.225) of *Unemployment* means that it works in favor of reducing the premium gap as Sweden has a level 1.09 percentage points below the average (seen in Table 4). If Sweden would in fact exhibit the average level, the expected premium would be about 0.17 percentage points lower.

A reverse effect is found looking at *Tax* having an estimated coefficient of -0.155. Given that Sweden would have had a tax wedge the same as in Denmark for example (≈ 8.1 percentage points lower, as seen in Table 4), the education premium would be approximately 1.26 percentage points, or around 21 %, higher. *Social Expenditure* shows a large positive coefficient (0.347), as opposed to the negative relationship we would expect. As we know Sweden has an above average level of this variable (seen in Table 4) it actually favors the education premium which would have been lower if Sweden had exhibited an average level. The same reasoning applies for *Unemployment* where Sweden experiences a level below the sample average while the estimated coefficient is negative. Lastly *Public Sector Size* has a coefficient of -0.264. As Sweden has a level 11.61 percentage points above the average (seen in Table 4), an estimated increase of more than 3 percentage points, or

¹⁹ $(4.615 - 1.722) / 4.615 \approx 0.63$

around 51 %, in the conditional mean of the premium would be seen if the *Public Sector Size* was instead the same as the average, holding every other control variable fixed.

6.2.2 Specification 2

Table 9: Specification 2 Regressions.²⁰

VARIABLES	Marginal Rate of Return to Tertiary Education							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sweden	-4.905*** (0.321)	-4.861*** (0.357)	-4.662*** (0.397)	-3.986*** (0.419)	-3.757*** (0.532)	-3.704*** (0.673)	-1.671** (0.702)	-2.782*** (0.755)
Share Tertiary Degrees			-0.0451 (0.0527)	-0.0471 (0.0535)	-0.0574 (0.0470)	-0.0240 (0.0527)	0.0752 (0.0562)	0.0953** (0.0408)
ln(GDP per Capita)			0.969 (0.856)	-0.688 (1.131)	-2.739** (1.281)	-1.598 (1.545)	-2.764** (1.343)	-4.142*** (1.228)
Collective Bargaining Coverage				-0.0465*** (0.0133)	-0.00259 (0.0227)	0.0108 (0.0362)	0.0145 (0.0283)	0.0296 (0.0271)
Unemployment				-0.101 (0.0897)	-0.108 (0.0812)	-0.0601 (0.104)	-0.134* (0.0784)	-0.224*** (0.0834)
Tax					-0.193*** (0.0543)	-0.136** (0.0680)	-0.153*** (0.0578)	-0.159*** (0.0485)
Social Expenditure					0.112 (0.103)	-0.0328 (0.143)	0.135 (0.116)	-0.0151 (0.118)
Public Sector Size							-0.248*** (0.0428)	-0.180*** (0.0436)
S.T.E.M.								0.154*** (0.0382)
Constant	10.94*** (0.229)	11.03*** (0.633)	2.063 (8.619)	23.67* (12.46)	46.73*** (13.43)	33.91** (16.53)	44.42*** (14.66)	56.47*** (13.80)
FE Time	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	151	151	151	143	143	94	94	93
R ²	0.163	0.175	0.183	0.252	0.364	0.346	0.499	0.582

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Excluding the economically different countries yields moderately different results, seen in Table 9 above. First we note that the Sweden intercept in the first regression is slightly more negative, meaning there is a larger disparity in the premium between Sweden and the high-income sample, than the full sample. We also observe an accumulated reduction in the *Sweden* intercept of around 23 % comparing the first and fifth regression, compared to 13 % without the high-income restriction. The change from controlling for labor market features in the fourth regression is also larger, approximately 15 % compared to 7 %. In addition the inclusion of the fiscal policy category

²⁰ The mean premium difference of 4.905 percentage points is assumed unchanged in regressions 1–5. The actual mean difference of the premium in the sample considered in regressions 6–7 is 4.617 percentage points, meaning we are able to explain approximately 64 % ($\approx (4.617 - 1.671) / 4.617$).

appears to better explain the gap compared to the full sample regressions, possibly because *Social Expenditure* no longer is significantly positive. Regarding the relationships in the seventh regression a noticeable difference is that *Social Expenditure* and *Unemployment* is not significant at the conventional 5 % significance level unlike before, weakening the ability to draw conclusions regarding these factor coefficients.

The inclusion of *S.T.E.M.* in the last regression shows an economically and statistically significant positive correlation which is what we would expect. However it does not help explain the lower education premium in Sweden as the intercept of *Sweden* decreases, i.e. becomes more negative, by the inclusion. Referring back to Table 4, Sweden showed a share of *S.T.E.M.* slightly above average.

6.3 Blinder-Oaxaca Decomposition

6.3.1 Specification 1

As regression (7), in Table 8, including most control variables, explained the largest part of the difference in the education premium, this is the one employed in the decomposition procedure of the gap presented below in Table 10.

Table 10: Overall Specification 1 Decomposition Results

Overall Difference	
Not Sweden	10.65*** (0.251)
Sweden	6.033*** (0.237)
Difference	4.615*** (0.345)
Explained	2.637*** (0.493)
Unexplained	1.979*** (0.584)
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1	

Consistent with what has already been shown in the regression model, a majority of the premium difference could be explained by controlling for level differences in the factors. However an unexplained portion of the gap still remains, constituting $1.979/4.615 \approx 43$ % of the mean differences in the premium. To understand what the explained and unexplained parts might consist

of in terms of the contribution of each control variable, the two parts are further examined using the detailed twofold decomposition according to Equation (12) and (13). The results are presented in Table 11 below.

Table 11: Detailed Decomposition of the Explained and Unexplained Part

Twofold Blinder-Oaxaca Decomposition		
VARIABLES	Explained	Unexplained
Share Tertiary Degrees	-0.259 (0.313)	-1.800 (2.477)
ln (GDP per Capita)	0.425* (0.218)	-85.83* (44.75)
Collective Bargaining Coverage	0.322 (0.331)	42.14 (44.47)
Unemployment	-0.334** (0.134)	1.158 (0.895)
Tax	0.642** (0.256)	-21.59** (9.855)
Social Expenditure	-1.141*** (0.374)	6.137* (3.435)
Public Sector Size	2.981*** (0.479)	-47.91*** (12.67)
Constant		109.7 (72.90)
Observations	126	126
Robust standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

Starting with the explained part of differences in outcome, the variable capturing the size of the public sector seem to account for the largest endowment disadvantage. This means that if Sweden would have had the same characteristics, with respect to size of the public sector, as the mean level of the other countries, the average increase in the education premium would be a substantial 2.981 percentage points higher. Further the tax wedge accounts for the second largest endowment disadvantage. Explicitly the Swedish rate of return is estimated to have been 0.642 percentage points higher if Sweden would have had the same tax wedge level as the mean level in the sample economies besides Sweden. Characteristics related to the social expenditure and unemployment in the advanced sector actually favor Sweden, meaning that given the same mean endowments as the rest of the sample the Swedish premium would have been lower. The contribution of *ln(GDP per Capita)* is found not to be significant at the 5 % level. Thus nothing can be said about its contribution with any confidence.

Concerning the unexplained portion of the gap, a high level of uncertainty is incurred, since the decomposition of the unexplained part is explicitly dependent on the estimated coefficients from a regression only including Sweden as can be seen in Equation (13). Because of inadequate data, with only nine (9) Swedish observations, these coefficients cannot be found significant. In addition an examination of each variable's contribution to the unexplained part require the assumption that each variable have natural zero points. This means that arbitrary intercepts of the independent variables may affect their individual contributions to the unexplained part (Jann, 2008). Therefore nothing can be said, with any degree of confidence, about differences in coefficients between Sweden and the rest of the sample affecting the mean difference in the premium. The same is true for the *Constant* in Table 11, capturing premium differences originating from group membership alone (i.e. being Sweden) including unobserved factors, not captured by the control variables.

6.3.2 Specification 2

Since regression (7) in Table 9 contained the highest (least negative) intercept of *Sweden*, the factors used there are the ones used in the two-folded Blinder-Oaxaca decomposition of the second specification.

Table 12: Overall Specification 2 Decomposition Results

Overall Difference	
Not Sweden	10.65*** (0.287)
Sweden	6.033*** (0.237)
Difference	4.617*** (0.372)
Explained	2.585*** (0.477)
Unexplained	2.033*** (0.567)
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1	

No substantial differences in results can be seen comparing with the decomposition of *Specification 1*. The explained part of the mean difference in premium is marginally smaller (56 % as compared to 57 %), which in turn means that the unexplained part is marginally larger compared to the first decomposition.

The explained and unexplained premium difference is further decomposed illustrating the relative importance of different control variables with the results presented in Table 13 below.

Table 13: Detailed Decomposition of the Explained and Unexplained Part

Twofold Blinder-Oaxaca Decomposition		
VARIABLES	Explained	Unexplained
Share Tertiary Degrees	-0.445 (0.297)	-0.487 (2.545)
ln (GDP per Capita)	0.0205 (0.111)	-80.47* (45.16)
Collective Bargaining Coverage	-0.177 (0.363)	44.55 (44.57)
Unemployment	-0.208 (0.142)	1.510* (0.902)
Tax	0.708** (0.321)	-22.20** (9.963)
Social Expenditure	-0.342 (0.237)	2.132 (3.564)
Public Sector Size	3.028*** (0.507)	-47.68*** (12.69)
Constant		104.7 (73.33)
Observations	94	94
Robust standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

Once again, the by far most important factor among the part of the difference explained by endowments, i.e. level differences in factors controlled for in the regressions, is *Public Sector Size*. Similar to the first specification, the second most important variable constituting the explained part seems to be *Tax* which contribution actually appears marginally more important when restricting the sample to high-income countries. As opposed to the decomposition including the full sample, the contributions of *ln(GDP per Capita)*, *Unemployment* and *Social Expenditure* are no longer found significant meaning that these factors better contributed to the explained part of the premium difference when including countries with greater differences in national income. Studying the unexplained part of the decomposition illustrating the difference in the premium attributed to differences in coefficients, it appears similar to the unexplained part for *Specification 1*. However a more detailed interpretation of the contributions of each control variable to the unexplained part is not carried out for the same reasons as described in part 6.3.1.

7. Discussion

7.1 Analysis of the Results

The resulting scatter plots illustrated factors experiencing a bivariate correlation with the outcome variable. Apart from Public Sector Size followed by Tax and Share Tertiary Degree most of the correlations proved weak, meaning that the effect on the premium should be contingent on the interaction between the variables. However this is given the bold assumption that the selected independent variables perfectly control for the theoretical factors presented in Section 2 related to, principally, productivity enhancement, relative supply of college graduates, relative demand of skilled labor as well as labor market dynamics and fiscal policy. Even though, for example, collective bargaining coverage, tax, public sector size and the supply of the population with a tertiary degree could explicitly be controlled for it is important to have in mind the inconclusiveness and contingency factors underlying the findings in previous research. Nevertheless among the factors indicating a non-negligible bivariate correlation, Sweden is positioned consistent with its low premium in a number of cases. This is most apparent for the three factors which showed the strongest correlation with the premium, where Sweden experiences a comparably high level while all of the bivariate correlations prove negative. The same is true for the variables Collective Bargaining Coverage and Social Expenditure, even though these correlations are considerably weaker. However these findings do not explain the comparably lower Swedish education premium, as its data points are no apparent outliers on the x-axis.

While the scatter plots could possibly indicate that some of the Swedish characteristics captured by the factors do support a low rate of return to tertiary education, it fails to capture the possible effect of interaction between these factors and the comparably low Swedish premium, which both of our regression specifications partially shed light on. Considering the results including the full sample, we showed that our selection of theory based factors could explain approximately 63 % of the gap in the premium. The most important factor explaining the gap seems to be the size of the public sector constituting a substantial 82 % of the explained part. However since including the public sector size variable results in a different subset of the sample to be considered, a risk of selection bias exists, making it nonviable to examine the relative importance of each of the other factors included with respect to the remaining 18 % of the explained part. This task is instead performed by decomposing regression 7 using Blinder-Oaxaca. In the regressions prior to the inclusion of *Public Sector Size* the relative contributions of the factors can, with better accuracy, be

assessed by observing the change in the intercept of *Sweden*. Even though a reduced subsample is considered, it seems like the size of the public sector is crucial in explaining the gap. This since only 13 % of the total gap could be explained by the other factors. Among these factors, the categories we call *Labor Market Features* and *Fundamental Economic Theory* constitute 50 % and 45 % of the explained portion, respectively. However the significance of *Unemployment* seems contingent on fiscal policy, since the significance improves while controlling for this category. Interestingly the other factor included in *Labor Market Features*, namely the level of collective bargaining coverage never proves significant and therefore does not seem to contribute to explaining differences in the education premium, despite Sweden having a level well above average. As pointed out in the regression results, the tax rate could possibly, to some extent, contribute with explanatory power because of its effect on model fit together with a relatively large and negative coefficient. This might reflect the effect of a progressive tax system compressing the wage differences.

Comparing the proportions of the gap successfully explained between *Specification 1* and *Specification 2*, without including *Public Sector Size*, we are able to explain almost twice as much (23 % as compared to 13 %). As we are able to explain more when using an income distinction this may indicate that distorting structural differences have been successfully excluded, which yields better results. One possible explanation for the larger fraction could be that we were then able to, implicitly, control for national income. Furthermore the marginal contribution of each category of factors differ to some extent from the regressions including the full sample. *Labor Market Features* now accounts for a marginally larger proportion of the explained part, constituting approximately 59 %, whereas *Fundamental Economic Theory* only constitute around 17 % and *Fiscal Policy* changes from having no marginal explanatory contribution to constituting almost 20 % of the explained part. Analyzing differences with respect to *Fundamental Economic Theory*, it makes intuitive sense that GDP per capita accounts for a smaller portion of the explained gap, when only including high-income countries. Interestingly the share of individuals holding a tertiary degree never proves significant in the second specification and its partial correlation with the premium having the full sample appears quite small. The change in marginal contribution of *Fiscal Policy* appears to be the result of *Social Expenditure* not being significant in the second specification, possibly revealing a weaker relationship between public social expenditures and the premium among high-income countries. The coefficient of this control variable never proves negative, as suggested by the literature review. Possibly the control is too broadly defined, and only specific kinds of public social expenditures have a negative relationship with the rate of return to tertiary education.

Another significant finding is that the inclusion of the productivity proxy *S.T.E.M.* leads to the greatest increase of model fit, possibly revealing its relative importance for variations in the premium. Interestingly the Swedish endowment of these graduates seem to work in favor of a higher Swedish premium and thereby cannot constitute as a factor explaining the gap. In short the results of our *Specification 2* regressions suggest, similar to our *Specification 1* regressions, that the size of the public sector alone explains the premium gap better than all the other factors combined. Including this factor in the analysis, *Specification 2* explains approximately 64 % of the total gap.

The decomposition using the twofold Blinder-Oaxaca method confirms that a relatively large part of the observed gap in the premium remains because of unexplained variation and may therefore depend on Sweden-specific coefficients, holding every country besides Sweden as the counterfactual. Alternatively, and highly plausible, the unobserved difference in the premium is caused by factors not controlled for in the regression specifications. Any further analysis regarding what specific factor coefficients constitute the unobserved part of the gap is not considered meaningful because of too much uncertainty incurred. The decompositions also reveal the relative importance of the control variables used in our regressions explaining most of the gap. *Public Sector Size* appears to constitute most of the explained variation which is in line with our regression analysis. The finding that tax is suggested second most important, clarify what the regression analysis implied. When decomposing each factor alone, the contribution of the tax wedge can be observed, not being offset by *Social Expenditure* which indeed shows the largest negative value meaning that its inclusion counteracts explanation. This offsetting effect is especially clear when including the full sample, as we would expect based on the regression results.

7.2 Limitations

A limitation applicable to both regression specifications in terms of estimating each factor's marginal contribution to the explained portion of the gap, only considering regression (1)–(5), is that the actual mean difference in the premium might fluctuate slightly as a small number of observations are dropped when including additional control variables. Another limitation related to interpreting the coefficients of our most extensive regressions that best explained the gap (regression (7) in both specifications) is that these expected changes in the Swedish premium given different levels of the factors, are given the assumption that the fitted coefficients can be applied to Sweden, when in fact systematic differences in coefficients between countries might prevail. As

previously mentioned a limitation is too few observations for Sweden in order to perform a detailed analysis of the unexplained portion established by the decomposition. In addition inadequate data for factors intended to be included as control variables, may increase the risk of omitted variable bias.

7.3 Implications

In terms of policy decisions our results suggest that a high progressive tax, which is present in Sweden, does work to suppress the education premium. This means that policy changes towards less progressivity could inflate the education premium and hence alter incentives, however we can hardly claim that this is new knowledge but rather a verification of earlier known facts. Similarly the public sector size seem to have a large impact on the education premium, in fact the individually largest marginal contribution of the control variables we used. This has also been highlighted in previous research and hopefully our study can help reinforce the possible effect of public sector size, which should be a factor to consider within the field of returns to education.

As for future research, the finding that level differences in factors *generally* important for explaining variation in the rate of return to tertiary education do not prove equally important when comparing Sweden to other OECD countries, sheds light on the importance of using other methods to understand variations in this setting. Our findings highlight the importance of exploring factors and conditions not suggested by classic theories primarily focusing on supply and demand, as has been the case in this thesis, in order to further disentangle the premium gap. This in order to, in detail, explore the unexplained portion of variation causing the Swedish premium to appear as an outlier. Instead of using yearly averages of the Mincerian return, an analysis of individual returns within a set of countries investigating the relationship with ability to exploit skills, together with skills required for specific jobs and potentially also taking attitude factors into account, could possibly help account further for variations in the premium. Certainly attaining a larger number of observations using different kinds of data, could enable a more precise estimation. Lastly, further research could be aimed at trying to establish causal effects of the factors suggested important by our study.

8 Conclusion

In this thesis we aimed to answer the question if factors suggested by conventional theory could explain the fact that Sweden has the lowest private rate of return to tertiary education among all OECD countries. If certain factors seemed to contribute with explanatory power we also intended to examine the relative importance of these factors. What factors to consider was driven by previous research attempting to explain what determines the education premium. Also the initial sample of countries was divided into two subsets based on income definitions in order to investigate whether a restriction to economies with more similar economic structure would allow for a larger fraction of the premium gap to be explained by the factors suggested by conventional theory. This proved to be the case, however not when including the size of the public sector as a control variable. In short a few factors could indeed to some extent explain why the Swedish education premium is comparably low, most importantly public sector size, followed by the tax wedge. To be on the conservative side, using the results from the Oaxaca decomposition we were able to explain around 57 % of the difference.

We can conclude that rather much of the difference remains unexplained and stems from factors not controlled for, and possibly also from differences in coefficients relating the factors to the premium. As we cannot with certainty analyze the unexplained portion of the premium difference, this sheds light on the importance of further research in order to fully understand variations in the private return to tertiary education constituting the disparity between the Swedish return and the higher returns in the rest of the OECD region.

9 References

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Control Variable Descriptive Statistics																										
AUS	AUT	BEL	CAN	CHE	CZE	DEU	DNK	ESP	EST	FIN	FRA	GRC	HUN	IRL	ISL	ITA	LTU	LUX	LVA	NLD	NOR	PRT	SVK	SVN	SWE	USA
Share Tertiary Degrees																										
33.10	26.38	32.58	41.88	34.65	25.63	25.86	29.83	34.46	36.36	27.57	23.65	19.10	31.68	31.62	13.84	30.01	30.67	24.19	31.86	35.35	14.75	15.78	23.12	32.87	39.07	
Mean																										
2.93	1.52	1.63	N/A	0.91	2.53	1.55	1.33	1.82	2.21	N/A	2.13	1.91	1.84	2.99	2.21	1.37	2.80	5.84	3.49	1.45	2.53	2.02	2.42	2.00	2.12	2.58
StdDev																										
0.09	0.06	0.05	N/A	0.03	0.16	0.06	0.04	0.06	N/A	0.08	0.08	0.10	0.09	0.07	0.10	0.09	0.19	0.14	0.05	0.07	0.14	0.15	0.09	0.06	0.07	
10	9	8	1	2	5	8	9	9	1	9	9	9	6	9	9	9	9	9	8	9	9	8	9	3	3	
GDP per Capita																										
55806	40118	36039	30133	57017	25945	38344	39693	31023	20794	37697	34184	27739	19942	42655	39262	33453	19109	81293	17306	43576	55894	25361	22225	27477	39679	42986
Mean																										
4528	4157	3168	N/A	1178	2997	3763	4261	2428	3679	N/A	2918	2188	2432	2942	2202	2431	3248	9697	2902	3184	7228	2014	4146	1849	3981	6040
StdDev																										
0.13	0.10	0.09	N/A	0.02	0.12	0.10	0.11	0.08	0.18	N/A	0.09	0.08	0.12	0.07	0.06	0.07	0.17	0.12	0.17	0.13	0.08	0.19	0.07	0.10	0.14	
10	9	8	1	2	5	8	9	9	9	1	9	9	9	6	9	9	7	9	9	8	9	8	9	3	3	
Collective Bargaining Coverage																										
59.07	98.00	96.00	30.40	49.08	47.36	61.26	82.60	77.13	24.87	87.60	97.47	74.44	26.26	41.28	88.33	80.00	10.66	57.00	19.13	82.01	68.85	80.59	38.82	87.38	90.67	13.30
Mean																										
1.45	0.00	0.00	N/A	0.88	4.17	2.23	1.56	1.73	1.80	N/A	0.73	1.254	1.57	0.62	0.26	0.00	0.83	1.57	2.28	7.28	1.10	4.66	3.19	10.89	2.37	0.82
StdDev																										
0.02	0.00	0.00	N/A	0.02	0.09	0.04	0.02	0.02	0.07	N/A	0.01	0.17	0.06	0.01	0.00	0.00	0.08	0.03	0.12	0.09	0.02	0.06	0.08	0.12	0.03	0.06
10	9	8	1	2	5	8	9	9	1	9	9	9	6	5	9	7	8	9	8	9	9	8	8	9	3	3
Unemployment																										
3.01	3.10	4.25	4.80	3.70	2.84	3.99	3.89	10.32	5.30	3.80	5.51	12.80	3.59	3.33	2.11	6.66	4.04	4.39	5.71	2.59	1.87	7.77	5.40	4.26	3.83	N/A
Mean																										
0.34	0.43	0.50	N/A	0.14	0.40	1.21	0.99	3.26	2.3																	

Appendix B: Decomposition Robustness Checks

Table B.1: Specification 1 Overall Decomposition

Results Estimating $\beta^* = \beta_A$

Overall Difference	
Not Sweden	10.65*** (0.251)
Sweden	6.033*** (0.237)
Difference	4.615*** (0.345)
Explained	2.668*** (0.497)
Unexplained	1.948*** (0.588)

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table B.4: Specification 2 Detailed Decomposition

Results Estimating $\beta^* = \beta_A$

Twofold Blinder-Oaxaca Decomposition		
VARIABLES	Explained	Unexplained
Share Tertiary Degrees	-0.268 (0.315)	-1.791 (2.482)
ln (GDP per Capita)	0.426* (0.220)	-85.83* (44.75)
Collective Bargaining Coverage	0.335 (0.332)	42.12 (44.46)
Unemployment	-0.332** (0.134)	1.156 (0.896)
Tax	0.654** (0.259)	-21.60** (9.857)
Social Expenditure	-1.159*** (0.380)	6.155* (3.437)
Public Sector Size	3.011*** (0.483)	-47.94*** (12.67)
Constant		109.7 (72.90)
Observations	126	126

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table B.3: Specification 2 Overall Decomposition

Results Estimating $\beta^* = \beta_A$

Overall Difference	
Not Sweden	10.65*** (0.287)
Sweden	6.033*** (0.237)
Difference	4.617*** (0.372)
Explained	2.630*** (0.481)
Unexplained	1.987*** (0.572)

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table B.4: Specification 2 Detailed Decomposition

Results Estimating $\beta^* = \beta_A$

Twofold Blinder-Oaxaca Decomposition		
VARIABLES	Explained	Unexplained
Share Tertiary Degrees	-0.450 (0.300)	-0.482 (2.551)
ln (GDP per Capita)	0.0198 (0.107)	-80.47* (45.16)
Collective Bargaining Coverage	-0.183 (0.365)	44.55 (44.57)
Unemployment	-0.199 (0.142)	1.501* (0.903)
Tax	0.724** (0.325)	-22.21** (9.966)
Social Expenditure	-0.357 (0.243)	2.147 (3.566)
Public Sector Size	3.074*** (0.513)	-47.72*** (12.69)
Constant		104.7 (73.33)
Observations	94	94

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1