

Reilich, Julia

**Working Paper**

## Return to schooling in Germany

Statistische Diskussionsbeiträge, No. 24

**Provided in Cooperation with:**

Wirtschafts- und Sozialwissenschaftliche Fakultät, Universität Potsdam

*Suggested Citation:* Reilich, Julia (2006) : Return to schooling in Germany, Statistische Diskussionsbeiträge, No. 24, Universität Potsdam, Wirtschafts- und Sozialwissenschaftliche Fakultät, Potsdam,  
<https://nbn-resolving.de/urn:nbn:de:kobv:517-opus-12175>

This Version is available at:

<https://hdl.handle.net/10419/337332>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*

Universität Potsdam

Wirtschafts- und Sozialwissenschaftliche Fakultät

Hans Gerhard Strohe (Hrsg.)

**STATISTISCHE DISKUSSIONSBEITRÄGE**

**Nr. 24**

Julia Reilich

**Return to Schooling in Germany**



Potsdam 2006

ISSN 0949-068X

# STATISTISCHE DISKUSSIONSBEITRÄGE

**Nr. 24**

Julia Reilich

## **Return to Schooling in Germany**

Herausgeber: Prof. Dr. Hans Gerhard Strohe, Lehrstuhl für Statistik und  
Ökonometrie  
Wirtschafts- und Sozialwissenschaftliche Fakultät der  
Universität Potsdam  
Postfach 90 03 27, D-14439 Potsdam  
Tel. +49 (0) 331 977-3225  
Fax. +49 (0) 331 977-3210  
Email: [strohe@uni-potsdam.de](mailto:strohe@uni-potsdam.de)  
2006, ISSN 0949-068X

**Outline**

Figure and Table Index.....	III
Index for abbreviations.....	IV
Return to Schooling in Germany.....	1
Introduction.....	1
German Schooling System.....	2
A descriptive overview.....	4
Data Analysis.....	4
Estimation model.....	7
Basic model.....	7
Differences by gender.....	10
Public versus Private sector workers.....	11
East versus West Germans.....	11
Part time versus Full time workers.....	12
Multi-equation models.....	14
System of equations.....	14
Three Stage Least Square.....	16
Correction for the selectivity bias.....	18
Heckman –Two Step Procedure.....	19
Maximum Likelihood Procedure.....	22
Conclusion.....	23
Future Extensions.....	24
References.....	25

---

**Figure and Table Index****Figure Index**

Figure 1: wage distribution.....	4
Figure 2: Average real gross hourly wage by age .....	5
Figure 3: Educational levels .....	5
Figure 4: Private and public sector worker and their shares male and female .....	6
Figure 5: East and West Germans .....	6
Figure 6: Part and full time workers.....	7

**Table Index**

Table 1: Estimation results for the basic models.....	8
Table 2: Estimation results for male and female separately.....	10
Table 3: Estimation results for public and private sector worker separately.....	11
Table 4: Estimation results for East and West German separately .....	12
Table 5: Estimation results for private and public sector worker separately.....	13
Table 6: Estimation results by running the Instrumental Variable Approach.....	15
Table 7: Estimation results by running the Three Stage Least Square.....	17
Table 8: Estimation results by running the regressions with the Heckman Two Step Procedure .....	21
Table 9: Estimation results by running the regressions with the Maximum Likelihood Approach .....	22

---

**Index for abbreviations**

C	cost
DIW	German Institute for Economic Research
empl	employed
$\varepsilon_i$	error term for each $i$
Exp	experience (counted by <i>(age-years of schooling-6)</i> ]
FE	father's educational level
FO	father's occupation
GLS	Generalized Least Squares
GSOEP	German Socio Economical Panel
H	high schooling degree (people with university or college degree, or any higher degree)
$\lambda$	inverse mills ratio
M	middle schooling degree (people with a high school diploma, apprenticeship or any higher degree based on that)
$\mu_i$	error term for each $i$
ME	mother's educational level
MO	mother's occupation
OLS	Ordinary Least Squares
PISA	Program for International Student Assessment
PC	parental concerning
Prob	probability
R	Revenue ( <i>Utility - Cost</i> )
S	years of schooling
U	Utility
unempl	unemployed
W	gross hourly wage

## **Return to Schooling in Germany<sup>1</sup>**

This paper tries to apply common methods to estimate unbiased coefficients for the return to schooling in Germany for the year 2004. Based on the simple Mincer-type wage equation, the return to schooling is around 9.5% per year. There is no sheepskin effect. As expected the return in the private sector is higher than in the public sector. Females have a higher return than males, but there are no differences between East and West Germans. An Instrumental Variables and a 3-Stage-Least-Squares approach give very high returns. For correcting the sample selection, the Heckman Two Step Procedure and the Heckman Maximum Likelihood Approach are used. For both methods, the coefficients are very similar, but higher than without correcting for it.

### **Introduction**

The examination of the return to schooling has its basis in Human capital theory. The first theoretical approaches were given by Gary S. Becker (1964) and Jacob Mincer (1974). Becker derived an optimization problem for the schooling decision. He shows that the difference between the present value of the worker's lifetime earnings<sup>2</sup> with the given level of education and the present value of the total cost for schooling has to be maximized. So by optimizing, the marginal rate of earnings has to be equal to the marginal rate of total cost. Mincer derived an equation that makes it possible to estimate this return to education. That equation became the basic model which is commonly used and tested.

After the basics were established, many people became concerned with estimating schooling returns. The first wave started in the US and continues until today. Then step by step other economists applied that theoretical framework for different countries. So, some people are concerned about that topic in Germany today. But only a few authors focus on the direct relationship between earnings and the educational level. Papers that consider Germany include Lauer and Steiner (2000a), Jochman and Pohlmeier (2004) and again Steiner and Lauer (2000b). A comparison of these papers reveals results that differ a bit because of different methodology. Boockman and Steiner (2000) analyze different cohorts and their returns to education.

---

<sup>1</sup> A thank to Prof. Scott Adams (UWM) for supporting and motivating me and for the financial help from the German Academic Exchange Service (DAAD). I enjoyed to work with the professors from the UWM and thanks for the chance and experiences I got.

<sup>2</sup> Where earnings are a proxy for the individuals utility.

They see a decreasing trend for older cohorts. Another interesting analysis is done by Pischke and Wachter (2005), who analyzed the return to one compulsory year of schooling. They estimate adding another obligatory year towards a possible schooling degree (as done in the 1950's and 1960's) yields no returns for this additional year.

This paper is concerned with finding a value for the marginal increase in earnings in Germany. Typical methods from the US are applied to a 2004 sample. Research in this area is not very sophisticated so this paper tries to overcome problems inherent in the returns to schooling literature, such as endogeneity and sample selection inherent in such estimates.

The paper is organized as follows. Section two first explains the German schooling system and the way the data is coded for simplification. Then it follows an overview over the given sample and some descriptive statistics. The analysis starts with the general Mincer equation. The model is then enhanced by looking at differences by gender, public versus private, part and full time workers, and the differences between East and West Germans. The third part tests the sensitivity of the estimated results for endogeneity and sample selection. Finally, the paper ends with a summarizing conclusion and possible future extensions.

### **German Schooling System**

Every individual in Germany starts its schooling career in the basic track at the age of six or seven. Everybody has to attend school or other educational trainings until he is 18. The required years in the basic track varies between state and school, but they always lie between four and six grades. After passing those years, the pupils decide on what level they want to proceed to. The lowest level is the secondary school.<sup>3</sup> That goes until the ninth grade, except in the states of Berlin and Nordrhein-Westfalen, where there is a schooling law that requires ten grades. The intermediate level<sup>4</sup> is similar to the junior high school in the US and consists of ten obligatory passing grades. The highest schooling degree is achieved by attending the high

---

<sup>3</sup> Called "Hauptschule" in German

<sup>4</sup> Called "Realschule" in German

school.<sup>5</sup> To get this degree the person has to pass twelve or 13 grades.<sup>6</sup> After that they are eligible to study at a college or university. There are also some other ways to get those degrees, but here it will be concentrated on the common way. Within the data the possible degrees are divided into distinguished groups. If a pupil does not pass a level of school, he must repeat this year. So there is the possibility that the number of grades differ from the years of schooling.

After the schooling career, it is not common to apply for a lifetime job. After finishing the secondary school and the intermediate level, the individual normally serves an apprenticeship or something similar for two or three years. Mostly it is a mixture between learning in a school<sup>7</sup> and getting practice in a company.

People with a high school degree can apply for an apprenticeship or they go forward to get a college or university degree. For a college degree, the student normally studies for four years, whereas a university degree actually takes about six years.

For some of the following analysis, all German degrees will be abstracted into three different levels. There is an index<sup>8</sup>, given within the sample that classifies the possible degrees in six different levels. For simplification, they are reduced to three, where the lowest level includes individuals with no degree<sup>9</sup> or with a schooling degree from the secondary or intermediate school. The next level shows people with a high school diploma, an apprenticeship or higher degrees that are based on the apprenticeship.<sup>10</sup> And the highest level includes all individuals with a university or college degree or any higher degree.

In the US, it is possible to allocate a specific number of years of schooling to an achieved degree. That is not procurable in Germany because there are too many degrees a person can attain and ways to attain them.

---

<sup>5</sup> Called "Gymnasium" with a degree called "Abitur"

<sup>6</sup> It again depends on the state.

<sup>7</sup> called "Berufsschule"

<sup>8</sup> index: isced04

<sup>9</sup> That is not common in Germany, most people are having at least secondary schooling degree.

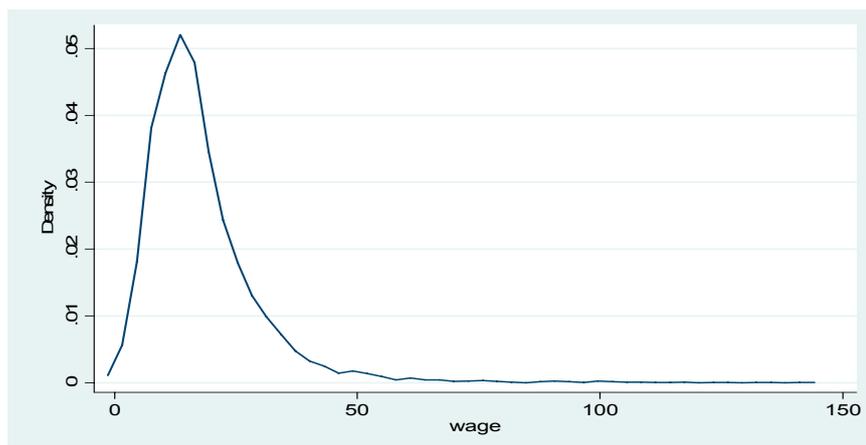
<sup>10</sup> for example the "Meister" degree

## A descriptive overview

### *Data Analysis*

For the analysis, data from the GSOEP<sup>11</sup>, wave 2004, are used. The GSOEP is a longitudinal household survey conducted on an annual basis by the DIW<sup>12</sup> since 1984. The sample includes 7691 individuals between the age of 18 and 65, of which 5423 have a positive income.

It is interesting to have a look to the wage distribution. It shows a steep distribution to the left. The mean is € 18.20. It is how it would be expected. Relative many people have a relatively small share from the whole average hourly wage. And just a few employees have a high part from the wage.



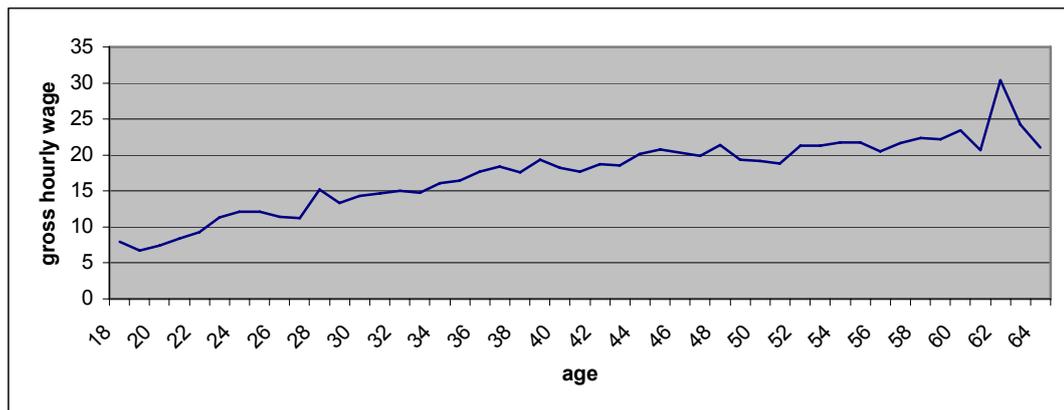
**Figure 1: wage distribution (gross hourly wage in €)**

Over all schooling levels and different occupational groups, an individual will earn in average € 18.20 per hour before taxes. The span from the average gross hourly wage per age lies between € 6.73 and € 30.38. Figure 2 plots average earnings by age. The minimum gross hourly wage occurs at age 20 and the maximum at age 63. From figure 2 it is clear that there is a positive relationship between earnings and age.

---

<sup>11</sup> German Socio-Economic Panel

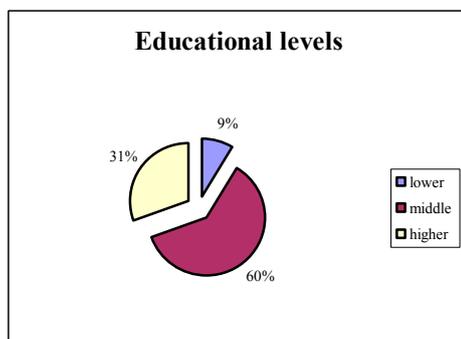
<sup>12</sup> DIW = German Institute for Economic Research



**Figure 2: Average real gross hourly wage by age**

The average gross hourly wage from individuals with a lower degree is around € 13. The middle degree has an average wage about € 15.30 and a person with a higher degree will earn € 25 per hour. So the step between low and middle degree educated worker is not so big, but an individual with a university degree will earn on average 63.4 % more than one with an apprenticeship.

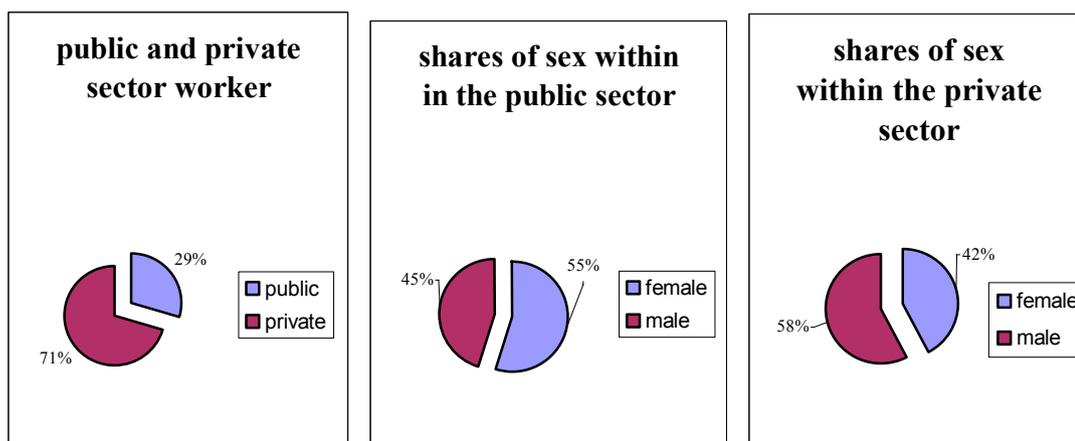
Decomposition is performed, because the objective is to get a better overview over the data. First, the different number of people within the three educational levels will be analyzed.



**Figure 3: Educational levels**

It can be seen that most people have a middle educational degree. This is a result that is not surprising. Less than 10 % of the sample has a lower degree. A high degree is not very uncommon. Over 30 % in the given sample achieved this educational level.

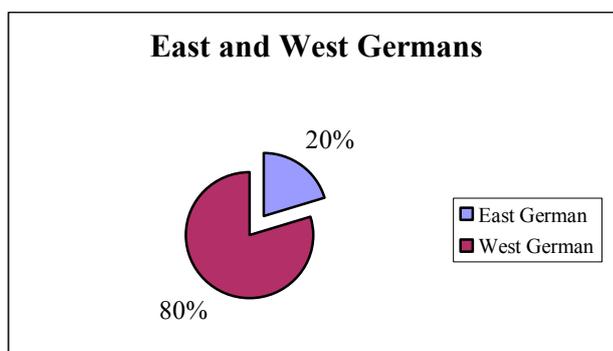
Dividing this sample into public and private sector workers, 30 % of all employees are working in the public sector. From them, more than 50 % are women.



**Figure 4: Private and public sector worker and their shares male and female**

The average gross hourly wage is € 18.92, higher within the public sector than in the private sector (€ 18.05 per hour). However, that can be explained with a high variance within the private sector and a higher proportion of lower income workers.

The later analysis looks at the differences between East and West Germans. It is necessary to clearly define both groups because of the overlapping generation when the wall broke down. So, if they have an East German schooling degree, they count as East Germans. Otherwise, if they were born in East Germany but their degree was not obtained under the East German system, they count as a West German.

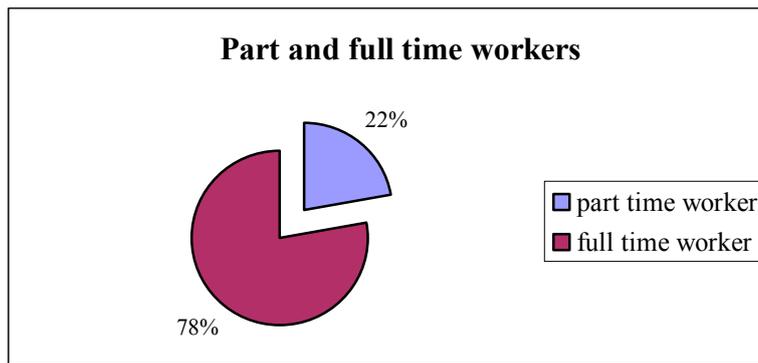


**Figure 5: East and West Germans**

Twenty percent of the individuals in the sample satisfy this definition of East German. That is as expected, because the population ratio was similar.

Their mean wage is € 14.40 per hour. West Germans earn around € 4.50 more per hour.

The last decomposition is the share in full and part time work. From the given sample 22 % are part time workers. The average gross hourly wage for that group of people lies at € 15.50. Full time workers have a higher gross hourly wage at around €19.50.



**Figure 6: Part and full time workers**

## Estimation model

### *Basic model*

The first analysis it focuses on the basic human capital earnings equation, derived by Mincer (1974). The equation for each individual  $i$  can be written as:

$$\ln w_i = \beta_1 + \beta_2 S_i + \beta_3 Exp_i + \beta_4 Exp_i^2 + \varepsilon_i,$$

where  $\ln w$  is the log gross hourly wage, Schooling ( $S$ ) stands for the years of education.<sup>13</sup> By assuming that the only costs that arise by getting a higher education are the forgone earnings, the coefficient directly measures the return to each additional year of schooling. Experience ( $Exp$ ) describes the years of labor market experience. By following common methodology, potential experience is ( $age - years\ of\ schooling - 6$ ). For experience, a concave shape is expected over the life time. Because of this, experience is added in a linear and squared form in the equation.  $\varepsilon_i$  explains all other effects that are omitted in this model. The error term,  $\varepsilon_i$ , is assumed to be normally distributed with mean zero, constant variance and uncorrelated with the explanatory variables of the model. We revisit the validity of these assumptions later.

<sup>13</sup> Given within the GSOEP, and explained in the first part. This first models are all regressed with a Ordinary Least Squares Regression (OLS), where  $\hat{\beta}_{OLS} = [(x'x)^{-1} x' \ln w]$ .  $x$  and  $\ln wage$  are the given vectors.

A problem with the estimation occurs as there is an overrepresentation of the people who have a lower degree. As explained above, they can choose to work earlier to expedite graduation. So, by including all working individuals between the ages of 18 to 65, a person between 18 to at least 23 can eventually obtain a tertiary degree. The coefficient for the return to schooling is therefore underestimated. For people of an older age, a similar problem appears as there are only a small number of people that work until the retirement age 65. To exclude this problem, the sample will be reduced to those between the age of 30 and the age of 55. That reduces the sample to only 3923 observations.

expl. Variables	basic model	30-55 aged worker	sheepskin	tenure
<b>schooling (<i>S</i>)</b>	0.0902 (0.027)	0.0936 (0.003)	0.0896 (0.006)	0.0868 (0.003)
<b>experience (<i>Exp</i>)</b>	0.0434 (0.029)	0.0428 (0.007)	0.0429 (0.007)	0.0311 (0.007)
<b>experience<sup>2</sup> (<i>Exp</i>)</b>	-0.0006 (0.000)	-0.0007 (0.000)	-0.0007 (0.000)	-0.0061 (0.000)
<b>middle (<i>M</i>)</b>	-	-	<b>-0.0219</b> (0.037)	-
<b>higher (<i>H</i>)</b>	-	-	<b>0.0107</b> (0.055)	-
<b>tenure (<i>Ten</i>)</b>	-	-	-	0.01683 (0.001)

**Table 1: Estimation results for the basic models.**

In every table, I map the  $\beta$  – coefficients from the included variables for each model that is explained above. In the first row, “schooling”, the coefficients for the return to schooling is shown. For this table, by calculating the percentage of this coefficient<sup>15</sup> the amount for the basic model suggests a 9.44 % return to schooling. That means, each additional year of schooling will give on average a 9.44 % higher gross hourly wage. The behavior of both experience variables are as expected. For all of these regressions, there is at first a positive effect from experience on wages, but as the employee ages the effect will become weaker.

<sup>14</sup>The numbers give the estimated return coefficients, and their standard error in brackets. The different fonts have the following meaning:

*just significant on the 5% level*

just significant on the 10% level

**neither significant in 1%, 5% nor on 10% level**

<sup>15</sup> Given by  $[exp(\beta)-1]*100$ .

As expected, the reduced sample for people between 30 and 55 years yields a percentage return about 9.81%. So, as was thought the return goes up and the assumed downward bias, because of the selectivity issue, is reduced. The  $H_0$  hypothesis for equality between the return to schooling from both models is accepted<sup>16</sup>. That shows that the truncation increases the return, but not significantly.

A problem with the above estimation is that it is based on the number of years, rather than a degree based measure of schooling. I now define three different types of schooling degrees and include them in the regression as dummies.

$$\ln w_i = \beta_1 + \beta_2 S_i + \beta_3 M_i + \beta_4 H_i + \beta_5 Exp_i + \beta_6 Exp_i^2 + \varepsilon_i, \quad 17$$

$M$  indicates a Dummy variable that is equal to one if individual  $i$  has a middle degree<sup>18</sup> and  $H$  is a Dummy variable for a higher degree level. Both of these are compared to the lowest degree level. By controlling for the different possible degrees the return to schooling will be reduced to 9.37%. However, the results show no significant effect for getting a degree. That is surprisingly because it differs from the evidence from the US. To cite Hungerford and Solon (1987), they found of all their results the existence of sheepskin effects in the return to education.

Another control variable that can be included is worker tenure, which has been shown in the past to significantly affect wages. The model then looks like:

$$\ln w_i = \beta_1 + \beta_2 S_i + \beta_3 Exp_i + \beta_4 Exp_i^2 + \beta_5 Ten_i + \varepsilon_i,$$

where  $Ten$  explains tenure of each individual  $i$ . Tenure shows the number of years an employee works for the company. So, it controls for the normal increase in wage per additional year in this company.<sup>19</sup> Robert Topel and Michael Ward (1992)<sup>20</sup> note that the growth rate of the wage within a job varies over time. After the first year the

---

<sup>16</sup> By assuming that the schooling coefficients are normally distributed, with a mean zero and the variance of  $\sigma^2$ , so  $H_0: (\beta_2\text{-hat})^{\text{basic}} = (\beta_2\text{-hat})^{\text{truncated}}$ , so  $t$  will be calculated by  $t = \frac{\hat{\beta}_2^{\text{basic}} - \hat{\beta}_2^{\text{truncated}}}{\sqrt{\sigma^2_{\text{basic}} + \sigma^2_{\text{truncated}}}}$ .

And then the calculated t-value will be compared to the t-statistics.

<sup>17</sup> There is a high correlation between the years of schooling and the achieved degree. That can bias the estimators.

<sup>18</sup> As defined in the part: German schooling system

<sup>19</sup> a reason for that continuous increase is the rising firm specific knowledge

<sup>20</sup> Topel, Ward "Job Mobility and the Career of young Men"

growth rate is 14 % and then goes down to 7 % on average. The effect of tenure on earnings always remains positive. So, it should be expected, that the return to schooling, by controlling for tenure, goes down. This happens as the return decreases, by comparing this with the truncated model. All results are highly significant.

*Differences by gender*

I next decompose the returns to schooling by sex. Now, all regressions are run separately for women and men. The return in both the basic case and the truncated sample are higher for women than men, but the differences are not significantly different from zero.

Another interesting aspect is that the effect of experience on earnings for women is small when compared with the coefficients for men. Sometimes they are even not significant. The likely reason for that is that women have less experience than men, but the variable of experience does not measure this. Given this measurement error, coefficients for woman are biased toward zero.

expl. Var.	basic model		30-55 aged work.		sheepskin		tenure	
	female	male	female	male	female	male	female	male
S	0.0887 (0.040)	0.0861 (0.003)	0.0957 (0.005)	0.0890 (0.004)	0.1087 (0.009)	0.0793 (0.008)	0.0846 (0.005)	0.0866 (0.004)
Exp	0.0378 (0.004)	0.0501 (0.004)	0.0277 (0.010)	0.0585 (0.009)	<i>0.0271</i> (0.010)	0.0583 (0.009)	<b>0.0144</b> (0.009)	0.0504 (0.009)
Exp <sup>2</sup>	-0.0006 (0.000)	-0.0007 (0.000)	-0.0004 (0.000)	-0.0009 (0.000)	<i>-0.0004</i> (0.000)	-0.0009 (0.000)	<b>-0.0003</b> (0.000)	-0.0009 (0.000)
M	-	-	-	-	<b>-0.0338</b> (0.052)	<b>-0.0352</b> (0.050)	-	-
H	-	-	-	-	<b>-0.1189</b> (0.078)	<b>0.0392</b> (0.073)	-	-
Ten	-	-	-	-	-	-	0.0173 (0.001)	0.0132 (0.001)

Table 2: Estimation results for male and female separately

The sheepskin effect again is not significantly different from zero. But by controlling for the different degrees it increases the return to schooling for women substantially, whereas it decreases this effect for men. So women have a higher return than men, the difference is around 72 %. The only time where the return to education for men is higher then for women is by controlling for tenure. But that is just a small difference.

<sup>21</sup> table explanations at footnote 14

### *Public versus Private sector workers*

The following regressions try to figure out the differences between the return to education for public and private sector workers. The characteristics of the German public sector are comparable to the American sector. There is relatively high job security, but the lower risk has to be paid with a lower wage.

expl. Var.	basic model		30-55 aged work.		sheepskin		tenure	
	public	private	public	private	public	private	public	private
<b>S</b>	0.0764 (0.003)	0.0961 (0.004)	0.0766 (0.004)	0.0983 (0.004)	0.0751 (0.008)	0.0910 (0.008)	0.0710 (0.004)	0.0947 (0.004)
<b>Exp</b>	0.0451 (0.004)	0.0428 (0.004)	0.0472 (0.008)	0.0416 (0.009)	0.0474 (0.008)	0.0416 (0.009)	0.0372 (0.008)	0.0307 (0.009)
<b>Exp<sup>2</sup></b>	-0.0007 (0.000)	-0.0006 (0.000)	-0.0008 (0.000)	-0.0006 (0.000)	-0.0008 (0.000)	-0.0006 (0.000)	-0.0007 (0.000)	-0.0006 (0.000)
<b>M</b>	-	-	-	-	<b>-0.0598</b> (0.041)	<b>0.0053</b> (0.053)	-	-
<b>H</b>	-	-	-	-	<b>-0.0347</b> (0.061)	<b>0.0563</b> (0.078)	-	-
<b>Ten</b>	-	-	-	-	-	-	0.0110 (0.001)	0.0207 (0.001)

**Table 3: Estimation results for public and private sector worker separately**

All schooling coefficients are different between public and private sector workers at the 5 % level of significance. The expected results are found with the return to schooling smaller for public sector workers, at most around 25 % less than those in the private sector. Another interesting finding is that there is always a higher impact of experience on earnings in the public sector. The reason for that can be the system of payment within the public sector. The wage will automatically increase with age. For all models, the effect can be seen but the difference is never significant. The sheepskin effect is never significantly different from zero. But again it decreases the return to schooling for both public and private sector workers.

### *East versus West Germans*

The following analysis decomposes the effect of different years of schooling for East and West Germans. The problem comes in, that they have many different influences within their life. One reason for that is the difference in the schooling

<sup>22</sup> table explanations at footnote 14

systems. With the isced04<sup>23</sup>, it is possible to equalize the different types of degrees so that they are more comparable.

A problem is that the selectivity of those people who could go further in higher education was different in both parts of Germany. In East Germany, society dictated the schooling and the individual benefits were less of a driving force.

expl. Var.	basic model		30-55 aged work.		sheepskin		tenure	
	East	West	East	West	East	West	East	West
S	0.0954 (0.007)	0.0922 (0.003)	0.0950 (0.007)	0.0976 (0.003)	0.0749 (0.014)	0.0939 (0.064)	0.0870 (0.007)	0.0914 (0.003)
Exp	<u>0.0176</u> (0.010)	0.0511 (0.003)	<b>0.0132</b> (0.018)	0.0543 (0.007)	<b>0.0125</b> (0.018)	0.0543 (0.007)	<b>0.0005</b> (0.017)	0.0439 (0.007)
Exp <sup>2</sup>	<u>-0.0003</u> (0.000)	-0.0007 (0.000)	<b>-0.0002</b> (0.000)	-0.0008 (0.000)	<b>-0.0002</b> (0.000)	-0.0008 (0.000)	<b>-0.0001</b> (0.000)	-0.0008 (0.000)
M	-	-	-	-	<b>-0.4531</b> (0.311)	<b>0.0520</b> (0.037)	-	-
H	-	-	-	-	<b>-0.3176</b> (0.342)	<b>0.0659</b> (0.057)	-	-
Ten	-	-	-	-	-	-	0.0169 (0.003)	0.0148 (0.001)

Table 4: Estimation results for East and West German separately

Overall the differences between East and West Germans are never significantly different from zero. Although, there is a high difference in the average gross hourly wage between those groups, the actual return to schooling does not differ much and is never significant. It can be seen that mostly the coefficients are a bit higher for West Germans. Only the coefficients for the schooling variable are always significant. Here there would be a big gain by looking at panel data, because of an expanding number of observations. The return to experience influences the wage for West Germans, but the coefficient for former citizens from the GDR is not significant.

### *Part time versus Full time workers*

Mostly, part time workers are women. The sample of part time workers is 8 % men. The reason for that can be that women are more responsible for the family. So, to make the samples comparable, this is an analysis just about women.

<sup>23</sup> An index for equalizing schooling levels, that is given in the GSOEP.

<sup>24</sup> Table explanations at footnote 14

expl. Var.	basic model		30-55 aged work.		sheepskin		tenure	
	part time	full time	part time	full time	part time	full time	part time	full time
S	0.0890 (0.006)	0.0830 (0.005)	0.0936 (0.007)	0.0864 (0.006)	0.1046 (0.012)	0.0998 (0.012)	0.0793 (0.007)	0.0805 (0.006)
Exp	0.0467 (0.007)	0.0400 (0.005)	<b>0.0239</b> <b>(0.015)</b>	<i>0.0270</i> <i>(0.013)</i>	<b>0.0233</b> <b>(0.015)</b>	<i>0.0267</i> <i>(0.013)</i>	<b>0.0090</b> <b>(0.015)</b>	<b>0.0170</b> <b>(0.012)</b>
Exp <sup>2</sup>	-0.0007 (0.000)	-0.0006 (0.000)	<b>-0.0004</b> <b>(0.000)</b>	<b>-0.0004</b> <b>(0.000)</b>	<b>-0.0003</b> <b>(0.000)</b>	<b>-0.0004</b> <b>(0.000)</b>	<b>-0.0002</b> <b>(0.000)</b>	<b>-0.0003</b> <b>(0.000)</b>
M	-	-	-	-	<b>0.0004</b> <b>(0.065)</b>	<b>-0.0688</b> <b>(0.084)</b>	-	-
H	-	-	-	-	<b>-0.0824</b> <b>(0.105)</b>	<b>-0.1495</b> <b>(0.115)</b>	-	-
Ten	-	-	-	-	-	-	0.0168 (0.002)	0.0146 (0.002)

Table 5: Estimation results for private and public sector worker separately

In all cases, the return to schooling is significantly different from zero. Except the model where the tenure variable is included as control variable, all schooling coefficients for part time workers are higher. The difference between part and full time workers, however, is never significant. The return to experience is significant and higher for part time workers in the basic model. For all other models, the coefficient is not significantly different from zero. As is found in previous analyses, the impact from experience on earnings is less for women. So it is not so surprising that the coefficients are not different from zero.

<sup>25</sup> table explanations at footnote 14

### Multi-equation models

Until now, I just changed the included variables to verify the results for the return to schooling. But other problems than omitted variables can change the result. A problem occurs if the explanatory variables are highly correlated with the error term. That is very often the case. This is hard to reduce by adding more variables because many relevant factors are not metrical. For example, ability highly affects the gross hourly wage and is correlated with schooling. Thus, there is a big problem with self selection into the particular educational level. Within this section for proving the robustness, an attempt is made to reduce the bias from self selection by using different approaches.

First I will use a system of equations and thus regress here at first the value for the years of schooling for each individual. Then this value will be included in the normal wage equation to get the value for the return.

The second part tries to correct for selectivity bias. Here for some binary decisions the group is performed and for them, the return to schooling will be counted.

### *System of equations*

For the next two analyses, the following models are assumed:

1. 
$$\ln w_i = \beta_1 + \beta_2 S_i + \beta_3 Exp_i + \beta_4 Exp_i^2 + \varepsilon_i,$$
<sup>26</sup>

where schooling can be estimated with the following equation:

$$S_i = \beta_1 + \beta_2 Sex_i + \beta_3 FO_i + \beta_4 MO_i + \mu_i.$$

So, the schooling level from individual  $i$  is a function depending on sex, father's ( $FO$ ) and mother's occupation ( $MO$ ).

---

<sup>26</sup> This is the same model that I used in the first part, symbols are equivalent.

2. The following model controls for gender (*Sex*) in the wage equation as well, so that the new equation follows:

$$\ln w_i = \beta_1 + \beta_2 S_i + \beta_3 Sex_i + \beta_4 Exp_i + \beta_5 Exp_i^2 + \varepsilon_i$$

3. Another high impact on the schooling level comes from the parents and their concern about the schooling of their children. This is measured by a Dummy variable that is given within the sample. If it is one, the parents are concerned about the educational degree, zero if not.<sup>27</sup> So the wage equation used in the second model and the schooling equation looks like:

$$S_i = \beta_1 + \beta_2 Sex_i + \beta_3 FO_i + \beta_4 MO_i + \beta_5 PC_i + \mu_i,$$

where the coefficient of *PC<sub>i</sub>* shows the impact from parental concerning.

4. The parental schooling degree can also have different impacts on the schooling level for individual *i*. So, as the last step, variables for mother's (*ME*) and father's schooling degree (*FE*) are added:

$$S_i = \beta_1 + \beta_2 Sex_i + \beta_3 FO_i + \beta_4 MO_i + \beta_5 PC_i + \beta_6 FE_i + \beta_7 ME_i + \mu_i$$

#### *Instrumental Variable Approach*

expl. Var	model 1	model 2	model 3	model 4
<b>S</b>	0.1274 (0.011)	0.1085 (0.011)	0.1099 (0.011)	0.1100 (0.010)
<b>Exp</b>	0.0471 (0.007)	0.0474 (0.007)	0.0474 (0.007)	0.0474 (0.007)
<b>Exp<sup>2</sup></b>	- 0.0007 (0.000)	- 0.0007 (0.000)	- 0.0007 (0.000)	- 0.0007 (0.000)
<b>Sex</b>	- -	0.2777 (0.169)	0.2781 (0.017)	0.2782 (0.017)

28

**Table 6: Estimation results by running the Instrumental Variable Approach**

By using an IVreg<sup>29</sup>, all coefficients are highly significant for every analysis. But the differences from the return to schooling between the models are not statistically

<sup>27</sup> This variable is critical, because it is no metric characteristic.

<sup>28</sup> Table explanations at footnote 14

<sup>29</sup> IVreg = Instrumental Variable Approach

significant. Even though the returns to schooling are higher, they mostly differ not significantly by comparing these with the OLS estimators. The reason for this higher estimator can be a measurement error. The coefficients for experience follow the normal pattern. Being a male has a positive impact on earnings and increases earnings by around 32%. By including the sex in the wage equation, the return is reduced. All other models follow the same patterns. The return to schooling now has an impact of about 11.6 %.

By using the IVreg there is just one specific equation necessary. The program just uses the reduced form to estimate the wage equation. The real form of the schooling equation does not matter. Another possibility is to run both regressions simultaneously. That means Three Stage Least Square. This method controls for contemporaneous correlation.

### *Three Stage Least Square*

If the problem of contemporaneous correlation is not important in this case, the estimation results for the IVreg and the 3SLS<sup>30</sup> will be the same. Contemporaneous correlation comes in if the error terms of the different equations are correlated with each other. So, if the assumptions that  $cov(\varepsilon_i, \mu_i) = 0$  is not satisfied, both equations have to be estimated simultaneously. The first step is similar to the IVreg. For the reduced form, instruments are estimated and plugged into the wage equation. Now, the regression is run not only for one equation, but for all together.

By comparing both approaches the coefficients seem very similar to the IVreg. By testing the equality, there is never any significant difference between them. So, it follows, that there is no problem with contemporaneous correlation. To get the best results from these approaches, the IVreg is adequate.

An interesting fact is that the positive effect from parental education is greater for the father than for the mother. Actually the return from the mothers schooling degree is negative.

---

<sup>30</sup> 3SLS = Three Stage Least Square

<b>expl. Var</b>	<b>model 1</b>	<b>model 2</b>	<b>model 3</b>	<b>model 4</b>
<b>lgwage</b>				
<b>S</b>	0.1213 (0.011)	0.1056 (0.011)	0.1068 (0.011)	0.1071 (0.099)
<b>Exp</b>	0.0434 (0.007)	0.0455 (0.007)	0.0457 (0.007)	0.0460 (0.007)
<b>Exp<sup>2</sup></b>	- 0.0007 (0.000)	- 0.0007 (0.000)	- 0.0007 (0.000)	- 0.0007 (0.000)
<b>Sex</b>	- -	0.2777 (0.169)	0.2780 (0.170)	0.2777 (0.170)
<b>Schooling</b>				
<b>fathers occ</b>	0.0770 (0.006)	0.0782 (0.006)	0.0762 (0.006)	0.0541 (0.007)
<b>mothers occ</b>	0.0520 (0.006)	0.0525 (0.006)	0.0502 (0.006)	0.0487 (0.007)
<b>Sex</b>	0.4201 (0.086)	0.1937 (0.087)	0.1957 (0.088)	0.1833 (0.087)
<b>parental concerning</b>	- -	- -	0.4134 (0.090)	0.3927 (0.089)
<b>fathers school degree</b>	- -	- -	- -	0.3302 (0.041)
<b>mothers school degree</b>	- -	- -	- -	-0.0805 (0.041)

Table 7: Estimation results by running the Three Stage Least Square

<sup>31</sup> table explanations at footnote 14

### *Correction for the selectivity bias*

The problem of sample selection emerges because information on earnings exists only of those who work. So, the sample is not randomly distributed.

Heckman (1974, 1979) developed solutions applicable to the problem of selection bias where only those who work have wage information. For all individuals there is a particular wage level,  $w^*$ , above which the individual is willing to work.

The following models will be estimated in this section. The focus here lies on the Labor Force Participation.

1. The first decision the individual can make is that whether he wants to work or not. The outcome equation is the basic Mincer model as before. In the selectivity equation three other variables are included: sex, the marital status of individual  $i$  and the number of kids under 14 years.
2. This model is used two times, but now it is estimated just for women. That can be an interesting analysis because of different behavior and different expectations for women in the society.
3. The second decision, relevant of some of the analyses, is whether the employee chooses the public or private sector. There are different properties as explained before. So, individuals who decide to work in the public sector are in general risk averse and this influences many other characteristics of the individual. The same cannot be said for the private sector worker. Not every person who wants to work in the public sector is getting a job there. The wage equation is again similar. In the selectivity equations, sex, age and the years of schooling are included.
4. Again the model from 3 is applied just for women. It could be seen in the first section, that there are more women in the public sector.
5. The last decision will be about the choice between part and full time workers. As noted before, this is typically a decision made by females and so the regression is just estimated for women by including years of schooling, number of kids fewer than 14, and the age as instruments in the selectivity term.

### *Heckman –Two Step Procedure*

Many economists applied this model from Heckman. One application is given by Willis and Rosen (1979). We follow their example.

If the person works, the following condition holds:

$$U[\text{employed}|x_i] - C[\text{employed}|x_i] > U[\text{unemployed}|x_i] - C[\text{unemployed}|x_i].$$

This can be written as

$$R(\text{empl.}|x_i) > R(\text{unempl.}|x_i) + d.$$

where  $R$  determines the Revenue - function<sup>32</sup> and shows the particular outcome to each choice and  $d$  is a constant term.  $R$  is assumed to follow a functional form like

$$R = X\beta + \text{error}.$$

For both possible choices, different error terms are assumed, where  $\varepsilon_i$  is the error term from  $R(\text{empl.}|x_i)$  and  $\mu_i$  is the error term from  $R(\text{unempl.}|x_i)$

$$(\mu_i - \varepsilon_i) > R(\text{empl.}|x_i) - R(\text{unempl.}|x_i) - d. \quad (1)$$

It is assumed that both  $\varepsilon_i$  and  $\mu_i$  are normally distributed, so in this case they follow a joint normal distribution where

$$v_i = (\mu_i - \varepsilon_i) \cap N\left(0, \begin{pmatrix} \sigma_\mu^2 & \sigma_{\varepsilon\mu} \\ \sigma_{\varepsilon\mu} & \sigma_\varepsilon^2 \end{pmatrix}\right) \text{ and so } \sigma_v^2 = \sigma_\mu^2 + \sigma_\varepsilon^2 - 2\sigma_{\varepsilon\mu}.$$

By standardization equation (1) with  $\sqrt{\sigma_v^2}$ , it can be assumed that the distribution is now standard normal, with mean zero and the variance of  $\frac{v_i}{\sigma_v}$  is equal to one.

---

<sup>32</sup>  $R = \text{Utility} - \text{Cost}$

$$\frac{v_i}{\sigma_v} = \frac{(\mu_i - \varepsilon_i)}{\sigma_v} > \frac{R(\text{empl.} | x_i)}{\sigma_v} - \frac{R(\text{unempl.} | x_i)}{\sigma_v} - \frac{d}{\sigma_v} = L. \quad (2)$$

Now the objective is to find the probability that the individual  $i$  works.

$$\text{Prob}(\text{empl.} | x_i) = \Phi(L) \quad (3)$$

From equation (3) the expected value of R can be solved by including the working decision. Optimizing R(empl.) requires the condition that individual  $i$  chooses to work. But that is a personal decision and is not randomly distributed. That means the error term in this equation is not normally distributed with mean zero. So, the expected outcome for this choice will be:

$$E[R(\text{empl.}) | x_i, \text{choose empl.}] = \beta_i X_i + \underbrace{E(\varepsilon_i | \text{choose empl.})}_{\neq 0}$$

The necessary condition to choose the working status is given by equation (2). Plugging that in, we get:

$$\begin{aligned} & E[R(\text{empl.} | x_i, \text{choose empl.} (\xrightarrow{\text{implies}} \frac{v}{\sigma_v} > L))] \\ &= \beta_i X_i + E(\varepsilon_i | \frac{v}{\sigma_v} > L) \\ &= \beta_i X_i - \frac{\text{cov}(\varepsilon_i, (v / \sigma_v))}{\text{var}(v / \sigma_v)} \Phi(-L) \end{aligned} \quad (4)$$

Now the expected value for the outcome R if the person chooses to be employed is given by equation (4). By running a Probit model the value of the inverse mills ratio can be estimated. That represents the expected value for the outcome of individual  $i$ .

As the second step, the inverse mills ratio will be included in the GLS<sup>33</sup> regression. This GLS becomes necessary because of heteroskedasticity. This

---

<sup>33</sup> GLS = Generalized Least Square

estimator looks like  $\hat{\beta}_{GLS} = (x'v^{-1}x)^{-1}(x'v^{-1}(\ln w))$ , where both  $x'$  and  $\ln w$ <sup>34</sup> are given vectors. But the variance is not given and needs to be estimated. So, that the actual GLS is not usable. Instead of this, the EGLS<sup>35</sup> will be used to estimate the returns to schooling. So the estimation rule follows  $\hat{\beta}_{GLS} = (x'\hat{v}^{-1}x)^{-1}(x'\hat{v}^{-1}(\ln w))$  and  $\hat{v}$  is the estimated variance for this sample. By now running the regression the return to schooling will be corrected for the selectivity bias.

	return to schooling	std. err.	$\lambda$	std. err.	
<b>model 1</b>	0.09	0.004	-0.9086	0.102	
<b>model 2</b>	0.0947	0.005	-0.2037	0.1026	
<b>model 3</b>	0.091	0.198	<b>3.331</b>	5.792	
<b>model 4</b>	<b>0.1022</b>	0.0717	<b>-7.7091</b>	17.024	
<b>model 5</b>	0.0962	0.005	-0.1	0.036	<sup>36</sup>

**Table 8: Estimation results by running the regressions with the Heckman Two Step Procedure**

Table 8 reports the results from the Heckman Two Step Approach. The significant coefficients lie between 9.4% and 10%. The significant coefficients for the inverse mills ratio are all negative. So the coefficients are influenced upward with the selectivity term. Interesting is that the selectivity term for both models with the public-private-decision is insignificant. The reason for that can be that there is not a typical difference between the characteristics between public and private sector workers. But also in this case by comparing the new results with the earlier estimates of returns to schooling they are not significantly different in the important cases.

<sup>34</sup> Where  $x'$  represents a vector of characteristic variables, especially years of schooling over all  $i$  and  $\ln w$  a vector of logarithmic wage for each  $i$ .

<sup>35</sup> Estimatable Generalized Least Square.

<sup>36</sup> Table explanations at footnote 14

*Maximum Likelihood Procedure*

With this approach, the decision-making takes place through maximizing the possible outcome. So, the wage with the most likely result will be chosen. Here a Tobit model is used, instead of the Probit used in the first case.

	<b>return to schooling</b>	<b>std. err.</b>	$\lambda$	<b>std. err.</b>
<b>model 1</b>	0.093	0.003	-0.4744	0.015
<b>model 2</b>	0.0947	0.005	-0.4492	0.028
<b>model 3</b>	0.0923	0.003	<b>0.046</b>	0.086
<b>model 4</b>	0.0946	0.005	<b>-0.1184</b>	0.128
<b>model 5</b>	0.0961	0.005	-0.785	0.034

**Table 9: Estimation results by running the regressions with the Maximum Likelihood Approach**

The return to schooling for all variables is around 9.7% to 10%. As assumed, the coefficients estimated within the basic analysis are mostly smaller than that. So, they are underestimated if there is no correction for sample selection. But again, for the public and private sector decision the correction term for selectivity bias is not significant. For all other regressions the term is significant

By comparing these results with the basic model and most of the variations, the difference is not statistically significant.

<sup>37</sup> table explanations at footnote 14

## Conclusion

In this paper, we have estimated the return to education using the wave 2004 from the GSOEP. The standard model that is used is derived by Jacob Mincer (1974). The sample is reduced to workers aged between 30 and 55 precisely estimate the return. The difference between the coefficients for the truncated sample and the full sample is never significantly different from zero.

After controlling for tenure, the estimate is smaller then before, because this variable works in a similar way as schooling and reduces the educational effect. A fourth model uses a degree based schooling measure. The sheepskin effect is never significantly different from zero, but it affects the return to schooling.

Within the next estimation, the regressions were run separately for males and females. Except when controlling for tenure, women have a higher return than men. Next, the analyses examine public versus private sector workers. For these regressions, the public sector workers earn less than the employees from the private sector. A look at East versus West German returns to schooling reveals no real difference. Then, the question comes in how the differences are between East and West Germans. But there was no real pattern to see between them. For the part and full time decision, it can be said that part time workers have higher returns to education with at most an 8 % difference over full time workers. Just the tenure variable changes this.

By proving the robustness of the OLS estimator we got the following results: The coefficients from the first two methods are higher than the OLS estimators. Neither the estimators from the IVreg nor the coefficients by correcting for endogeneity differ significantly. So also by using different methods the results from the OLS estimates are robust. The span for the return lies between 9.4 % and 10 % and differs within this span for the analyzed groups.

### **Future Extensions**

The German regions are not very similar to each other. Within this paper a return to schooling for the whole of Germany is researched. But another interesting analysis would be to figure out the differences between each state. Or it can be extended in a way that these models are used for more than one country and then compared to each other. Especially within Europe it would be very interesting and a good approach after the PISA<sup>38</sup> study.

Another problem occurs, that in this paper only cross sectional data are used. Hence it is not possible to say something about how the return to schooling changes over time. It is just possible to mention one particular year. So it would be better to use more waves than one and estimate them over time. Then it can be concerned about different cohort effects

It is said above that the effect from experience to earnings changes over time. An interesting analysis would be segregating these effects into different years of experience and to look when that effect changes and how the development is.

One other problem that should be controlled for is the length of studying. By increasing studying the total costs increase as well. So, it could be that not the highest schooling level will give you the highest return by controlling for length. This analysis was done by Lauer and Steiner (2000).

Another point is that there are many differences that should be controlled for within particular groups. For example, it would be better to have a more intensified look at East and West Germans and their different characteristics. They differ a lot, so that the correlation with the error term by omitting variables are very different for both equations that are run for the basic analysis.

This paper's objective is to give an overview and try to show how that topic works for Germany. Later specifications for particular topics are a good point to work on.

---

<sup>38</sup> PISA= Program for International Student Assessment, that is an European survey 2000 and 2003. Pupils that attend the ninth grade are tested for their general education. They get overall scores for this. The average score for Germany was alarmingly bad.

## References

- Becker, G. S. (1964): “*Human Capital: A Theoretical and Empirical Analysis with special reference to Education*”, National Bureau of Economic Research
- Belman, D.; Heywood J.S. (1991): “*Sheepskin Effects in the Return to Education: An Examination of Women and Minorities*”, the Review of Economics and Statistics.
- Boockman, B., Steiner, V.(2000): “*Cohort Effects and the return to Education in West Germany*” ZEW
- Heckman, J.J. (1974): “*Shadow Prices, Market Wages and Labor Supply*”,  
Econometrica
- Heckman, J.J. (1979): “*Sample Selection bias as a specification error*”,  
Econometrica
- Hungerford, T.; Solon G. (1987): “*Sheepskin Effect in the Returns to Education*”, the Review of Economics and Statistics.
- Jochman M., Pohlmeier W. (2004): “*Der Kausaleffekt von Bildungsinvestitionen: Empirische Evidenz für Deutschland*“ ZEW<sup>39</sup>
- Lauer, C., Steiner, V. (2000a): “*Returns to Education in West Germany – An Empirical Assessment*” ZEW
- Mincer, J. (1974): “*Schooling, Experience and Earnings*”, National Bureau of Economic Research
- Pischke, J-S., Wachter, T. v. (2005): “*Zero Returns to Compulsory Schooling in Germany: Evidence and Interpretation*” IZA<sup>40</sup>
- Steiner, S.; Lauer, C. (2000b): “*Private Erträge von Bildungsinvestitionen in Deutschland*“, ZEW

---

<sup>39</sup> ZEW = Centre for European Economic Research

<sup>40</sup> IZA = Institute for the Study of Labor

Topel, R., Ward, M. (1992): "*Job Mobility and the Career of Young Men*", Quarterly Journal of Economics

Willis, R.J., Rosen, S. (1979): "*Education and Self- Selection*" Journal of Political Economy

UNIVERSITÄT POTSDAM  
Wirtschafts-und Sozialwissenschaftliche Fakultät

**STATISTISCHE DISKUSSIONSBEITRÄGE**

Herausgeber: Hans Gerhard Strohe  
ISSN 0949-068X

- Nr. 1 1995 Strohe, Hans Gerhard: Dynamic Latent Variables Path Models  
-An Alternative PLS Estimation –
- Nr. 2 1996 Kempe, Wolfram: Das Arbeitsangebot verheirateter Frauen in der  
neuen und alten Bundesländern  
- Eine semiparametrische Regressionsanalyse –
- Nr. 3 1996 Strohe, Hans Gerhard: Statistik im DDR-Wirtschaftsstudium zwischen  
Ideologie und Wissenschaft
- Nr. 4 1996 Berger, Ursula: Die Landwirtschaft in den drei neuen EU-Mitglieds -  
staaten Finnland, Schweden und Österreich  
- ein statistischer Überblick –
- Nr. 5 1996 Betzin, Jörg: Ein korrespondenzanalytischer Ansatz für Pfadmodells  
mit kategorialen Daten
- Nr. 6 1996 Berger, Ursula: Die Methoden der EU zur Messung der Einkommens -  
situation in der Landwirtschaft  
- am Beispiel der Bundesrepublik Deutschland –
- Nr. 7 1997 Strohe, Hans Gerhard/ Geppert, Frank: Algorithmus und Computer –  
programm für dynamische Partial Least Squares Modelle
- Nr. 8 1997 Rambert, Laurence/ Strohe, Hans Gerhard: statistische Darstellung  
transformationsbedingter Veränderungen der Wirtschafts- und  
Beschäftigungsstruktur in Ostdeutschland
- Nr. 9 1997 Faber, Cathleen: Die Statistik der Verbraucherpreise in Rußland  
- Am Beispiel der Erhebung für die Stadt St. Petersburg
- Nr. 10 1998 Nosova, Olga: The Attractiveness of Foreign Direct Investment in  
Russia and Ukraine  
-A Statistical Analysis –
- Nr. 11 1999 Gelaschwili, Simon: Anwendung der Spieltheorie bei der Prognose  
von Marktprozessen
- Nr. 12 1999 Strohe, Hans Gerhard/ Faber, Cathleen: Statistik der Transformation –  
Transformation der Statistik, Preisstatistik in Ostdeutschland  
und Russland

UNIVERSITÄT POTSDAM  
Wirtschafts-und Sozialwissenschaftliche Fakultät  
**STATISTISCHE DISKUSSIONSBEITRÄGE**

Herausgeber: Hans Gerhard Strohe  
ISSN 0949-068X

- Nr. 13 1999 Müller, Claus: Kleine und mittelgroße Unternehmen in einer hoch konzentrierten Branche am Beispiel der Elektrotechnik. Eine statistische Langzeitanalyse der Gewerbezahlungen seit 1882
- Nr. 14 1999 Faber, Cathleen: The Measurement and Development of Georgian Consumer Prices
- Nr. 15 1999 Geppert, Frank/ Hübner, Roland: Korrelation oder Kointegration - Eignung für Portfoliostrategien am Beispiel verbriefteter Immobilienanlagen –
- Nr. 16 2000 Achsani, Noer Azam / Strohe, Hans Gerhard: statistischer Überblick über die indonesische Wirtschaft
- Nr. 17 2000 Bartels, Knut: Testen der Spezifikation von multinominalen Logit – Modellen
- Nr. 18 2002 Achsani, Noer Azam / Strohe, Hans Gerhard: dynamische Zusammenhänge zwischen den Kapitalmärkten der Region Pazifisches Becken vor und nach der Asiatischen Krise 1997
- Nr. 19 2002 Nosova, Olga: Modellierung der ausländischen Investitionstätigkeit in der Ukraine
- Nr. 20 2003 Gelaschwili, Simon / Kurtanidse, Zurab: Statistische Analyse des Handels zwischen Georgien und Deutschland
- Nr. 21 2004 Nastansky, Andreas: Kurz- und langfristiger statistischer Zusammenhang zwischen Geldmengen- und Preisentwicklung: Analyse einer kointegrierenden Beziehung
- Nr. 22 2006 Kauffmann, Albrecht / Nastansky, Andreas: Ein kubischer Spline zur temporalen Disaggregation von Stromgrößen und seine Anwendbarkeit auf Immobilienindizes
- Nr. 23 2006 Mangelsdorf, Stefan: Empirische Analyse der Investitions- und Exportentwicklung des Verarbeitenden Gewerbes in Berlin und Brandenburg
- Nr. 24 2006 Reilich, Julia: Return to Schooling in Germany

Bezugsquelle: Universität Potsdam  
Lehrstuhl für Statistik und Ökonometrie der  
Wirtschafts- und Sozialwissenschaftlichen Fakultät  
Postfach 90 03 27, D-15539 Potsdam  
Tel. (+49 331) 977-32 25, Fax. (+49 331) 977- 32 10