

Does education improve labour market outcomes? Evidence from a large sample of twins

Author: Mathias von Buxhoeveden Supervisor: Martin Nordin

May 26, 2014

Abstract

This paper estimates the causal relationship between years of schooling and unemployment. The results are derived from a high quality dataset containing observations on 13,896 twins. A control for twin pair specific heterogeneity is introduced by exploiting the twin dimension through the fixed effects estimator. Although the OLS estimator reports a strong negative correlation between education and unemployment, the relationship vanishes once a control for unobserved ability is introduced. These results are consistent with previous studies about the effect of education on unemployment in a Swedish context. Altogether, the evidence would suggest that the negative correlation between schooling and unemployment is a result of more able individuals self selecting into higher education.

1 Introduction

The unemployment rates in Europe and the United States have remained relatively high in the aftermath of the great recession. This raises important policy questions since there is considerable evidence that unemployment imposes significant costs on the individual and society as a whole. Eliason and Storrie (2006) found evidence that workers who are exposed to job displacement are subjected to earnings penalties for up to 12 years. Moreover, Fagan and Freeman (1997) found evidence that unemployment increases the risk of social dislocation and the probability of engaging in criminal behaviour. In addition, results from Bell and Blanchower (2011) indicated that youth unemployment diminishes adult happiness and earnings prospects. Finally, Eliason, Lundborg and Vikstrom (2010) found evidence that workers who are exposed to long term unemployment are subjected to significant health deterioration.

Simple descriptive statistics demonstrates that groups with lower educational attainments experience unemployment to a greater extent than better educated segments of the population. However, since educational attainments are assigned non randomly, these results do not imply that further schooling diminishes the duration or incidence of unemployment spells. Hence, a more rigorous investigation is required to determine if further investments in education have the potential of reducing unemployment.

The difficulties of estimating the returns to schooling were formalized in a theoretical model of educational attainments by Card (2001). In the model, optimal schooling decision are made by balancing the cost and benefits of education. Moreover, different individuals may have different tastes and aptitudes for education which leads to different optimal schooling decisions. Since aptitude for education is likely to be influenced by cognitive abilities, motivation and other characteristics that improve labour market outcomes, statistical estimates of the returns to schooling are likely to be confounded by unobserved heterogeneity. Moreover, Blackburn and Neumark (1995) and Ashenfelter and Rouse (1998) found empirical evidence that unobserved ability do lead to upward bias in conventional OLS estimates of the returns to schooling.

Previous research would thus suggest that a control for unobserved heterogeneity is required if one wants to give a causal interpretation to the estimated impact of education on unemployment. This paper uses high quality data on a large sample of twins to control for unobserved ability. The control is introduced by exploiting the twin dimension through the fixed effects estimator.

By contrasting differences in educational attainments and years of unemployment between identical twins, I will attempt to eliminate any potential bias introduced by unobserved ability. The purpose of this paper is thus to answer the question: *Does further education reduce unemployment?*

The data set used in this paper was constructed by the Swedish twin registry. This is the largest twin registry in the world and it contains information about approximately 170,000 twins. The data was collected through a survey conducted in 1972-1973 where same sexed twins from the cohort born in 1926-1958 were asked to respond to questions about their labour market experiences. The sample consists of observations on 13,890 individuals and 6,945 twin pairs. In addition, the data set contains information about the zygosity (term used to determine if the twins are identical or not) of the twins. This allows the researcher to compare how the estimated impact of education on unemployment changes with different controls for unobserved ability.

Monozygotic (identical) twins possess identical sets of genetics while dizygotic (not identical) twins do not. The fixed effects estimator will thus control for childhood environment and genetics if the sample is restricted to monozygotic twins. A sample of dizygotic twins will by contrast only introduce a control for social environment. Estimates based on monozygotic twins should therefore be subjected to less ability bias. I will use this information to examine the extent to which unobserved ability drives the differences in employment rates among groups with different educational attainments.

The schooling variable used in this paper was constructed through a combination of survey and registry based data. This would suggest that measurement error will introduce an additional source of bias. Building on Bound and Solon (1999), I will consider the impact of measurement error when interpreting the results.

This paper is organized as follows: In the next section, I will provide a comprehensive review of the literature about the returns to education. The third section reviews some theoretical contributions that make predictions about the impact of schooling on labour market outcomes. The data is described in the fourth section and the fifth section presents the econometric model. The sixth section will present the empirical results and the final section provides a concluding discussion.

2 Literatur Review

The economics literature is replete with estimates of various returns to education. The research ranges from question concerning earnings premiums associated with higher education, the health returns to schooling and the impact of education on offspring outcome. The effect of further education on unemployment does however remain a relatively unexplored area within labour economics.

Much research has been devoted to estimating the economic returns to education. Since educational attainments are assigned non-randomly, conventional OLS estimates are likely to be subjected to upward bias due to unobserved ability. The difficulties of controlling for time invariant individual heterogeneity have lead economists to study monozygotic twins.

Isacsson (2004) used data from the Swedish twin registry to estimate the earnings premiums associated with different levels of educational attainments. By contrasting differences in schooling and earnings between identical twins, the author was able to hold constant some hard to measure factors such as intelligence and motivation. The evidence would suggest that earnings premiums grow with higher levels of education. The average return to years of schooling was estimated to about 3%.

Ashenfelter and Krueger (1994) and later Ashenfelter and Rouse (1998) used the same research design to estimate the economic returns to schooling in an American context. They did however find evidence of substantially larger earnings premiums than Isacsson. Ashenfelter and Krueger found evidence that an additional year of schooling increases earnings by 16%. The corresponding figure for Ashenfelter and Rouse was 9%.

In addition to the vast literature about the economic returns to education, economists such as Lundborg (2008) and Kenkel (1991) have been able to document a causal effect of education on higher health status. Moreover, Lundborg et al (2012) used a compulsory schooling reform in Sweden to instrument for parental education. They found evidence of positive effects of maternal education on sons skills and health status.

Despite the vast literature about the returns to schooling, little attention has been paid to the potential reduction in unemployment induced by further education. Some research within this area has nevertheless been carried out. Hall (2013) exploited an educational reform in Sweden during the 1990:s to obtain exogenous variation in years of schooling. The reform prolonged vocational programs and

gave them a significantly larger theoretical component. The effect was evaluated by comparing labour market outcomes of individual with different levels of educational attainments during the great recession of 2008-2010. The researcher was unable to find any evidence that additional schooling reduced the risk of unemployment.

Ashenfelter and Ham (1979) used data from the University of Michigan Income Dynamics Survey (IDS) to estimate the impact of schooling on unemployment in an American context. The evidence indicated that further education reduced unemployment incidence but left duration unaffected. They did however find evidence that work experience reduced unemployment duration.

Stenberg (2005) used registry data from SCB (statistics Sweden) to examine the effects of the Adult Education initiative (AEI) on unemployment in Sweden. The topic of this paper does however differ slightly from the question that I attempt to answer. Stenberg evaluated the impact of AEI on unemployment incidence and duration. The effects of the program were however defined as the difference between what would have happened if the participants had instead entered into vocational Labour Market Training (LMT). This was another labour market program introduced by the government to reduce unemployment. The counterfactual used in Stenbergs paper does therefore involve enrolment into another labour market program. In this paper, the counterfactual is simply not obtaining an additional year of schooling.

This is an important distinction since positive results in Stenbergs paper does not necessarily imply that further education reduces unemployment. The estimates could come out positive event though the effect is actually zero if the other program harms its participants employment prospects. This might sound far fetched but several researchers such as Larsson (2003) and Gern and Lechner (2002) have actually found evidence of labour market programs with detrimental effects on its participants employment prospects. The evidence from Stenbergs study would suggest that the AEI reduced unemployment incidence but lead to longer duration. The net impact of further education on unemployment is thus ambiguous.

Finally, it is worth noting that the evidence about the returns to schooling suggests that further education is worth more on the American labour market. This can be seen by comparing the earnings premiums associated with higher education in Sweden and the United States. Previous evidence would thus suggest that further schooling in the United States should diminish the risk of unemployment to a greater extent. The direct evidence of the impact of education on unemployment reviewed in this paper is consistent with this observation.

3 Theoretical Framework

There are primarily two competing schools of thought that make predictions about the impact of education on labour market outcomes. Both frameworks attempt to explain the empirically documented earnings premium associated with higher education. One can however easily extend the line of reasoning to make predictions about the impact of schooling on unemployment.

Human capital theory views educational attainments as a long term investment. The costs of further schooling entails opportunity costs in terms of forgone earnings and direct costs such as tuition fees (maybe not so relevant in a Swedish context). Moreover, the individual will only undertake such an investment if life time earnings are expected to increase with a sufficient amount. Since wages are assumed to be a function of productivity, this would imply that further schooling make workers more productive. See for example Willis (1986) for a deeper discussion. Moreover, higher productivity is obviously an attractive feature in the labour market. Employers will tend to value high productivity workers more since they can contribute more to the firms output. The human capital view of educational investments would therefore imply that further schooling diminishes the risk of unemployment.

The Human capital explanation of the earnings premium associated with higher education has however not gone unchallenged. The assumption that further schooling increases productivity has received a variety of criticism. Many researchers have instead suggested that higher education can act as a signal through which employers sort workers according to their levels of innate ability. The idea is basically that the costs of education are inversely related to ability since more able individuals can go through school with less effort. Employers would then exploit this information during the screening process to get a good pool of applicants. Moreover, if education produces an advantages during the screening process, one would expect schooling to diminish the risk of long term unemployment.

In his famous signalling model, Spence (1974) did show that it is possible for profit maximizing firms to pay wage premiums to better educated workers even if schooling does not raise productivity. In addition, he showed that the earnings premiums would induce wealth maximizing individuals to make educational investments. The idea behind the model is easily illustrated with a numerical example. This builds heavily on Willis (1986).

Assume that the economy consists of low and high ability workers. Individuals from the first group have a marginal productivity of 1. The corresponding figure

for individuals in the second group is 2. If firms had perfect information, low and high ability workers would thus earn wages of 1 and 2 respectively.

Now, assume that firms cannot perfectly differentiate between low and high productivity workers. If firms were to offer competitive salaries to high ability individuals, workers from the other group would obviously have an incentive to misrepresent themselves. Moreover, suppose that high ability individuals can signal their productivity by investing in higher education. This could be a credible signal if the costs of getting an education are inversely related to ability. This would be the case if the effort required to get an education is lower for high ability individuals.

Consider the following equilibrium. The cost of higher education is 0.5 for high ability individuals and 1.5 for low ability individuals. Since the two groups earn wages equal to 1 and 2 respectively, the net benefit of an education is 0.5 for high ability individuals and -0.5 for low ability individuals. In this simple example, workers will thus self select themselves into different educational categories. Educational attainments will thus become a credible signal of high ability. Moreover, firms will find that it is justified to pay better educated workers higher wages due to their innate level of ability.

The Human capital versus signalling debate about the earnings premium associated with higher education has however been proved difficult to resolve. It seems reasonable to assume that the earnings premium could be decomposed into a productivity and a signalling component. Ideally, one would however determine the relative importance of each component empirically. This would be fairly straightforward if the researcher had access to experimental data.

Consider a simple example of how such a test could be constructed. Assume that the economy consists of workers who either have a marginal productivity of 1 or 2. According to the signalling framework, marginal productivity is determined by some innate level of ability and is unaffected by education. Building on the previous equilibrium model, assume that the cost of education is 0.5 for high ability individuals and 1.5 for low ability individuals. This would imply that workers will not self select into higher education unless they have a marginal productivity of 2. The human capital framework does by contrast state that schooling raises productivity. In such a model, every worker would have an initial level of productivity equal to 1. Those who choose to pursue further schooling will increase their marginal productivity to 2.

In a controlled experiment, the researcher could simply randomly assign test sub-

jects into lower and higher educational attainments. If productivity is unrelated to education, one would expect both groups to have an average productivity of 1.5 at the end of the experiment. If on the other hand schooling raises productivity, one would expect the average productivity in the group with further education to be 2. The corresponding figure for the group with lower educational attainments would instead be 1.

Economists are however rarely fortunate enough to have access to experimental data. This is problematic since both frameworks would predict the same income distribution in the simple economy described above. The signalling model would predict that more able individuals self select into higher education. They would then earn a wage equal to 2 simply because of their innate level of ability. The human capital framework would also predict that better educated workers earn wages equal to 2. The interpretation would however be that higher education raised their productivity to a level that justified a higher wage. The identification issue illustrated in this example is the reason why the empirical literature on this issue is neither large nor persuasive.

4 Data

The data set used in this paper was constructed by the Swedish twin registry. This is the largest twin registry in the world and it contains information about approximately 170,000 twins. The data was collected through a survey conducted in 1972-1973 where same sexed twins from the cohort born in 1926-1958 were asked to respond to questions about their labour market experiences.

The "years of unemployment" variable was constructed by first asking the respondents if they are or had ever been unemployed. Those who said yes were then asked to provide information about how many years they had been unemployed. The other important variable used throughout the empirical part of this paper is "years of schooling". This variable was constructed through a combination of self-reported educational attainments and register based data. Moreover, one would typically expect survey based variables to be measured with error. The analysis in this paper will be performed under the assumption of classical measurement error.

The Swedish twin registry did nevertheless receive answers from 36,000 individuals and 14,000 twin pairs. Every respondent in the sample has been linked to the national income registry. The earnings variable is thus constructed with registry based data so measurement error should be minimal. Moreover, the analysis of

earnings will be restricted to income from labour market participation. The "income" variable is thus defined as annual earnings from employment before taxes. Note that it has been inflated to the price level of 2007.

A substantial part of the original sample will however be deleted. Several of the respondents failed to provide information about their unemployment history. Moreover, the "years of schooling" variable has not been constructed for every respondent in the sample. In addition, twin pairs where information about one twin's education or unemployment history is missing will have to be deleted since this renders the within twin pair variation undefined.

Twins with identical levels of educational attainments will also be deleted from the sample. Since the fixed effects estimator uses within twin pair variation to estimate the parameters, twins with identical levels of educational attainments will not alter the estimates. This would imply that the OLS and the fixed effects estimates are obtained through different samples. Any comparisons between the estimates would thus be meaningless.

The available sample is reduced to 13,896 observations and 6,948 twin pairs. This includes 4,812 monozygotic and 8,842 same sexed dizygotic twins. Note that the zygosity of 242 twins has not been determined. The method used to distinguish monozygotic from same sex dizygotic twins has been proven to have 98% or higher accuracy, Lichtenstein et al (2002). Descriptive statistics of the available sample is provided in table 1 on the next page.

The gender distribution in the sample is very balanced. Approximately half of the sample is male and female respectively. A fairly small share of the respondents (9.8%) has ever experienced unemployment. Moreover, the average age is just below 30 so the data consists of observations on fairly young individuals.

It is clear that the sample does not consist of particularly well educated individuals. The average amount of schooling is about 11 years which is just below what is required to finish secondary school. In addition, the average income that the respondents had in 1973 is fairly low. These results are however not surprising since some of the respondents are very young. The survey was conducted in 1973 and includes individuals born in 1958. Some of the respondents will thus be 15 years of age.

Table 1: Descriptive Statistics: Means

	Full sample	MZ twin	DZ twins
Years of schooling	11.36 (2.9)	11.53 (2.9)	11.289 (2.906)
Income	128,400 (110,518)	129,565 (111,300)	127,943 (110,390)
Gender dummy	1.51 (0.5)	1.53 (0.5)	1.509 (0.5)
Unemployment dummy	0.098 (0.297)	0.1 (0.3)	0.096 (0.3)
Years of unemployment	0.054476 (0.48)	0.052 (0.44)	0.053 (0.435)
Age	29.2 (8.69)	29.39 (8.7)	29.07 (8.6667)
Observations	13,896	4,812	8,842

¹ Notes: The standard errors are reported within parentheses. The gender dummy equals 1 if the respondent is male and 2 otherwise. The unemployment dummy equals 1 if the respondent has experienced unemployment and 0 otherwise.

The monozygotic and same sexed dizygotic twins appear to be very similar. All of the available variables are almost identical in the two sub samples. This would imply that differences between fixed effects estimates based on MZ and DZ twins can be attributed to different controls for ability.

5 Empirical Model

The economics literature is replete with estimates of the link between education and labour market outcomes. The research has primarily been focused around the earnings premium associated with higher education. Estimating the causal effect of education on earnings without experimental data is however problematic. This was illustrated in a theoretical model of educational attainments by Card (2001). The model asserts that optimal schooling attainments are determined by balancing the costs and benefits of education. Moreover, different individuals may have different tastes and aptitude for education. This leads to different optimal schooling decisions.

Furthermore, it is generally assumed that the effort required to get an education is inversely related to ability. This would suggest that high ability individuals on average obtain more education. If we accept the analysis above, it would follow that the schooling variable in conventional earnings equations is endogenous. Moreover, ability is typically assumed to increase earnings so conventional OLS estimates will tend to overestimate the returns to education. The endogeneity problem is easy to illustrate with a concrete example. Consider the following earnings equation:

$$Y_i = \alpha + \beta^T X_i + \gamma S_i + \lambda A_i + \epsilon_i \quad (1)$$

Where Y_i is individual i 's earnings. It is assumed that Y depends on some $k \times 1$ vector of covariates (X) containing features such as gender, age, ethnicity and so forth. Earnings are also influenced by years of schooling (S) and some unobservable level of ability, (A). The ability variable contains unobservable features such as intelligence, motivation, soft skills and so forth. The ability variable is however unobservable so the researcher will end up estimating:

$$Y_i = \alpha + \beta^T X_i + \gamma S_i + \mu_i \quad (2)$$

$$\mu_i = \lambda A_i + \epsilon_i \quad (3)$$

The OLS estimator will thus have the following probability limit;

$$\text{plim}_{n \rightarrow \infty} \gamma_{ols} = \gamma + \frac{\lambda \text{Cov}(A, S)}{\text{Var}(S)} \quad (4)$$

The covariance between unobserved ability and schooling is typically assumed to be positive. Equation (4) would thus suggest that the conventional OLS estimator is subjected to upward inconsistency.

Several researchers have attempted to solve the endogeneity problem with monozygotic twins. The twin design rests on the assumption that the ability variable in equation (1) is identical within any given twin pair. The justification for such an assumption is partly that monozygotic twins possess identical sets of genetics. In addition, twins are exposed to the same childhood environment. It would therefore seem reasonable to assume that twins are identical with respect to unobserved ability. Within twin pair variation in schooling is therefore assumed to be exogenous.

This research design has been used extensively to examine the causal link between education and earnings. See for example Bonjur et al (2003) for twin based estimates of the returns to schooling in British context. In addition, Isacsson (2004) and Ashenfelter and Krueger (1994) used the same research design to estimate the returns to schooling in a Swedish and an American context respectively.

The twin design did however not go unchallenged. Bound and Solon (1999) raised some serious objections to it. The twin design rests on the assumption that the ability variables in equation (1) is identical within any given twin pair. Bound and Solon did however argue that this is an implausible assumption. They pointed out that in some extreme cases of the so called twin transfusion syndrome, monozygotic twins can have dramatically different birth weights. This is due to an uneven distribution of nutrition in the uterus.

Behrman, Rosenzweig and Taubman (1994) used a sample of monozygotic twins from Minnesota to examine differences in birth weights between identical twins. Their results indicated that significant differences are quite common. Moreover, birth weight disparity's were also found to have a strong correlation with differences in educational attainments. This is not surprising since there is a well documented link between birth weights and cognitive ability, see for example Richards et al (2001).

Bound and Solon (1999) concludes that it is implausible to assume identical levels of ability within any given twin pair. Moreover, depending on the extent to which within twin pair differences in ability drives differences in schooling, the fixed effects estimator might be subjected to just as much inconsistency as the estimator in equation (4).

In addition, Bound and Solon (1999) pointed out that the twin design is likely to amplify the impact of measurement error. Due to the similarities between identical twins, one would expect educational attainments within twin pairs to have a strong correlation. Within twin pair differencing will therefore delete a substantial part of the "signal" component of the proxy variable. There is however no reason to expect a corresponding reduction in the noise from measurement error. The relative importance of measurement error will thus be amplified if one uses the twin design.

This causes some concern since unobserved ability causes upward bias in the estimated returns to education. Measurement error does by contrast bias the estimator towards zero. Moreover, it seems unclear whether unobserved ability or measurement error introduces the dominant source of bias. This would suggest that the

bounding properties of the twin based estimates are lost.

The twin design can however be saved with some additional assumptions. Monozygotic twins have identical sets of genetics and have been exposed to the same childhood environment. One would therefore expect differences in ability between twins to be negligible most of the time. Moreover, the similarities between monozygotic twins would also suggest that educational attainments within twin pairs are highly correlated. One would therefore expect twin based estimates to amplify the effect of measurement error substantially. Under the assumption that any ability bias is dominated by the effect of measurement error, the twin based estimates could be viewed as a lower bound on the returns to education.

Consider two individuals who would be identical with respect to the "years of unemployment" variable if they had the same education. Then randomly assign an additional year of schooling to one of them. Is there an expected difference in the "years of unemployment" variable? This question: "*Does further education reduce unemployment*" is what this paper will attempt to answer. More formally, the effect to be estimated is given by:

$$y_i = E(u_i | s_i = n) - E(u_i | s_i = n - 1) \quad (5)$$

Where u_i and s_i are individual i 's years of unemployment and schooling respectively. The effect will be estimated with the twin design. I will consider the previous criticism of the research design in great detail when interpreting the results.

Consider the following set up:

$$U_i = \alpha + \beta^T X_i + \gamma S_i + \lambda A_i + \epsilon_i \quad (6)$$

Where U_i is the number of years individual i has spent in unemployment. It is assumed that U depends on some vector of covariates, (X) , which contains features such as age and gender. In addition, years of unemployment depends on years of schooling, (S) , and some unobserved level of ability, (A) .

Now, consider the same set up for twin pair i :

$$U_{i1} = \alpha + \beta^T X_{i1} + \gamma S_{i1} + \lambda A_{i1} + \epsilon_{i1} \quad (7)$$

$$U_{i2} = \alpha + \beta^T X_{i2} + \gamma S_{i2} + \lambda A_{i2} + \epsilon_{i2} \quad (8)$$

Where $X_{i1}=X_{i2}$ and $A_{i1}=A_{i2}$. Within twin pair differences in years of unemployment are thus given by:

$$\Delta U_i = \gamma \Delta S_i + \Delta \epsilon_i \quad (9)$$

Since the sample consists of same sexed twins, the vector of covariates cancels out. Moreover, unobserved ability is assumed to be identical within twin pairs. The ability variable is thus eliminated. As outlined in the previous part of this section, this assumption is probably too restrictive. I will therefore relax this premiss in the next section.

6 Results

This section will present the empirical findings of this paper. The problems associated with estimating the causal relationship between schooling and unemployment is that educational attainments are assigned non randomly. One would typically assume that the costs associated with schooling are lower for high ability individuals. This would be the case if the effort required to get an education is inversely related to ability. The analysis above would thus suggest that high ability individuals on average obtain more schooling. More formally, this would imply that $cov(A, S) > 0$.

Moreover, unobservable features captured in the ability variable will probably reduce the likelihood of experiencing persistent unemployment spells. More formally, this would suggest that $\lambda < 0$ in equation (6). Looking at equation (4), it is easy to see that this will render the conventional OLS estimator downward inconsistent. The reduction in unemployment induced by further education will thus tend to be overestimated.

The twin design uses within twin pair variation in years of schooling and unemployment to eliminate any potential bias introduced by unobserved ability. The idea behind the twin design is illustrated in equation (9). Note that the ability variable cancels out since it is assumed to be identical within twin pairs.

The previous section did however review some strong arguments for why this assumption might be too restrictive. One could nevertheless interpret the twin based estimate as a conservative assessment of the true effect. This does however require the additional assumption that any remaining ability bias is dominated by measurement error. It is easy to check if such an assumption is appropriate. One can simply compare how the estimates change with different controls for ability. For this purpose, I estimated model (6) with the entire sample and model (9) with the monozygotic and same sexed dizygotic twins respectively. This produces the results collected in table 2.

Table 2: Regressions, years of unemployment on schooling

	Full sample (OLS)	DZ twins (Fixed effects)	MZ twins (Fixed effects)
Years of schooling	-0.0064*** (-0.009 -0.003)	-0.005** (-0.01 0)	-0.0026 (-0.01 0.0048)
Gender dummy	0.0145 (-0.0012 0.03)		
Years of age	0.000984 (-0.0002 0.002)		
Observations	13,896	4,421	2,406

¹ Notes: *** $p \leq 0.01$, ** $p \leq 0.05$, * $p \leq 0.1$. Confidence intervals (95%) are reported within parenthesis. The gender dummy captures the effect of being female.

Since the regressions are based on fairly large samples (ranging from 2,406 to 13,896 observation) I will rely on the asymptotic properties of the estimators and not make any assumptions about the distribution of the error terms. The Breusch-Pagan test provided strong evidence for heteroscedasticity in every model considered. The test statistics were thus computed with Whites robust standard errors. Furthermore, autocorrelation will not be considered since no time dimension was ever present.

The conventional OLS estimates are correctly signed but mostly insignificant. There is a strong negative correlation between years of schooling and unemployment respectively. The estimate would suggest that an additional year of educa-

tion reduces unemployment with 0.0064 years (or 2 days). The effect of schooling is thus moderate but highly significant. Furthermore, the gender dummy would suggest that being female increases the risk of unemployment. The estimate is however insignificant. The OLS estimator does also report a positive correlation between years of age and unemployment respectively. This is to be expected since older individuals have been active on the labour market for longer periods of time. They are thus more likely to have experienced events that increases the risk of unemployment (such as recessions, downsizing, etc). This effect is however also insignificant.

The estimated schooling parameter increases to -0.005 when the sample is restricted to same sexed dizygotic twin. This would suggest that an additional year of schooling reduces unemployment with 0.005 years (or 1 day).

The estimate remains significant but only at the 5% level. Note that there is no need to control for age and gender in the twin design. The sample consists of same sexed dizygotic and monozygotic twins. Every twin pair in the sample is thus identical with respect to age and gender. Within twin pair variation will thus eliminate these variables. This is illustrated in equation (9) where the vector of covariates (X) cancels out. The estimated impact of schooling on unemployment is reduced even further when the sample is restricted to monozygotic twins. The effect is not even significant at the 10% level.

The previous part of this section outlined some arguments for why unobserved ability is likely to bias the schooling parameter downwards. Moreover, monozygotic twin pairs possess identical sets of genetics while same sexed dizygotic twins do not. This would suggest that within twin pairs differences in ability are smaller in monozygotic twin pairs. The fixed effects estimator will therefore remove a larger amount of ability bias when the sample is restricted to monozygotic twins. The empirical results produced in this paper is consistent with this argument since the schooling parameter comes out closer to zero when the sample is restricted to monozygotic twins. Moreover, both twin based estimates came out close to zero than the corresponding OLS estimate. This would suggest that the twin design did remove a substantial amount of ability bias.

The previous section reviewed some criticism against twin based estimates. Bound and Solon (1999) argued that it is too restrictive to assume that unobserved ability is identical within twin pairs. Moreover, they also pointed out that the twin design is likely to amplify the impact of measurement error. This causes some concern since unobserved ability will bias the schooling parameter downwards. Measurement error will by contrast bias it towards zero. This would suggest that

the bounding properties of the twin based estimates are lost. I did however argue that it is plausible to assume that the effect of measurement error would dominate any remaining ability bias if the sample is restricted to monozygotic twins. If we accept that assumption, it would follow that the twin design yields a conservative estimate of the reduction in unemployment induced by further education.

The pattern that emerges when one moves from the OLS to the fixed effects estimator and then from same sexed dizygotic to monozygotic twins is entirely consistent with this argument. The estimate based on monozygotic twins could thus be interpreted as a lower bound on the impact of schooling on unemployment.

Measurement error could potentially cause some concern in this situation since it generally leads to lower t-scores. This is easy to see since lower parameter estimates reduces the numerator in the test statistic. In addition, measurement error inflates the corresponding denominator since it increases the variance. Altogether, the t-ratios will therefore tend to be smaller than they would have been in the absence of measurement error. The estimated schooling parameter is however not even significant at the 10% level when the sample is restricted to MZ twins. The decision not to reject the null hypothesis would therefore most likely have been the same even in the absence of measurement error. Altogether, these results do not appear to provide any evidence that further education reduces the risk of unemployment.

7 Conclusion

The purpose of this paper is to answer the question: *"Does further education reduce unemployment?"* Although the OLS estimator reports a strong negative correlation between years of schooling and unemployment, the effect vanishes once a control for unobserved ability is introduced.

Moreover, the estimated impact of schooling on unemployment is monotonically going down as more rigorous controls for ability are introduced. These results would thus suggest that the negative correlation between education and unemployment is a result of self selection bias. High ability individuals simply choose to pursue more education. Furthermore, it is the same features that induces them to pursue further schooling that improves their labour market outcomes. These results would thus suggest that the negative correlation between schooling and unemployment is spurious.

The second section of this paper reviewed some previous research about the im-

impact of schooling on unemployment. Even though it is a relatively unexplored area within labour economics, some research on this topic has been carried out. The results produced in this paper are consistent with those presented in the literature review. Hall (2013) used a different research design to investigate if further education reduced unemployment. The researcher exploited an educational reform in Sweden during the 1990:s to obtain exogenous variation in years of schooling. The effect was then evaluated by comparing labour market outcomes for groups with different educational attainments during the great recession. The researcher was however unable to find any evidence that further schooling reduced the risk of unemployment.

Another paper that was presented in the literature review was Stenberg (2005). The topic of this paper does however differ slightly from the question that I attempt to answer. Stenberg compared the effects of two labour market programs introduced by the government to reduce unemployment. The first program (AEI) had an academic emphasis while the second program (LMT) offered vocational training in sectors with insufficient labour supply. The effect of further schooling on unemployment was thus defined as the differences between what would have happened if the participants had instead enrolled into vocational labour market training. Stenberg was nevertheless unable to find any persuasive evidence that further schooling was more efficient in reducing unemployment.

Ashenfelter and Ham (1979) were by contrast able to document a negative relationship between education and unemployment. This study was however conducted in an American context. Moreover, the literature about the returns to schooling would suggest that further education is worth more on the American labour market. The research about the effect of schooling on unemployment reviewed in this paper is consistent with this observation. Altogether, the results produced in this paper are thus similar to those found in the previous literature.

The third section on this paper reviewed some theoretical contributions that makes predictions about the impact of education on labour market outcomes. The two frameworks considered were human capital theory and the signalling model introduced by Spence (1974). Both frameworks attempt to explain the empirically documented earnings premium associated with higher education. One can however easily extend the reasoning to make predictions about the effect of schooling on unemployment.

Human capital theory asserts that education raises productivity and that this leads to higher wages for better educated segments of the population. The signalling model does by contrast assert that productivity is determined by some innate

level of ability and is unaffected by education. Schooling does however produce an advantage in the labour market since it is a signal of high ability. The idea is basically that more able individuals pursue more education since they can get through school with less effort. Employers would then exploit this information during the screening process to get a good pool of applicants.

I have argued that the human capital and signalling frameworks would suggest that education diminishes the risk of unemployment. More productive workers are obviously more valuable to their employers. One would therefore expect education to reduce the risk of unemployment if the human capital explanation holds true. Moreover, if education produces an advantage during the screening process, one would also expect schooling to diminish the risk of unemployment. The results produced in this paper strongly suggest that more able individuals choose to pursue further education. The absence of a causal relationship between schooling and unemployment would however suggest that employers fail to act upon this information. In addition, the absence of a causal relationship between schooling and unemployment appears to contradict the notion that education raises productivity.

The internal validity of the empirical results produced in this paper are arguably fairly high. The twin based estimate can be viewed as a conservative assessment of the true effect under the assumption that any remaining ability bias is dominated by measurement error. The results produced in this paper does provide a strong empirical foundation for such an assumption. The impact of measurement error could potentially cause some concern since it typically raises the risk of type II errors. The estimated schooling parameter was however not even significant at the 10% level. It is thus unlikely that the decision not to reject the null hypothesis would have been reversed if the variables had been measured without error.

The external validity of twin based estimates has become a much debated topic. Twins differ from singletons with respect to some important dimensions. It has for example been pointed that twins influence each other to a greater extent during their childhood than ordinary siblings. This effect has been attributed to their psychological need to differentiate themselves from one another, Bound and Solon (1999). It does however seem unlikely that these effects would influence how they react to schooling.

Moreover, it has also been documented that singletons tend to have higher birth weights than twins, Bleker et al (1979). This is somewhat problematic since it is well known that lower birth weights are correlated with lower levels of cognitive ability. This would thus suggest that a twin based study consists of observations on more low skilled workers than a random sample from the Swedish labour force.

There is however some evidence that the economic returns to education are slightly higher for less able individuals, see for example Ashenfelter and Rouse (1998). One would therefore expect schooling to decrease the risk of unemployment further for low ability individuals. Twin based estimates should therefore tend to overestimate the impact of schooling on unemployment. The external validity of these estimates are thus not affected by this selection problem.

It is however worth pointing out that the generalizability of these results are fairly low. It is for example unknown what type of education the individuals in the available sample have chosen to pursue. One would typically expect stark differences in the marketability of different degrees. These results are therefore by no means proof that all types of educational investments leaves the risk of unemployment unaffected. It does however seem to contradict the notation that more schooling necessarily reduces the risk of unemployment.

Moreover, these results are derived from data collected in 1973. It is therefore unclear if they can be generalized to the situation in the labour market today. The educational system and the skills required to be competitive in the job market has probably changed quite a bit since 1973. Further research would thus have the potential of producing results that are somewhat more relevant to the situation in the labour market today.

8 References

Ashenfelter and Ham (1979) "Education, Unemployment and Earnings" *Journal of Political Economy* 87: 99-116

Ashenfelter and Krueger (1994) "Estimates of the Economic returns to Schooling from a New Sample of Twins" *American Economic Review* 84: 1157-1173

Ashenfelter and Rouse (1998) "Income schooling and ability: Evidence from a large sample of twins" *The Quarterly Journal of Economics* 113: 253-284

Behrman, Rosenzweig and Taubman (1994) "Endowments and the allocation of schooling in the family and in the marriage market: The Twins Experiment" *Journal of Political Economy* 102: 1131-1174

Bell and Blanchower (2011) "Youth unemployment in Europe and the United States" *Nordic Economic Policy Review* 1: 11-37

Blackburn and Neumark (1995) "Are OLS estimates of the returns to schooling biased downwards? Another look" *The Review of Economics and Statistics* 77: 217-230

Bleker, Breur and Huidekoper (1979) "A study of birth weight, placental weight and mortality of & twins as compared to singletons" *BJOG: An International Journal of Obstetrics & Gynaecology* 86: 111-118

Bonjour, Cherkas, Haskel, Hawkes, and Spector (2003) "Returns to Education: Evidence from U.K Twins" *The American Economic Review* 101: 1629-1635

Bound and Solon (1999) "Double trouble: On the value of Twin-Based estimation of the returns to schooling" *Economics of Education Review* 18: 169-182

Card (2001) "Estimating the returns to schooling: Progress and some persistent econometric problems" *Econometrica* 69: 1127-1160

Eliason, Lundborg and Vikstrom (2010) "Massuppsagningar arbetsloshet och sjuklighet" Statens offentliga utredningar

Eliason and Storrie (2006) "Lasting or Latent Scars? Swedish Evidence on the Long - Term Effects of Job Displacement" *Journal of Labor Economics* 24: 831-856

- Fagan and Freeman (1997) "Crime, work and unemployment" *Mimeo*
- Gern and Lechner (2002) "A microeconomic Evaluation of the Active Labour Market Policy in Switzerland" *The Economic Journal* 112: 854-893
- Gregg and Tominey (2005) "The wage scar from male youth unemployment" *Labour Economics* 12: 487-509
- Hall (2013) "Does more general education reduce the risk of unemployment? Evidence from labor market experiences during the great recession" Working Paper, IFAU - Institute for Evaluation of Labour Market and Education Policy No. 2013:17
- Hammarstrom (1994) "Health consequences of youth unemployment" *Public Health* 108: 403-412
- Isacsson (2004) "Estimating the economic returns to educational levels using data on twins" *Journal of Applied Econometrics* 19: 99-119
- Kenkel (1991) "Health behavior, Health Knowledge, and Schooling" *Journal of Political Economy* 99: 287-305
- Larsson (2003) "Evaluation of Swedish Youth Labor Market Programmes" *Journal of Human Resources* 38: 891-927
- Lichtenstein, De Faire, Floderus, Svartengren, Svedberg and Pedersen (2002) "The Swedish Twin Registry: A unique resource for clinical, epidemiological and genetic studies" *Journal of Internal Medicine* 252: 184-205.
- Lundborg (2008) "The health returns to Education: What can we learn from Twins?" IZA Discussion Papers 3399, Institute for the Study of Labor (IZA)
- Lundborg, Nilsson and Rooth (2012) "Parental education and Offspring Outcomes: Evidence from the Swedish Compulsory School Reform" *American Economic Journal: Applied Economics* 6: 253-78
- Richards, Hardy, Kuh and Wadsworth (2001) "Birth weight and cognitive function in the British 1946 cohort: longitudinal population based study" *BMJ* 322: 199-203
- Spence (1974) "Market signalling: information transfer in hiring and related screening processes" *Cambridge: Harvard University Press*

Stenberg (2005) "Comprehensive education for the Unemployed - Evaluating the Effects on Unemployment of the Adult education Initiative in Sweden" *Labour* 19: 123-146

Willis (1986) "Wage determinants: A survey and reinterpretation of human capital earnings functions" *Handbook of Labor Economics, volume 1, edited by Ashenfelter and Layard*