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*A cross-country analysis of the association
between educational mobility and income
inequality*



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Abstract

The main objective of this paper is to investigate the relationship between intergenerational educational mobility and income inequality. Previous research suggests that this relationship is expected to be positive, i.e. high income inequality is associated with low intergenerational educational mobility. To estimate the association between the two specified variables data on educational mobility is taken from a previous study and data on the income inequality measure, the Gini coefficient is taken from the World Bank. A weighted least square regression shows that 0.10 increase in the Gini coefficient leads to a 0.135 increase in the measure of educational mobility. Moreover, one underlying mechanism for this certain linkage is inspected. Pearson correlation between public spending on education as a percent of GDP and educational mobility show a rather strong negative association suggesting that higher spending on education is related to higher educational mobility.

Keywords

Intergenerational mobility, educational mobility, income inequality

Thanks

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1. Introduction

The idea that individual talent and hard work will determine one person's future outcome is something that is regarded highly. However, this idea may seem too optimistic as we live in an era with rising income inequality and where the poor stay poor and see their children grow up to be the next generation of poor (OECD, 2015).

One indicator that has been used to measure the equality of economic opportunity in a society is the intergenerational mobility. The intergenerational mobility quantifies the degree to which children inherit their parents' socio-economic status, for instance in terms of income or education, and can be interpreted as a measure of how much the society provides equal opportunities to children from diverse family backgrounds.

Further, as income inequality rises in many OECD countries, there has been an increased interest, in recent years, in the relationship between the intergenerational mobility and income inequality. Corak (2013) explained this relationship with The Great Gatsby Curve which was initially popularised by Alan Krueger in 2012. The curve shows that economically unequal countries are the least socially mobile. More precisely, the more unequal one society is, the more likely it is that children occupy the same position in the earnings distribution as their parents - implying a less mobile society (Corak, 2013). This leads us to the question on the role of education in this relationship. Previous studies show that one crucial factor in transmission of (dis)advantages across generations is educational attainment (Becker and Tomes, 1986) (Solon, 2004). Indeed, Solon predicts in his model that the key determinants of intergenerational income mobility are closely related to human capital investments. As the role of education has been emphasised greatly in the literature, it seems natural to measure this association directly.

Whilst some research has been concerned with estimation of educational mobility i.e. the transmission of education from parents to children, the relationship between educational mobility and income inequality has not been inspected to the best of my knowledge.

An extensive literature shows that educational attainment persists across generations (OECD, 2014). Parents' level of education seems to be a crucial determinant of children's future outcomes. In addition, parents facing monetary constraints cannot invest in their offspring's human capital as much as rich parents. High parental education and thus income, is associated with better quality of education as high-income families live in good neighbourhoods, send

their children to high-quality schools and provide a supportive learning environment for their children (Durlauf, 1997). Thus, highly educated parents will have highly educated children while children with low-educated parents will inherit their parents' socio-economic status. Additionally, research shows that intergenerational mobility is low at both ends of the education distribution. Therefore, if access to high education is constrained only to high-educated families, this will result in a so-called under-education trap. Existence of under-education traps, i.e. when a dynasty remain unskilled with generations, will, in turn, create education gaps between the rich and the poor. Since income inequality is growing in many developed countries, low educational mobility and elitist societies may be the reason for this. Thus, education can work in both ways, as a tool for a more equal society but also as an instrument for social reproduction (Gazenboom et al., 1991).

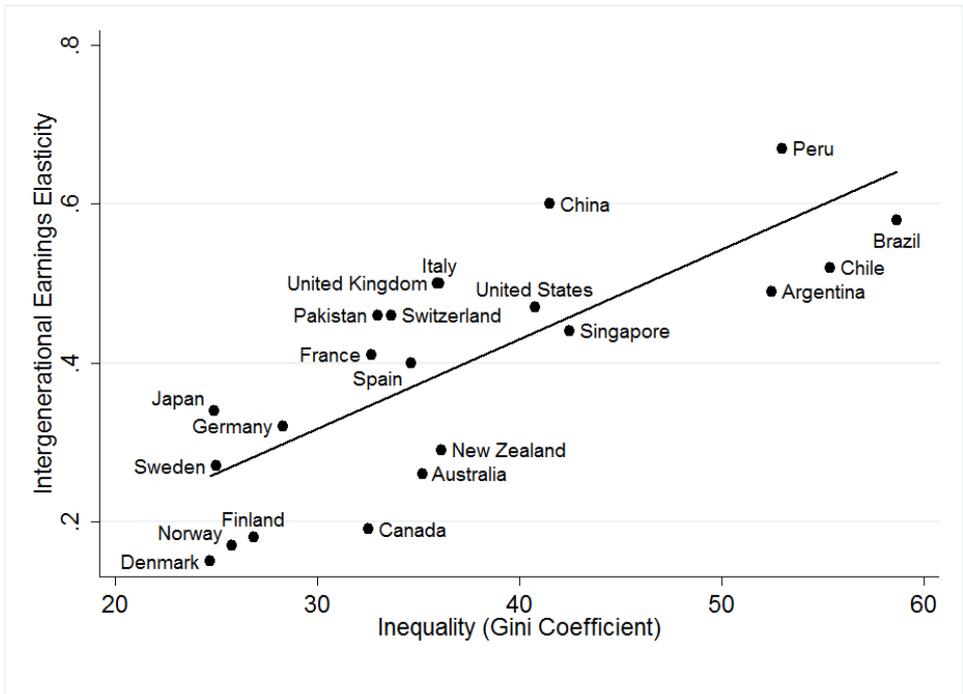
The objective of this essay is to explore the relationship between income inequality and intergenerational mobility in education in a similar manner as in Corak (2013). The main hypothesis is that as income inequality grows, the intergenerational immobility in education is increasing. This relationship is expected to be positive, rising inequality is associated with low educational mobility, and thus one underlying mechanism for this will be inspected. Focus will be given on the monetary constraints faced by families. The aim is to explore why we get low intergenerational educational mobility in highly unequal countries. Can different school systems across countries play an important role? Therefore, one institutional factor that may affect educational mobility will be inspected, that is public spending on education.

The structure of this thesis proceeds as follows. Section 2 reviews the existing literature and section 3 presents the theoretical framework. Section 4 and 5 outlines the data and the model while section 6 presents the results. Section 7 will discuss the results and conclude.

2. Literature review

Since the finding of The Great Gatsby Curve (hereafter GGC), which is usually depicted in a graph where the income inequality is shown on the horizontal axis and the intergenerational earnings elasticity on the vertical axis, studies have predominantly been concerned with the estimation and reproduction of the curve including various numbers of countries. This relationship between intergenerational mobility and income inequality (Figure 1) was first found by Corak (2011) but it wasn't until Alan Krueger named this upward-sloping line that it reached widespread attention. The GGC has been replicated and reproduced in several studies, using various types of datasets, methods and choice of countries (e.g. Andrew and Leigh, 2009; Gründler, 2014). The GGC has even been estimated on a national level, comparing different provinces (Mora and Vicente, 2015) (Fan et al. 2015). The GGC for 21 developed and developing countries is depicted in Figure 1.

Figure 1. The Great Gatsby curve



Source: Corak (2013)

Note: Intergenerational mobility is measured by the intergenerational earnings elasticity as it shows the elasticity between parental earnings and son's adult earnings. Corak extracted the estimates from published studies with comparable methods. Income inequality is measured with the OECD Gini coefficient. Note that higher intergenerational earnings elasticity coefficient shows low mobility and higher Gini coefficient shows higher inequality.

The intergenerational mobility is measured by the intergenerational income elasticity which shows the persistence of income from one generation to the next while income inequality is

captured by the Gini coefficient on the horizontal axis (Corak, 2013). On two extremes, we see the Scandinavian countries on the left and the South American countries on the right of the curve showing low mobility and high income inequality.

At first, intergenerational mobility in education and income inequality may seem disconnected as they measure different things; one shows the generational transmission of education while the other the distribution of income. However, the rationale can be found in the model of investment in child human capital by Becker and Tomes (1986) which was later developed further by Solon (2004).

The pivotal works of Becker and Tomes (1979, 1986) predicted that in the absence of borrowing constraints, earnings and thus educational attainment are determined only by ability. Therefore, children's outcomes will depend solely on the level of heritability by their parents. However, in imperfect capital markets, beside endowments, access to capital is crucial. Thus, poorer families will have difficulties to borrow on the credit market and maximize the future earnings of their children. Two types of families will be present on the credit market: the poor or the capital constrained families and the rich or the non-capital constrained families. The non-capital constrained families will invest in their children until they maximize their children's future earnings, while the poor families will not be able to optimally invest in their children. One of the key findings of Becker and Tomes (1986) is that earnings regress towards the mean and that in the long run, there will be a convergence of all dynasties towards the same human capital level. However, this will happen at a slower rate for capital constrained families. The idea of 'regression towards the mean' implies that children of low-income families will be on average better off than their parents but they will still stay below the average of their generation. This will, create persistence in intergenerational inequalities in education. This essay is in line with Becker and Tomes findings, apart from that emphasis is given to education instead to earnings.

Moreover, the prediction of Solon's model is that as income inequality rises, the investments in child human capital by parents will change as well. Parents at the bottom of the income distribution will not invest the same as parents at the top of the income distribution (Solon, 2004). The key implications of his model are that the steady-state intergenerational earnings elasticity will increase (i.e. intergenerational mobility will decrease) with greater heritability, more productive human capital investments, higher returns to human capital but decrease with less progressive public investment in children's human capital (Solon, 2004).

If we think in terms of educational attainment instead of in income, since education is a primary determinant of income, we can interpret Solon's prediction as following: the steady-state intergenerational elasticity in education is increasing (i.e. educational mobility is decreasing) with stronger heritability of learning-related traits, more productive human capital investment, higher return to human capital. Further, educational mobility is increasing with more progressive public investment in human capital. Solon assigns different parameters to measure these factors. Changes in these parameters, per Solon, result in increased/decreased level of inequality of human capital and thus in intergenerational mobility in education between countries. Hence there is a strong link between educational mobility and income inequality through the channel of human capital investments.

Furthermore, institutional settings and educational systems continue to contribute to variations in educational mobility between countries (Solon, 2004). It has been shown that increase in public spending on child human capital, in form of health and education, can offset income inequality and the importance of family background (Aizer, 2014). Chusseau and Hellier (2011) create a model where three different educational systems are applied in a single economy: elitist (inequality oriented, low public funding), egalitarian (pro-education, high public funding) and one in between. The results from the study show that the egalitarian system creates equality in income and education while the consequences of the elitist system are under-education trap and high income inequality (Chusseau and Hellier, 2011). Related to this, Harrington (2015) investigates if differences in public education and tax policies between Norway and the US are possible explanations of the gap in income inequality and intergenerational persistence between the two countries. The author's focus is on these two countries as they represent two extremes on the GGC. Harrington's analysis suggests that about one-third of differences in income inequality and 14 % of differences in intergenerational mobility are a consequence of variation in taxes and public education spending between the US and Norway (Harrington, 2015). This is an additional argument that public spending on education has indeed a considerable effect on educational mobility.

3. Theory

3.1 Investments in Human capital and the role of Family

To understand the relationship between differences in educational attainment and income inequality one must consider the theory of human capital investments. The theory of human capital goes back to 1964 with Gary Becker's leading work "*Human Capital*". Here, human capital is defined as a set of skills and abilities, both innate and acquired, that one individual has that contributes to his or her productivity. The key concept of the model is that education is an investment that will produce income in the future (Becker, 1964). Thus, differences in productivity or differences in levels of human capital accumulations, will result in wage differentials. However, investments in human capital, such as education or training, bring direct costs in form of tuition fees and travel and material expenses but also costs in form of foregone potential income as time is spent on studies and not on the labour market.

Nonetheless, after netting out for direct and indirect costs, accumulation of human capital should pay off in the future in the form of higher earnings (Becker, 1964).

In the context of intergenerational inheritance, human capital is of vast significance. Parents invest in their offspring's human capital as their well-being is important to them. This is emphasized in Becker and Tomes (1986). Their model shows that altruistic parents maximize their utility by dividing their income between their own consumption and investments in their children's human capital. Thus, parent's utility is a function of their own consumption and the child's income in the future: $U = U (C_t, I_{t+1})$, where C_t is the parental consumption and I_{t+1} denotes the future income of the child. Further, parent's endowments are transmitted to their children in form of cognitive ability, attitudes and as well as cultural and genetic traits. Financial assets are also transmitted to children (X_{t+1}). Hence according to Becker and Tomes, parental investment in human capital (h_{t+1}), government spending on education (G_{t+1}) and endowments (e_{t+1}) determine the level of human capital that children will acquire. This can mathematically be solved with following maximization problem

$$\max_{C_t, C_{t+1}, h_{t+1}, X_{t+1}} U (C_t, I_{t+1}) \quad (1)$$

s. t.

$$I_t = C_t + X_{t+1} + h_{t+1};$$

$$I_{t+1} = w_{t+1} H (h_{t+1}, G_{t+1}, e_{t+1}) + (1 + r) X_{t+1} + u_{t+1};$$

Where w_{t+1} is the return on human capital investments, r is the interest rate and u_{t+1} is the market luck. The first constraint show that parent's income depends on consumption C_t , financial assets X_{t+1} , and the investments in their offspring's human capital h_{t+1} .

The second constraint shows that the child's future income depends on the return of education w_{t+1} and the financial transfers left by their parents. The human capital production $H(h_{t+1}; G_{t+1}; e_{t+1})$, in turn, depends on the investments in human capital by their parents h_{t+1} , the government spending on education G_{t+1} and the endowments that are inherited from their parents e_{t+1} . In this context, the model implies that parents influence their offspring's outcomes by passing on endowments and by investments in their education, health and learning motivation.

However, in the case of imperfect credit markets, poor families may face difficulties in financing their children's education as they cannot borrow against future earnings of their children (Becker and Tomes, 1979). In contrast, non-capital constrained families will optimally invest in their offspring's human capital, that is up to the point where marginal return of investment is equal to the rate of interest. Earnings will regress towards the mean, i.e. all children will come closer to the mean earnings of their generation as intergenerational mobility increases, but at slower rate for poor families. This finding, that parental income matters for human capital investments, is further investigated in Solon (2004).

Solon adapts the framework of Becker and Tomes into his model in which the starting point is the role of education. The key implication of the model is that families differ in the capacities to invest in their children, which is in line with Becker and Tomes. However, families are also differing in incentives to invest in their children as they come from countries with a different social context and from various socio-economic settings.

The assumptions of the Solon model are somewhat in line with the Becker-Tomes model. Parents divide their lifetime after-tax earnings between their own consumption and investments in the child's human capital. However, he relaxes the assumption that parents leave financial assets to their children, which is present in the Becker-Tomes model. The government is included in the model as well, as they progressively invest in children's human capital. Further, the child's human capital is explained by following equation

$$h_{t+1} = \theta \log(I_t + G_t) + e_{t+1} \quad (2)$$

Thus, Solon follows the same Becker-Tomes framework on what determines child's human capital: the family's investments I_t , the government's public investments G_t and the labour market θ , as θ shows the returns to human capital investments.

The family investment decision begins with dividing their income into their own consumption and their children's future earnings, i.e. investments in the child's human capital. Solon considers the parental utility function in a Cobb-Douglas form:

$$U = (1 - \alpha) \log C_t + \alpha \log y_{t+1}. \quad (3)$$

α is the altruism parameter (lies between 0 and 1), which measures to what extent parents will want to invest in their children. If public investment in the child's human capital is so low that parents prefer to supplement it with private investments, solving for the optimal choice of I_t gives

$$I_t = \left[\frac{\alpha \theta p}{1 - \alpha(1 - \theta p)} \right] (1 - \tau) y_t - \left[\frac{1 - \alpha}{1 - \alpha(1 - \theta p)} \right] G_t \quad (4)$$

The intuitive explanation of this equation according to Solon is that i) holding public investment constant, high-income parents will invest more in their children's human capital; ii) holding taxes constant, if public investment in child's human capital is sufficiently high, parent's investments are crowded out; iii) parents' investment increase in the altruism parameter and iv) parents' investment increases in return to human capital as well.

To see the how parent's log earnings are correlated with the child's log earnings in the steady-state, Solon derives the steady-state intergenerational income elasticity coefficient:

$$\beta = \frac{(1 - \gamma) \theta p + \lambda}{1 + (1 - \gamma) \theta p \lambda} \quad (5)$$

With this finding, Solon can explain the factors for changes in the intergenerational income elasticity. First, the intergenerational elasticity is greater with the heritability coefficient (λ). Second, the intergenerational elasticity is growing as the effectiveness of human capital investments grow (θ) and as the return to human capital is greater (p). Third, the intergenerational income elasticity is decreasing with the progressivity of public investment in children's human capital (γ).

Solon argues that the same parameters (λ , θ , p , γ), are also central for creating income inequality. Income inequality is related to the four parameters in the same means as the intergenerational elasticity β is; income inequality is higher when: heritability is stronger,

returns to human capital are greater, human capital investments are more productive and the public investment in human capital is less progressive.

The intuition of this can be better explained using two countries, A and B, where country A shows a wider distribution of income than in country B. According to Solon, the differences between the two countries might be due to that disadvantaged children in country A faces greater obstacles to upward mobility. Accordingly, country A may have stronger heritability, more productive human capital investment, higher returns to human capital and less progressive public investment in human capital.

This could be the case for educational mobility as well. If low-educated parents with presumably low income, send their children to low quality schools and face borrowing constraints on the credit market, upward mobility for their children may not be possible. Thus, inequality in childhood will have consequences for children's future outcomes.

Although family income can have a substantial effect on children's outcomes, one implication is that family's income is not sufficient for determining children's educational attainment. Heckman and Carneiro (2003) argue that factors connected to early childhood are far more important than family income during the college-going years. Factors such as environments, attitudes, and social skills provided by parents play an important role in children's educational life. Tastes for education and life expectations are influenced by parents. Thus, well-educated parents will provide a better college readiness than low-educated parents because the environment in which children are raised is shaping their preferences and abilities. Further, parents with high educational attainment can create a stimulating learning environment with supportive teaching (Heckman and Carneiro, 2003).

3.2 Measures of Intergenerational mobility

Intergenerational mobility is a measure of the relationship between an outcome of parents, in terms of earnings or education, and the same outcome of their children. The intergenerational mobility can be measured for instance in terms of income or education, although the literature on intergenerational mobility is mostly dominated by estimates on intergenerational income mobility. Becker and Tomes (1979) were one of the first to estimate the association between parent's permanent income and their children's income. A review and comparison of more recent studies on the intergenerational income mobility is given by Solon (2002).

The intergenerational income mobility is measured by the intergenerational earnings elasticity (β) which shows the persistence of income from one generation to the next. The following regression is usually used to estimate the intergenerational income elasticity:

$$\ln Y_{i,t+1} = \alpha + \beta \ln Y_{i,t} + \varepsilon_i, \quad (6)$$

where $Y_{i,t+1}$ is the child's permanent income i.e. the expected long-term average income, $Y_{i,t}$ is the permanent income of the parent, α is the generational average income of the children when adults and ε_i is the error term which captures unexplained components. In most studies, Y refers to the incomes of fathers and sons because of the changing role of women on the labour market across countries. The coefficient β captures the elasticity of children's income with respect to their parents' income. In theory, $\beta=0$ represents no correlation across generations, i.e. one individual's earnings are completely unrelated to his or her parents' earnings. If $\beta=1$, earnings are completely inherited across generations. Estimates of β usually lie between 0 and 1, indicating divergence across generations. For example, an elasticity of 0,3 means that if individual A earns 100% above the generational mean, children of individual A will earn 40% above the mean in his/her generation. Thus, a lower β means the child has lower income stickiness and therefore higher income mobility.

Intergenerational mobility can be also estimated in terms of educational persistence across generations. This measure will show the extent to which parent's and children's educational attainments are related. One implication that the literature has emphasised is that estimating educational mobility can be more manageable, relative to integrational income mobility, as longitudinal data is not necessary.

One way of measuring educational attainment is in years of schooling. The coefficient of educational mobility is captured in a similar way like income mobility:

$$YearsEd_{i,t+1} = \alpha + \beta_s YearsEd_{i,t} + \varepsilon_i \quad (7)$$

Here $YearsEd_{i,t+1}$ denotes the child's years of schooling and $YearsEd_{i,t}$ denotes parental years of schooling. Further, β_s will capture the educational mobility. A high β_s means low educational mobility, while a low β_s represents high educational mobility.

3.3 Measuring Income inequality

Cross-country differences in income distributions are well-known in the economic literature. A large number of countries show a wide income distributions, with a large gap between the rich and the poor while some countries show a more compact income distribution (Brandolini and Smeeding, 2009).

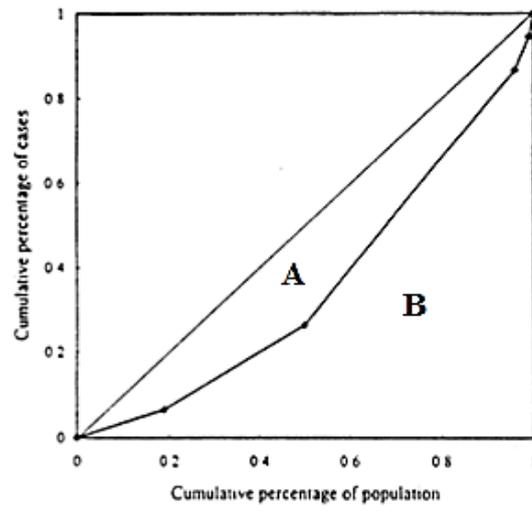
Inequality in the income distribution is measured in several ways in the economics literature. Most of the measures calculate how much of the total income in one country goes to a particular segment of the distribution (Atkinson and Bourguignon, 2000). One measure that is heavily reported and used in the literature is the Gini coefficient. The coefficient is based on the Lorenz curve which graphically represents the income distribution.

First, households are ranked according to their income level, from lowest to highest. Further, the population is divided into five equal groups i.e. quintiles, each containing 20% of the population. If there were perfect income equality, 20% of the income would belong to the first quintile, 20% to the second quintile and so on (Atkinson and Bourguignon, 2000). Thus, the total income would equally be distributed to the total population, so that every household earns the same. This perfect equality line is graphically shown with 45°-line in Figure 2. However, the actual Lorenz curve lies below the equal distribution line, showing that the actual income distribution is not perfectly distributed.

The graph shows (Figure 2) that the further away the Lorenz curve is from the perfect equality line the more inequality there is in the income distribution. The Gini coefficient is calculated by dividing the area above the Lorenz curve (A) with the area below it (B). The Gini coefficient ranges between 0 and 1, 0 meaning perfect equality and 1 meaning perfect inequality i.e. all income goes to the highest quintile (Atkinson and Bourguignon, 2000). Hence the lower the Gini coefficient, the lower income inequality and thus more equally distributed the income in one country.

Moreover, the Gini coefficient can be measured using primary or disposable income. The difference is in that disposable income includes employment-related transfers and taxes while primary income excludes them.

Figure 2. The Lorenz Curve and the Gini coefficient



Source: Everitt (2002)

4. Data

To estimate the relationship between income inequality and educational mobility (The Educational-Mobility-Gini curve) in the manner clarified previously in this essay, estimates on educational mobility and the Gini coefficients are needed. Since the scope of this essay does not allow for estimation on educational mobility for so many countries due to the enormous data requirement, estimates on educational mobility will be taken from a previous study. Although, estimates on educational mobility could in principle be taken from various studies, one difficulty would be that different studies use diverse data sets and methods of measuring educational mobility. Therefore, this essay will use estimates from only one study.

Hertz et al. (2007) provide regression and correlation coefficients on educational mobility for a broad sample of 42 countries. The nations are widespread which gives us a good basis for an international comparison. The data used in Hertz et. al is extracted from World Bank Living Standards Measurement Survey (LSMS) and from other surveys provided by various national statistics agencies (Hertz et al. 2007). The surveys are conducted between 1985 and 2004, although most of them have been conducted between 1994 and 2004. Further, the surveys contain information on parental education and match more than 390,000 parent-child pairs for the 42 nations included. The age criterion of the study is 20 to 69. One possible drawback of Hertz et al. is that the study relies on relatively small samples for some countries, while sample sizes for other counties are large.

Moreover, educational attainment is defined in number of years which is in line with the measure on educational mobility presented in the theory section. For the educational level of the parents, the average of both the mothers' and fathers' is taken, whenever feasible. This is one important advantage of Hertz et al. comparing to other studies as both mothers and fathers' educational levels matter for educational persistence.

Hertz et al. provide both correlations and regression coefficients as measured in equation (7). Although the difference between the correlations and the coefficients is not substantial, I will use the regression coefficients as a measure of educational mobility as captured by the β_s in equation (7). This, because this paper measures educational mobility by regressing children's years of schooling on their parent's years of schooling, as stated in the theory section. The coefficients on educational mobility are represented in Table 1 in the Appendix.

Led by the theoretical discussion above, income inequality will be measured by the Gini coefficient as it is widely reported. It is necessary that the Gini coefficient is measured for

many developing countries as our estimates on education mobility cover over 40 nations. The World Bank offers the Gini index for a large set of countries for many years, both developed and developing, including the nations which are included in Hertz et al. Therefore, the World Bank measure is appropriate for a cross-national comparison.

As previously mentioned, the surveys of Hertz et al. are conducted between 1985 and 2004, with most of the being conducted between 1994 and 2004. The birth years of the two generations span between 1918 and 1984 and the age criterion for the study is 20-69 which shows that both generations were adults at the time when the survey was conducted. The theoretical discussion above suggested that income inequality may have effect on intergenerational mobility in education because parents differ in their investments in their children's human capital. Consequently, in order to get the true effect of income inequality on parent's investments in their offspring's human capital, the Gini coefficient should be extracted for the years when the children were still in school i.e. while parents were still investing in their human capital. Since most of the second generation is born around the end of the 1970's and beginning of the 1980's, the years of the Gini coefficient should ideally lie somewhere around the 1990's i.e. when the second generation was still in school. The World Bank Gini coefficient is available for most of the Hertz et al. countries, but only for the years 1997-2003. Thus, following the discussion above, the Gini coefficient will be extracted for the years 1997-2003.

However, the World Bank Gini estimate is still missing for five countries from the Hertz et al. set and these countries will be excluded from the data. The countries for which both estimate on educational mobility and the Gini coefficient are available are 37 in total.

For the estimation of the relationship between educational mobility and public spending on education, the data will be taken from the World Bank. The World Bank offers data on total expenditure on education as percent of GDP for a large number of countries and years. The data will be extracted for the time period as the Gini coefficient was i.e. circa 1999 but only for 21 countries.

5. Method

The association between intergenerational mobility in education and income inequality can be measured in several ways. To conduct the analysis, the relationship with both Pearson correlation between the two variables and with a weighted least squares regression will be estimated.

As discussed previously in the data section, one drawback with the intergenerational educational regression coefficients measured in Hertz et al. (2007) is that the estimates sometimes depend on small sample sizes. For instance, sample sizes vary from 1 047 for the Philippines and 149 477 for Brazil (Hertz et al. 2007). Since some countries are oversampled while other under-sampled, the estimates on educational mobility may lack reliability. Solon et al. (2013) discuss that estimation on the population mean based on a sample that is not representative can be made by weighting. Hence it might be inappropriate to weight all estimates on educational mobility from the Hertz et al. (2007) equally with a OLS regression¹.

The WLS estimator will give different weights to different intergenerational educational estimates according to their sample sizes. For instance, educational mobility coefficients coming from a large sample size (Brazil) will get relatively larger weights while coefficients coming from relatively small sample sizes (Philippines) will get smaller weights. With the WLS we will get a better estimation of the relationship between educational mobility and income inequality. The WLS estimator β_2 in following equation will capture the effect of income inequality on intergenerational mobility in education.

$$\text{Educational mobility} = \beta_1 + \beta_2 \text{Gini} + \varepsilon \quad (8)$$

Where the dependent variable is the educational mobility captured by the parameter β_s in equation (7) and the independent variable is the income inequality measure Gini and ε is the residual. To graphically illustrate this relationship, the fitted regression line will be shown on a scatterplot, where the outcome variable educational mobility is on the vertical axis and the predictor, income inequality is on the horizontal axis.

Furthermore, my sample of countries include nations with various political and economic settings. Although this may be good for an international comparison, the Hertz et al. sample include individuals born between 1918 and 1984 when some of the nations were still under

¹ In order to do a comparison between the results from both the OLS and WLS, the OLS results will be given in the Appendix, Table 2.

communist rule or were transitioning from a planned economy to a market economy. As Andrews and Leigh (2009) argue, it may be insensible to compare countries under transition or communist-ruled with market economies since individuals in the first experience considerable economic and political change. This change may lead to instability and thus the relationship between educational mobility and inequality may not hold. In addition, Solon (2004) included both private and public spending on education in his model and this is more applicable in capitalist economies than in communist-ruled ones. From the total 37 countries, 16 countries were either still communist-ruled, transitioning economies or still young democracies during the 1980's and the 1990's. A dummy variable for transitioning countries will be introduced in the regression in order to check if the relationship between educational mobility and income inequality changes for transitioning countries. A new WLS regression will be ran,

$$\text{Educational mobility} = \beta_1 + \beta_2 \text{Trans} + \beta_3 \text{Gini} + \beta_4 (\text{Trans} \times \text{Gini}) + \varepsilon, \quad (9)$$

where *Trans* is a dummy for a transitioning country and the variable (*Trans* × *Gini*) is an interaction term between the Gini coefficient and the dummy variable. If there is indeed a significant difference between transitioning and non-transitioning countries, the parameter β_3 will capture the change in the intercept for transitioning countries while the parameter β_4 will capture the change in the slope. Consequently, if β_3 is equal to β_4 then there is no significant difference in the slopes between the transitioning countries and non-transitioning countries.

In addition, Pearson's correlation coefficient will be calculated for the two variables and show the linear association between the two. The correlation is captured by ρ in following equation

$$\rho = \frac{\text{cov}(X,Y)}{\sqrt{\{\text{var}(X)\text{var}(Y)\}}} . \quad (10)$$

Pearson's correlation coefficient takes values between -1 and 1, -1 meaning perfect negative correlation and 1 meaning perfect positive correlation (Gujarati and Porter, 2009). Following the discussion above, the correlation will be estimated first for 37 countries and then for only 22 countries when transitioning countries are excluded.

After exploring the relationship between educational mobility and income inequality the next step is to inspect an underlying cause for this particular relationship. The correlation between educational mobility and public spending per education as a percent of GDP will be measured. A simple Pearson correlation will show how the educational mobility varies across countries when investments in education differ and OLS will show the slope of the fitted

regression line. The β_2 in following equation will capture the effect of an increased/decreased spending on education as a percent of GDP on the estimate on educational mobility.

$$\text{Educational mobility} = \beta_1 + \beta_2 \text{Spending on Education} + \varepsilon \quad (11)$$

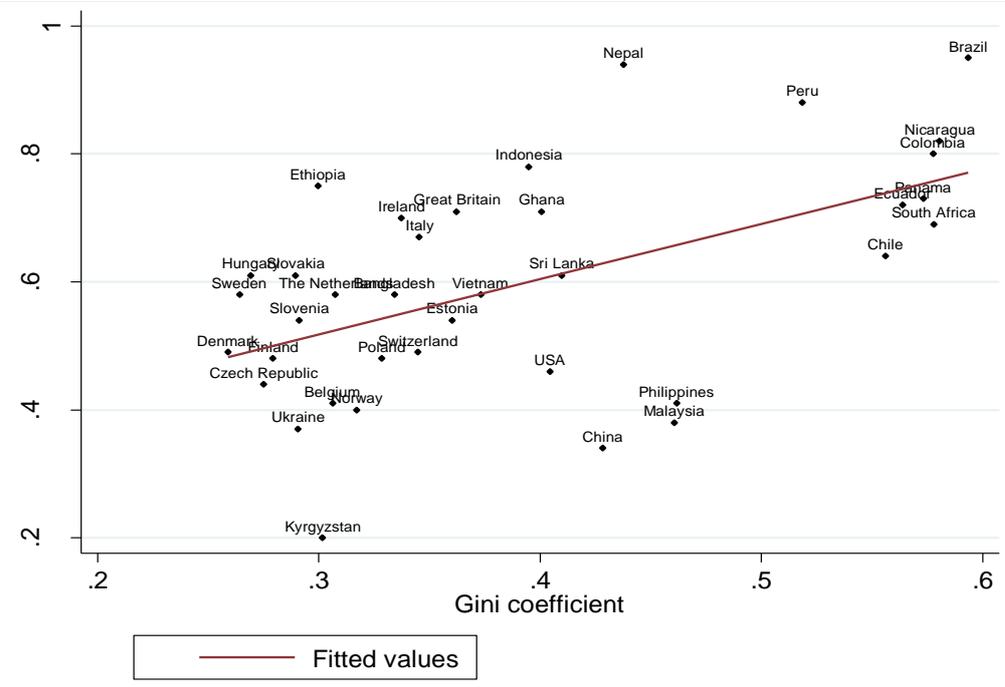
Educational mobility is the estimate on educational mobility extracted from Hertz et al. (2007) and Spending on Education is the total public spending on education as a percent of GDP extracted from the World Bank. This regression will be estimated for a total of 21 countries.

6. Results

Figure 3 shows the Educational-Mobility-Gini (hereafter EMG) curve for 37 countries. Intergenerational mobility in education is depicted on the vertical axis while income inequality measured by the Gini coefficient is shown on the horizontal axis. Recall that higher coefficients in educational mobility signifies low mobility and therefore higher values of the coefficient points to high immobility. Consequently, the higher the Gini coefficient is, the higher is the income inequality in one country.

What stands out in Figure 3 is that we see a positive relationship between educational mobility and income inequality which is shown with the fitted upward-sloping regression line. Hence high inequality is associated with higher inheritance of education between parents and their children and is indeed in line with the hypothesis of this paper. The first column in Table 4 shows the results of the WLS regression as shown in equation (8). The estimate shows that 0.10 increase in the Gini coefficient leads to a 0.135 increase in the educational mobility coefficient (β_8) and is statistically significant at 1% level.

Figure 3. EMG Curve for 37 countries



Source: coefficients on educational mobility from Hertz et al. (2007) and Gini coefficient for years 1997-2003 from the World Bank.
 Note: Representation of the Educational-Mobility-Gini curve for 37 countries. Higher values of educational mobility coefficient signify lower mobility and higher values of Gini coefficient signify high income inequality.

The R^2 value is reasonably high - for a regression with only one explanatory variable - which shows that approximately 62% of the variance in educational mobility coefficient is accounted for by the model, or in this case by income inequality. In addition, the correlation coefficient shows a rather high positive value of 0.54.

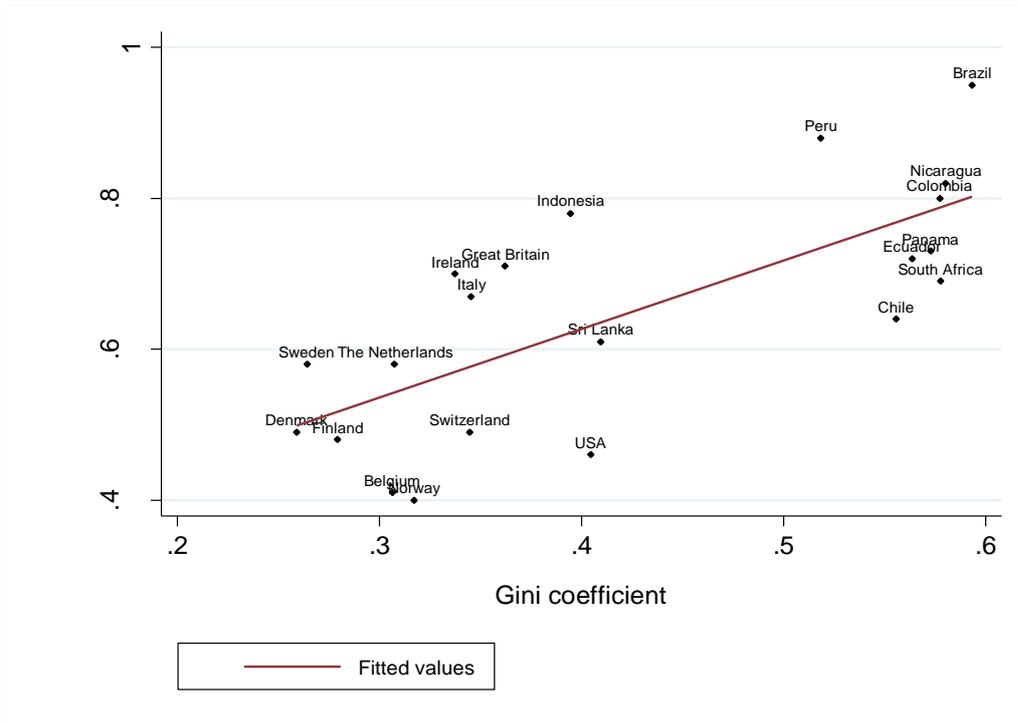
Hence I find evidence that there is indeed a positive relationship between intergenerational mobility in education and income inequality. Closer inspection of the graph (Figure 3) shows that the South American countries (Brazil, Nicaragua, Colombia, Panama, Ecuador, Chile and Peru) show low educational mobility and high inequality which places them on the on the right end of the EMG curve. In contrast, we see the Nordic European countries (Denmark, Sweden, Finland, Norway) and some of the Central and Eastern European countries (Czech Republic, Slovenia, Belgium, Hungary) on the left end of the curve, showing high mobility and low income inequality. The US, Great Britain and Italy show highest income inequality and educational immobility among the Western countries. Thus, one can clearly see the vast differences between developed and developing countries but also among Western countries as well.

Table 4. Weighted least square regression results

Variables	(1) Educational mobility	(2) Educational mobility
Gini	1.350*** (0.177)	1.486*** (0.237)
Transitioning		0.061 (0.120)
Trans x Gini		-0.022 (0.305)
Constant	0.111 (0.090)	0.029 (0.130)
Observations	37	37
R-squared	0.625	0.633

*Source: data from Hertz et al. (2007) and World Bank, own calculations.
Note: Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$*

Figure 5. The EMG Curve for 24 countries



Source: coefficients on educational mobility from Hertz et al. (2007) and Gini coefficient for years 1997-2003 from the World Bank.

Note: Representation of the EMG curve for 21 countries (16 countries excluded from the sample). Higher values of educational mobility coefficient signify lower mobility while higher values of Gini coefficient denote high income inequality. The correlation coefficient is 0.7 this time, showing a much stronger positive relationship between educational mobility and income inequality.

Further, as discussed in the method, the link between income inequality and educational mobility may not hold for transitioning economies. With the introduction of a dummy variable for transitioning countries one would expect a stronger relationship between the Gini and educational mobility. However, the results from the WLS regression as shown in the second column of Table 4 shows the contrary². Indeed, we see a slight significant increase in the parameter β_2 (from equation 9) from 1.35 to 1.48, but all other regression parameters are statistically insignificant. Thus, we cannot conclude that there is truly a statistically significant difference between the intercept or the slope parameter for transitioning as opposed to non-transitioning countries. Namely, the results show that the relationship between income inequality and educational mobility is perhaps the same for both transitioning and non-transitioning countries.

² For a comparison between the weighted and the non-weighted regressions, the results of the OLS regressions are reported in the Appendix in Table 2.

Still, the insignificant results should be interpreted with caution as the regression includes too many independent variables for such small sample size³.

Contrary to this, the Pearson correlation between the Gini and the educational mobility coefficient is much stronger when transitioning countries are excluded. The results from the correlational analysis are represented in Table 6. Namely, the Pearson correlation coefficient increases to 0.72 when 16 countries are excluded. This correlation is comparable with previous similar studies, for instance, Macmillan and Jerrim (2015) show a correlation of 0.86 between income inequality and intergenerational mobility. The stronger correlation is also in line with Andrews and Leigh’s reasoning, specifically that when transitioning countries are excluded from the sample the relationship between income inequality and intergenerational mobility comes to be stronger.

From Figure 5 we can see the EMG curve for only 21 countries. Brazil clearly sticks out in the upper right corner of the graph while Denmark sticks out in the left corner showing high educational mobility and low income inequality. The two countries represent two extremes on the EMG curve and this finding is in line with Corak’s depiction of the GGC curve which was presented in the literature review. Indeed, we see strong differences between the Nordic European countries and the Latin American countries. While the Nordic countries show both low educational mobility coefficient and low income inequality, the Latin American nations show the opposite.

Table 6. Pearson correlations between educational mobility and the Gini coefficient

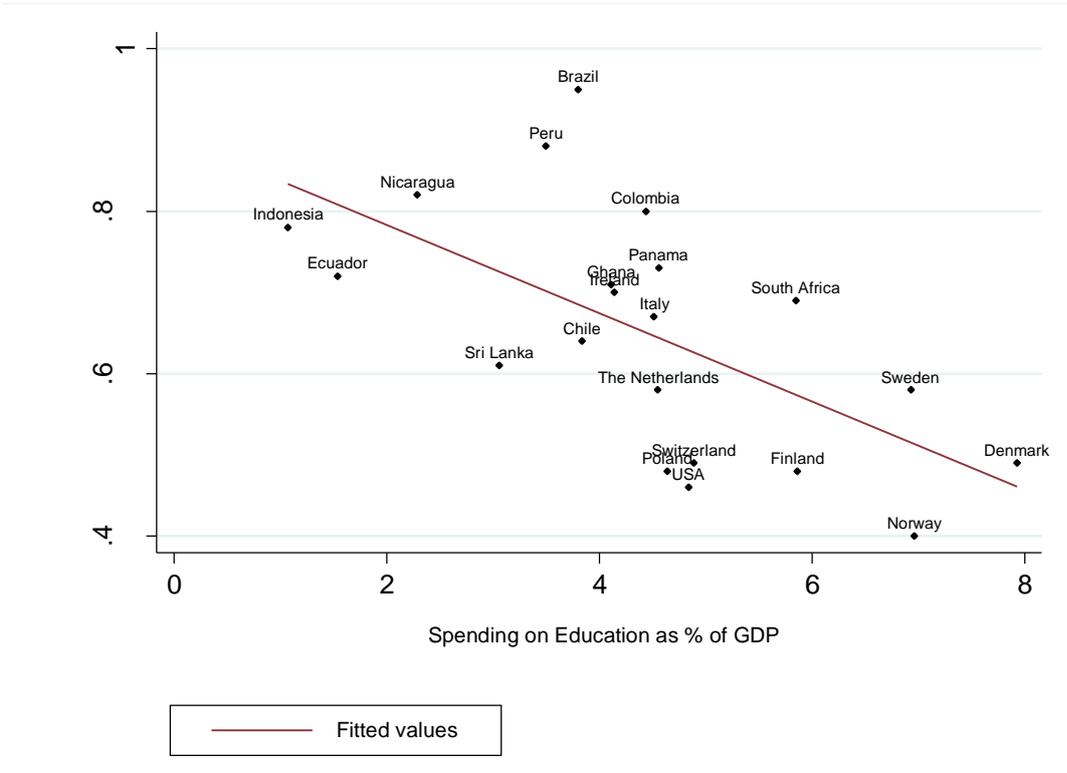
	<i>Pearson Correlation coefficient</i>
<i>For 37 countries</i>	0.53
<i>For 21 countries</i>	0.72

*Source: data from Hertz et al. (2007) and the World Bank, own calculations.
Note: Pearson correlation coefficients for the two estimations of the EMG curve. The first estimation of the EMG curve includes all 37 countries while the second estimation includes only 21 counties (transitioning and young democarcies excluded, that is Bangladesh, Czech Republic, China, Estonia, Ethiopia, Ghana, Hungary, Kyrgyzstan, Malaysia, Nepal, Phillipines, Poland, Slovakia, Slovenia, Ukraine and Vietnam).*

³ The same regression was estimated with only three parameters, as to solve for the problem of too many estimated parameters. The intercept for transitioning countries was excluded as we are only interested in the changes of the slopes. Following regression was estimated with WLS, $Edu\ mob = \beta_1 + \beta_2 Gini + \beta_3 (Gini \times Trans)$. However, even here the results pointed in the same direction – that there is no difference between transitioning and non-transitioning.

Furthermore, as discussed previously in this essay, one of the objectives of this study is to inspect one possible underlying reason for the positive relationship between educational mobility and income inequality. On Figure 7 we see spending on education as a percent of GDP plotted against the educational mobility coefficients for 21 countries. The negative downward sloping line shows that countries that invest more in education as a share of their national income, tend to experience higher educational mobility. The slope of the regression line is -0.047 implying that 1 unit increase in the spending per education measure is associated with 0.047 unit decrease in the educational mobility coefficient. In addition, the correlation coefficient (-0.6) shows a rather strong negative relationship between the two variables. Further, the distinction between the Scandinavian countries and the rest of the countries is quite clear. Namely, the Scandinavian countries are known as large welfare states providing free healthcare and free public education on all levels. This is thus showing in their share of national income devoted to investments in education.

Figure 7. Relationship between educational mobility and public spending on education



Source: data from Hertz et al. (2007) and the World Bank.
 Note: Relationship between educational mobility regression coefficient and public spending on education as % of GDP for 21 countries. Regression coefficients are extracted from Hertz et al (2007) while data on total public spending on education as % of GDP is extracted from World Bank Databank for the year 1999. The fitted regression line's slope is -0.047.

7. Discussion & Conclusion

The initial objective of this thesis was to inspect the hypothesis that the relationship between intergenerational educational mobility and income inequality is positive. Figure 3 shows that this relationship is indeed positive and that in highly unequal societies, educational attainment is persistent across generations. Consequently, the results show that 0.10 increase in the Gini coefficient is associated with 0.135 increase in the educational mobility regression coefficient. Thus, it seems that, from this finding, we learn that low-educated parents will have low-educated children in countries where the income is unequally distributed. This can be shown on Figure 3 where the EMG curve is represented. Children from Brazil for instance, are more likely to attain the same educational attainment as their parents while children in Denmark are less dependent on their family's background. At the same time income inequality is high in the first and low in the second country.

This finding is consistent with the theoretical framework presented in section 3.1 as well. Namely, the model developed by Solon (2004) predicted that educational mobility and income inequality are determined by the same factors. High heritability between generations, high returns to educational investments, and less progressive public investments in human capital will all lead to higher educational immobility and higher income inequality. Hence, according to Solon, the same factors will drive income inequality and educational immobility in the same direction. Another theoretical prediction is that high-educated parents will offer a better learning environment and school readiness than low-educated parents, causing persistence in educational attainment across dynasties.

Moreover, in the method section, it was specified that the EMG curve will not hold for transitioning countries. Contrary to the expectations, the results did not show a significant difference between transitioning and non-transitioning countries. Indeed, from Table 4, we can see that neither the slope or the intercept parameter are statistically significant implying that the positive relationship between educational mobility and the Gini coefficient holds for transitioning countries as well. Few explanations may argue for this. One is that, this may be the case for the association between intergenerational income mobility and income inequality as argued in Andrews and Leigh (2009) but not for the association between educational mobility and income inequality. Indeed, the results show that the hypothesised relationship does hold for transitioning countries implying that parental background plays a role in unequal countries, irrelevant of the institutional settings in which the country operates.

Another reason for why the expectations for transitioning countries did not hold may be due to the large number of parameters being estimated given the number of observations. Thus, it is important to bear in mind the possible bias in the estimation of the regression. Indeed, the Pearson correlation increases, although not substantially, when transitioning countries are excluded and this is further evidence that the relationship between the two specified variables gets stronger.

With closer inspection of the second representation of the EMG curve (Figure 5), we can see the large differences between the Scandinavian countries and the Latin American countries. These countries differ substantially in their income inequality measure as in the extent to which family background matters. The Latin American countries stand out as highly unequal and high-persistence countries, as opposing to the Scandinavian countries. The reasons for the high-persistence in educational attainment could be many. For instance, imperfections in the credit market, as suggested by Becker and Tomes, altruism between families, costs of education and the structure of the educational system as suggested by Solon, can all have substantial influence on the persistence of education between generations. To develop a better picture of the relationship between educational mobility and income inequality, this study emphasised the role of the institutional settings and the structure of the educational system. One factor that was investigated to be correlated with intergenerational educational mobility is the public spending on education as given by a percent of GDP.

Figure 7 illustrates how the educational mobility regression coefficients as given by Hertz et al. (2007) are correlated with total spending on education by countries. One can clearly see a negative relationship, indicating that countries that invest more on education experience higher educational mobility. Even here, as in the EMG curve, the same distinction between countries is apparent. Nicaragua and Ecuador are two of the countries with lowest spending on education as a percent of their national income whereas Denmark, Sweden, Norway and Finland are the countries with the highest percent of their GDP devoted to education investments. Although the data does not show how the money is actually used by the governments, it is evident that the countries that spend more on education experience higher levels of educational mobility. Hence it could be hypothesised that public investments in education is a possible underlying cause for variations in educational mobility. Indeed, there are reasons to think that the more the government spend on education, the less is parental background important as parent's investments are supplemented with government's investments. This is emphasised in Solon (2004) as well, namely that the less progressive the investment in human capital are, the higher will the intergenerational immobility be. Two

countries' educational systems that reflect this are Sweden's and Indonesia's. These two countries differ substantially in their levels of educational mobility as well in their spending in education as they represent two extremes in Figure 7. Sweden's spending on education lies around 7% of its GDP as the country offers free tertiary education and generous student support systems. In contrast, total spending on education in Indonesia was around 1% of their national income around the end of the 1990's and thus this is showing in their level of educational mobility. Hence, Solon's and Becker-Tomes' predictions about the relationship between educational investments and mobility are supported by the cross-national comparison presented in Figure 7.

To conclude, one would ask why the relationship between educational mobility and income inequality is of so vast importance. The EMG curve shows that in economically unequal societies, children with low-educated children will grow up to be the next generation of low-educated parents. Thus, high income inequality goes hand in hand with high educational immobility. However, whether income inequality reinforces educational mobility or vice versa is still uncertain as more research is required to establish this.

Further, the exact underlying mechanisms for this association are still unknown, but one can argue about the influence of the state. My results show a rather strong correlation between educational mobility and government spending on education. Therefore, it seems that one way of diminishing the importance of family background is by offering equal opportunities in early childhood by higher investments in education. Other possible underlying factors which were not investigated in this paper might be differing school quality for the rich and the poor, high tertiary tuition fees, elitist educational systems and inequalities in the labour market.

Since little is known about further potential drivers of the EMG curve, additional policy recommendations are rather dubious here. The lack of consistent longitudinal data for estimation of the educational mobility is perhaps one of the main limitation of this study. Future research should therefore focus on establishing why highly economically unequal societies show high persistence in education with more consistent estimates on educational mobility.

Overall, the findings of this study have extended our knowledge on the link between intergenerational mobility in education and income inequality. In the future, a greater focus on this issue would produce interesting findings along with policy recommendations.

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Appendix

Table 1. Estimates of the intergenerational education mobility from Hertz et al (2007)

<i>Country</i>	<i>Coefficient</i>	<i>Year of survey</i>
<i>Bangladesh</i>	0.58	1996
<i>Belgium</i>	0.41	1996
<i>Czech Republic</i>	0.44	1998
<i>Brazil</i>	0.95	1996
<i>Chile</i>	0.64	1999
<i>China</i>	0.34	1995
<i>Colombia</i>	0.80	1997
<i>Denmark</i>	0.49	1998
<i>East Timor</i>	1.27	2001
<i>Ecuador</i>	0.72	1994
<i>Egypt</i>	1.03	1997
<i>Estonia</i>	0.54	2004
<i>Ethiopia</i>	0.75	1994
<i>Finland</i>	0.48	1998
<i>Ghana</i>	0.71	1998
<i>Great Britain</i>	0.71	1996
<i>Hungary</i>	0.61	1998
<i>Indonesia</i>	0.78	2000
<i>Ireland</i>	0.70	1994
<i>Italy</i>	0.67	1998
<i>Kyrgyzstan</i>	0.20	1998
<i>Malaysia</i>	0.38	1988
<i>Nepal</i>	0.94	2003
<i>New Zealand</i>	0.40	1996
<i>Nicaragua</i>	0.82	1998
<i>Northern Ireland</i>	0.59	1996
<i>Norway</i>	0.40	1998
<i>Pakistan</i>	1.00	1991
<i>Panama</i>	0.73	2003
<i>Peru</i>	0.88	1985
<i>Philippines</i>	0.41	1999
<i>Poland</i>	0.48	1994
<i>Slovakia</i>	0.61	2004
<i>Slovenia</i>	0.54	1998
<i>South Africa</i>	0.69	1998
<i>Sri Lanka</i>	0.61	2000
<i>Sweden</i>	0.58	1994
<i>Switzerland</i>	0.49	1998
<i>The Netherlands</i>	0.58	1994
<i>Ukraine</i>	0.37	2004
<i>USA</i>	0.46	2000
<i>Vietnam</i>	0.58	1998

Source: Hertz et al. (2007)

Table 2. OLS regressions

Variables	(1) Educational mobility	(2) Educational mobility
Gini	0.862*** (0.228)	0.887*** (0.243)
Transitioning		0.137 (0.129)
Trans x Gini		-0.496 (0.351)
Constant	0.259*** (0.093)	0.261** (0.107)
Observations	37	37
R-squared	0.290	0.337

Source: data from Hertz et al. (2007) and World Bank, own calculations.

*Note: Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$*