How Education Became Positional

A comparative analysis of the role of education in the labor market between 1951 and 2003

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Abstract

The transition from education for the privileged to the masses has had massive effects on society. Most research on educational expansion focuses either on the explanation of expansion as such, or on how expansion is related to processes of overschooling and credential inflation. However, it has not yet been fully acknowledged that expansion completely changed the way in which education operates in labor markets. In this article we investigate how the increasing number of educated individuals in the labor market altered the way education functions on labor markets. During times when education was highly dispersed, with few graduates in higher education, employers would look at educational levels as being informative about the absolute skill level of employees. Earnings would, in such a 'human capital model' of education, be determined on education as it has been used in the human capital framework; more schooling means higher earnings. However, in a world of mass education, education has become a positional good, where reward is not primarily dependent on absolute skill levels, but instead on the relative position in the labor market of workers. Using data from the International Social Survey Program (ISSP) from 1985 to 2008, which allows us to create cohorts of people who graduated between 1951 and 2003 for 37 countries, we find support for the claim that education has become positional.

Keywords

Educational expansion; positional good; education; labor market; longitudinal

1. Introduction

In the 20th century the role of education in society changed tremendously. Whereas up to mid-century education was only accessible for children born in privileged classes, during the second half of the century it became an institution for the masses. Research to date has mostly focused on two strands. First, scholars have aimed to explain the trend towards educational expansion. Very different perspectives have been taken in this regard, varying from functionalist claims relating to the increasing need for qualifications in complex labor markets and appropriate matching of occupational positions to achieved qualifications (Davies & Moore 1945; Bell 1974), to views that the logic of expansion is more a 'myth', because the relationship between education and production is far from evident in modern societies (Meyer & Rowan 1977; Schofer & Meyer 2005; Ramirez et al. 2006). A second strand of literature on educational expansion has related expansion to distributional consequences on the labor market, most clearly in connection to overschooling and the resulting credential inflation (Clogg & Shockey 1984).

However, existing research on the consequences of expansion in terms of distributions has focused predominantly on how stratified the labor market gets by these processes. For instance, the credential inflation literature has examined the wage returns in an overschooled labor market (Freeman 1976; Hartog 2000), or how credential inflation affects the strength of the effect of education occupational attainment (Wolbers, De Graaf & Ultee 2001).

By directing the research agenda towards the question how expansion affects how strongly educational attainment is related to labor market outcomes, the field has not sufficiently addressed the underlying mechanisms why education is rewarded in labor markets in mass education societies. However, based on three theoretical explanations we claim that expansion (and credential inflation) has not only changed the earnings and occupational distributions of people with different levels of education, but has also changed the way in which education is used to determine rewards. On a most general level, we claim that, with expansion, education has increasingly become a positional good, in which the relative position of workers is increasingly important to set earnings. This positional model replaces the human capital model in which the absolute level of skills was important to determine earnings.

In this article we demonstrate that with the rise of mass (higher) education for cohorts graduating between 1951 until 2003, rewards in the labor market have become more and more based on a relative measurement of educational level, and decreasingly on the basis of the absolute level of schooling.

2. Educational change in the 20th century

Educational expansion is a topic in sociological research for decades, either focusing on the origins (e.g. Meyer et al. 1977; Trow 1972; Boli et al 1985) or the outcomes of the process (e.g. Woodhall 1967; Psacharopoulos 1989; Raftery & Hout 1993; Schofer & Meyer 2005; Hannum & Buchmann 2005). The expansion of participation in education most prominently took place in the postwar period, although it already started at the beginning of the twentieth century (Schofer & Meyer 2005). Changes in education did not stand on themselves and were fuelled by events that changed society as a whole. The most prominent one was the industrialization in Western society at the end of the nineteenth century. This industrial revolution led to a more sophisticated division of labor with a growing demand of expert skills as a consequence (Scott 1995). These skills had to be learned in education, with an increase in participation as a result. Industrialization not only influenced the labor market and educational system, it broadly affected the idea of how to organize society as a whole: bureaucracy became the dominant way of ordering society (Blau 1987).

Mass education is a logic outcome when schooling is organized in a bureaucratic manner as more and more students are processed by the educational system, with an increasing differentiation in the skills that need to be provided (Halsey et al. 1997). Moreover, bureaucracy is heavily linked to the concept of meritocracy which also presumes that there are objective criteria on the basis of which individuals can be distinguished (Young 1972). Besides industrialization the early twentieth century was also characterized by democratization: a growing need to civilize society, whether it was as a means of social control or as a means of emancipation (Scott 1995). Education was used as a way to civilize the growing middle class (Elias 1939), or, formulated in a more positive manner, as a method for citizens to emancipate themselves. From this democratic perspective compulsory education was expanded. The industrialization and the need to equalize and control citizens were the first steps towards the ongoing expansion of education in the postwar period.

[Figure 1 about here]

From the 1950s onwards the amount of educated individuals increased even more rapidly than the fifty years before (figure 1). During that time Western societies experienced a shift from industrial to post-industrial (Bell 1975), a modern to a post-modern or a Fordist to a post-Fordist society (Brown et al. 1997). The meritocratic ideology, assuming that educational achievement should be the main way to sort citizens by capacity, became even more dominant. The most important change for mass education, however, was the idea that educated citizens would result in more economic prosperity for the nation. Education became an investment in 'human capital' (Becker 1964). When it is a highly educated labor force that leads to economic success, it is important to have the most talented individuals as highly educated as possible. And with most unskilled jobs disappearing, the demand for an educated workforce increased. In the first two decades after World War II governments supported educational expansion as they were optimistic of the eventual pay-off (e.g. Halstead 1974). This economic pay off of educational expansion has been confirmed by several studies (Petrakis & Stamakis 2002; Poot 2003). But why does education expand?

Explaining expansion

A functionalist explanation is that the society changed in such a way that there is a growing demand for higher educated individuals. Society became more complex, more advanced and more differentiated which created a collective and individual need for more and higher education. The demand for higher education is for example a function of a growing complexity of the labor market. During the past century, technological change led to a more differentiated and specialized labor market. From a functionalist point of view the increase in high skilled workforce is due to changes in the production process; the idea, originated from economics, of skill biased technological change (e.g; Acemoglu 2002; Katz & Autor 1999).

The labor markets of most Western societies slowly but steadily shifted from production to service markets and education kept on expanding. In the 1960s, 1970s and 1980s the expansion of education continued. With the evolvement of a global market technology and knowledge became vital assets to get a competitive advantage

over other countries (Green 2006). The outsourcing of skilled labor led to an increase in the demand of higher educated.

With the rapid evolution of technology in the 20th century the demand for employees with more skills increased. Technological innovation has disproportionally increased the productivity of high skilled labor and therefore led to an increase of the demand for high skilled workforce as a consequence. This is also the main reason that educational expansion has a positive effect on economic growth; in countries with on average more and higher educated individuals the stock of human capital, and therefore the economic growth, is higher. Education increases the level of productivity and thus the rewards. Two studies for example show that the growing returns to education in the United States between roughly 1960 and 1990 can be partly attributed to a shifting demand due to technological change (Katz & Murphy 1992; Juhn et al. 1993). In a case study of a plant retooling these findings are confirmed: the technological change in the tools led to greater wage dispersions between low and high educated employees (Fernandez 2001).

There are however many researchers who question this functionalist line of reasoning. Garnier et al. (1989) argue that it is a mistake to assume that supply always follows demand. According to them not all educational systems are as demand driven as others. Rubinson (1986) even argues that most societies are supply driven, where strong states hold a tight control over the outflow of students. Especially in those countries where the state couples the educational system to the economy (by providing programmes that are geared to the specific needs of the labour market) the human capital explanation might hold true (Hage et al. 1988). Since there are clear differences in the extent to which educational systems provide students with (job specific) skills (Shavit & Muller 1998), the extent to which educational expansion affects the human capital stock differs as well. In countries with strong vocational schooling the link between skill, productivity and growth is easier to make than in countries where vocational education rarely exists. This means that educational expansion does not have a uniform way in which it leads to economic prosperity but depends on the type of skills that are provided by the educational system as well.

Besides discussing the idea of skill biased technological change, the hypothesized strong relationship between educational and economic growth is questioned as well (e.g. Pritchett 1996; Schofer & Meyer 2005). Ramirez et al. (2006), for example, argue that although there are strong beliefs in society that mass

education only has positive outcomes, the results are not as convincing. According to their study educational expansion mainly has a positive effect on economic growth in the lowest deciles of the development distribution. Only in those countries where formal education has not developed much educational expansion leads to more economic prosperity. Other studies share these findings and acknowledge that support for a causal effect of educational expansion on economic growth is weak (Pritchett 1996).

But if it is not clear at all if the rise of mass education is a function of a changing society, why is education expanding? Neo-institutionalists argue that this is mainly due to the 'myth' that surrounds educational expansion (Meyer 1977). In an early work Meyer and Rowan (1977) theorize institutional development in postindustrial society. They argue that institutions "dramatically reflect the myths of their institutional environments instead of the demand of their work activities" (Meyer & Rowan 1977: 341). The same argument can be made for the development of the institution that education is: the effects of educational expansion are more important as a cultural claim in society than as an actual reflection of the process. Educational expansion has become a goal in itself; the knowledge economy has become a myth that is kept alive by social actors (Meyer et al. 2007). The objective is to get as many persons as highly educated as possible, without considering what these individuals will do with their education. Because all important social actors – students, employers, and governments – are optimistic about the outcomes of education it expands. Although educational expansion in the early postwar period might be functional, the past decades it is mostly subscribed to the ongoing myth that surrounds it (Ramirez et al. 2006).

Governments, for example, are still very optimistic when it concerns the effects of the higher educated workforce. In the recent EU 2020 strategy, a guideline for all European Union countries it is mentioned that the purpose is to increase "the share of the population aged 30-34 having completed tertiary education from 31% to at least 40% in 2020" because "better educational levels help employability and progress in increasing the employment rate helps to reduce poverty" (EU 2010: 9). A comparable stand is taken by the USA secretary of Education who recently stated that it is necessary "to invest in our economic future and enable our kids to compete in today's global environment. America's students and workers need a higher level of education and training" (Duncan 2009).

Consequences of educational expansion

Although the functionalist and neo-institutionalist explanation for educational expansion differ, the expansion itself is real and is likely to have consequences for the labor market opportunities of people with different levels of education. It is a well known fact that education is strongly related to earnings, although there are substantial between-country differences in the size of the educational returns (Nielsen & Westergard-Nielsen 2001; Andersen & Van de Werfhorst 2010). The modernization thesis derived from functionalism, which is strongly related to neoclassical economic theory with regard to the reward of education (Barone & Van de Werfhorst 2011) holds that the societal trend is towards an increasing return to *absolute* levels of education. More educated individuals earn more as a consequence of structural change, and the less educated individuals earn less (Blau & Duncan 1967; Morris & Western 1999).

However, if educational expansion is not a function of a growing complexity in society but merely reflects a myth, as the neo-institutionalists argue, the outcomes would be different. Employers, under such a model, increasingly 'believe' in the power of education, even if the relationship between education and production is unclear. This would make them likely to increasingly demand higher levels of qualifications among their workforce, even for jobs that would initially not require the level of skill that is demanded. Known trends in mismatching would be compatible with this perspecitve (e.g. Clogg & Shockey 1984), as would be the observed displacement of lower qualified workers by higher qualified workers for jobs that do not require high-level skills (Wolbers et al. 2001; Van der Ploeg 1994, Wolbers et al. 2001, Freeman 1974). Thus, if educational expansion exceeds the upgrading of occupations, a process of displacement could result from a mythical belief in the relevance of education, besides from better known explanations concerning 'labor queue processes' as described by Thurow (1975). Both these processes imply, too, that educational qualifications become of increasing relevance. However, contrary to the human capital model, it is particularly the *relative* position of educational qualifications that determine their value.

Besides earnings there are several other labor market outcomes that are supposedly influenced by educational expansion. Hannum and Buchmann (2005) for example argue that educational expansion leads to an increase in unemployment as graduates become more alike and compete for the same jobs. This finding can be

explained by reverse causality as well; Walters (1984) argues that especially in times of high unemployment individuals are more inclined to stay in school. Another proposed association can be found between the occupational structure and educational expansion. Over the course of the twentieth century new jobs evolved, generating a demand for different skills (Walters 1984). Some authors however argue that expansion itself is not only an effect of but also an explanation for changes in the occupational structure as it creates jobs for higher educated that were previously seen as not needed (Garnier et al. 1989).

3. How education became positional

As shown above, several dependent variables are studied in relation to the expansion of education that took place in the past century. Especially when it concerns the consequences of educational expansion the main focus has been on changes in the strength of the education effect on labor market rewards. Little has been done with regard to the more fundamental question whether a new model of education has emerged in labor markets, in which education is mainly seen as a positional good rather than an objective indicator of skills. In this paper we look at how the role of education in the labor market changed with educational expansion. Did the increasing amount of educated and highly educated workforce change the way employers reward education? It is highly unlikely that educational expansion did not change the way employers look at qualifications. Our central research question is: how did educational expansion changed the mechanism by which employers reward employees?

Having a great effect on several aspects of the labor market, educational expansion is likely to have changed the actual behavior of employers when they reward employees.[1] Educational expansion causes a downward pressure on the returns to education. At the same time educational expansion alters the occupational structure, which results in allocation problems of graduates in the labor market. To differentiate between graduates, employers use the relative educational position, the place an individual takes in the educational hierarchy of job seekers, instead of the absolute level of education. Where before the rise of mass education the rewards to education had relatively little to do with the educational level of competing job seekers this

[1] Although we will not directly study the behavior of employers, we research their behavior by examining income data of employees.

changed in the postwar era. Our main hypothesis is that with the expansion of education the mechanism by which education is rewarded changed from a human capital towards a positional model. Similar to this approach, other studies have shown that the human capital model fits better with an industrialized work force in which strongly vocationalized educational institutions predominate (Van de Werfhorst 2011). Given that the size of the vocational education sector is inversely related to participation in higher education, that study too argues that more expanded educational systems depreciates the usefulness of the human capital model of education.

Employers are the most crucial actor in the labor market when it concerns labor market rewards for education. They decide to a large extent what kind of education is rewarded and how high this reward is.[2] Why does education pay off? A common idea is that education provides students with productivity-enhancing skills (Kerckhoff et al. 2001). Schooling gives an individual, among other things, certain skills and techniques that have a value in the labor market. Human capital theory can be seen as the main advocate of this idea by arguing that each person will get the full returns for their marginal product (their skills) in the labor market (Becker 1964). From this point of view education is seen as having an absolute return on the labor market: each person with the same amount of skills should get the same returns.

The idea of absolute labor market returns to education is refuted by positional good theory which states that education has a relative value only (Hirsch 1977; Thurow 1975; Sorensen 1977). Education provides vital information for an employer to determine an individual's relative position in the job queue. Therefore, the returns to these skills differ across time and context; the educational pay off in the labor market is fully dependent on what the skills of other job-seekers at that time and place are. Employers reward different characteristics in the two theories: according to human capital theory they reward the absolute amount of skills while the positional good theory argues that employers only reward an individual's relative educational position.

Why should employers reward more and more on the basis of relative educational position as (higher) education expands? We argue that there are at least three separate explanations to support this hypothesis: (1) the educational myth

[2] Although there are large country differences in the influence that wage setting institutions have on the extent to which employers are able to reward employees.

(Meyer 1977), (2) displacement (Thurow 1975) and (3) marginalization (Gesthuizen, Solga & Kunster 2010)

Educational expansion as a myth

In the previous section it became clear that the positive relation between educational expansion and economic growth is debatable. What happens is that the growing supply of educated workforce might not meet the demands of the labor market.[3] How is the behavior of employers, the key actors in the labor market, influenced by this process?

The increase of qualified entrants to the labor market led to a larger pool of graduates from which employers can select and reward. Evidently, when there is a larger group to select from, the relative position one has in contrast to others becomes more important. Since neoinstitutionalist theory (Meyer 1977) argues that educational expansion became a goal in itself and therefore the supply of highly skilled workforce exceeds the demand, the group of potential employees increased. There is more competition between school leavers, and that competition is increasingly based on the relative position that graduates take. According to the myth thesis, the policy target of educational expansion to achieve economic growth is not supported by evidence. Yet the whole world adopts a model of society in which education is thought to be an important individual and collective asset. An ideology emerges that prefers highly educated individuals for reasons unrelated to their productivity, even for jobs for which high-level skills are unnecessary. Such a process is likely to emphasize the relative position of educational qualifications, rather than the absolute skill levels associated to them.

Displacement

Neoclassical economic theory argues that in the labor market labor demands and labor supplies are matched. Wages are determined by productivity levels according to the human capital model, and the price for labor clears markets by an equilibrium between supply and demand for qualifications. Absolute skill levels are rewarded, in the human capital model typically assessed by years of education.

[3] If this is really the case is often discussed in the context of credential inflation and the mismatch between educational supply and labor market demand. To study this mismatch is however beyond the scope of this paper.

Thurow (1975) nuances this view, as it presupposes that the individuals who sell their labor are skilled to do a job. On the contrary, he argues that "most cognitive job skills, general or specific, are acquired either formally or informally through on-the-job training after a worker finds an entry job and the associated promotion ladder" (Thurow 1975: 78). The productivity of workers is not something connected to the human capital of workers themselves, but rather to the jobs they hold. Education, in Thurow's alternative view, is used as a signal of trainability, and employers use educational level as an indicator of future training costs. When productivity does not reside in individuals, education has no absolute value but only a relative meaning as a signal for employers. Those with the highest level of education are picked for better paid jobs because the future training costs are expected to be lower – not because they have more skills. In that sense job competition theory gives much more importance to the demand side than human capital theory as job opportunities are solely created by employers when there is a demand for that specific type of work (Goldthorpe 2009). Job competition theory argues that individuals are constantly in competition to get the best paid jobs, with attaining a high level of education as the main way to outplay the competition.

While the job competition theory clearly shows why education is relative instead of "absolute", it does not answer the question why education is expected to become more relative as education expands. This is mainly due to a mismatch between the job queue and the labor queue: the line of highly educated job seekers is larger than the line of available jobs (Wolbers et al. 2001). Individuals will get as highly educated as possible. The larger the supply of higher-educated job seekers, the more intensified the job competition is between these workers, and the more important one's relative position will become (Gesthuizen, Solga & Kunster 2010).

There is however a second reason. The types of skills that are demanded, and therefore the jobs that are offered, by employers are different now than they were 60 years ago. The transition to post-industrialism caused a change in occupational structure with industrial jobs being replaced by service jobs. It is especially in these kinds of jobs that the rewarding of employees takes place more on the basis of trainability instead of skills acquired in education (Beduwé & Planas 2003). With the educational expansion the number of jobs requiring a qualified workforce increased, and so did the demand for trainable employees. This means that the importance of the relative value of education is expected to become more and more important.

Marginalization of lower-educated

A final theoretical explanation for why the educational explanation is expected to induce rewarding on the basis of relative educational position can be found in the idea of marginalization of lower-educated. The expansion of education caused not only a change in the job allocation of lower educated individuals by making them compete with higher educated individuals more and more, it also resulted in a stronger line of demarcation between these two groups. Lower-educated individuals have become a social minority (Gesthuizen, Solga & Kunster 2010; Goffman 1963) and educational expansion caused them to be the deviant group. They are stigmatized, and as a result of that their abilities and capacities are structurally underestimated by employers (Solga 2008).

With the lower educated getting more and more pushed to the margins of what is perceived as valuable education, employers rely on more higher educated for more jobs. Occupations that were previously done by individuals with no or little education now require high education. The number of higher educated occupations grows as education expands. For employers there are more jobs for which more homogenous employees need to be recruited. This leads to more rewarding on relative educational position instead of level of education: when the pool of graduates grows and becomes more alike employers will pick the individual who is, relatively to the other job seekers, best educated.

Three theoretical explanations

We summarized three theories that all support our main hypothesis: when education expands, employers are more likely to select on relative instead of absolute educational position. All these explanations point to an increase of a more homogenous group of higher educated. Employers will find it hard to choose between absolute educational degrees and base their rewards more and more on an individual's relative educational position.

4. Data and variables

How should we measure the growing importance of the relative educational position as an explanation for labor market rewards? Following Ultee (1983) we argue that to do this one needs to compare an absolute measure of education with a relative

measure of education. We tested our hypothesis of the growing importance of the relative measure with two different designs: (1) a two step cohort design and (2) a survey year design. For both of these designs data we use the data of the International Social Survey Program (ISSP) from 1985 until 2008 and harmonized the demographic variables used in these surveys. A total of 37 countries[4] in the first design and 29 countries[5] in the second design provided the necessary data for our analyses. Only those who are employed, have an income and are between the age of 25 and 65 are included in our sample. A total of 141,118 and 127.916 observations remain to be analyzed in respectively design one and design two.

Two step cohort design

In this design we use a two step multilevel approach. Individuals (*i*) are nested in graduation years (*j*) and graduation years are nested in countries (*k*). In the first step, we use the individual level data to estimate the predictive value of a relative and absolute measure of education on earnings for each country and graduation year combination. Individuals are grouped within the countries by their graduation cohorts, which is operationalized bi-annually. The first graduation cohort in our sample is from 1951 the latest from 2003, a total of 27 graduation cohorts. In our design a school leaver is expected to compete for a job mainly with those who leave education within these two year time frames[6]. For these models two OLS regressions are performed: one with the absolute measure of education as main independent variable (equation 1) and one with the relative measure of education as the main independent variable (equation 2):

$$\text{income}_{ijk} = \alpha_{ijk} + \beta_1 \text{abs\_education}_{ijk} + \beta_2 \text{gender}_{ijk} + \beta_3 \text{experience}_{ijk} + e_{ijk} \quad \textbf{(1)}$$

$$\text{income}_{ijk} = \alpha_{ijk} + \beta_1 \text{rel\_education}_{ijk} + \beta_2 \text{gender}_{ijk} + \beta_3 \text{experience}_{ijk} + e_{ijk} \quad \textbf{(2)}$$

[4] These countries are: Australia, Austria, Belgium, Bulgaria, Canada, Chile, Cyprus, Czech Republic, Denmark, Dominican Republic, Finland, France, Germany, Great Britain, Hungary, Ireland, Israel, Italy, Japan, Latvia, Mexico, Netherlands, Norway, New-Zealand, Philippines, Poland, Portugal, Russia, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Taiwan, Uruguay and the USA.
[5] The same countries as in design 1 expect Belgium, Dominican Republic, Mexico, Poland, Portugal, Taiwan, Uruguay and South Africa.
[6] While the strongest competition will be between those who just enter the labor market, individuals who are already in the labor market compete as well. To control for this shortcoming we ran models were all those who are active in the labor market compete in the second design.

The micro model is merely used to create a measure of importance of the relative measure over the absolute measure. To do this, both regressions are performed for each country/graduation year combination separately and the difference in model fit for each of these combinations is taken (equation 3).

$$\Omega = r^2(\text{equation 2}) - r^2(\text{equation 1}) \quad \textbf{(3)}$$

where Ω is the importance of the relative educational measure over the absolute educational measure. There is however a problem with comparing the fit statistic of two non-nested models, as a maximum likelihood test assumes that models are nested (Vuong 1989). To compensate for this we performed a likelihood ratio test for the difference in model fit of the two separate regressions. We weighted the difference in fit statistic for the p-value of this significance test to correct for measurement error:

$$\varphi = \Omega * (1 - p(\Omega)) \quad \textbf{(4)}$$

were φ is the weighted and Ω is the unweighted importance of the relative over the absolute measure. As a dependent variable we use the weighted importance of the relative educational measure (φ).

$$\varphi_{jk} = \alpha_{jk} + \beta_1 \text{educ\_exp}_{jk} + \beta_2 \text{GDP}_{jk} + \beta_3 \text{sec\_sector}_{jk} + \beta_4 \text{patents}_{jk} + u_k + e_{jk} \quad \textbf{(4)}$$

where φ is the importance of the relative educational position, u_k is the between country error term and e_{jk} the between graduation years within countries error term. Besides the OLS and multilevel models we run General Least Squares models as well to ensure the robustness of our findings (following Schofer & Meyer 2005).

Individual level variables

Our dependent variable in model 1 and 2 is net income. The ISSP income variable is measured differently across countries, but also between survey years within countries. In some countries it is measured on an interval scale while other countries only supply income categories. We therefore need to standardize the measure to make it comparable across countries and survey years. This is achieved by taking the log of

the distance of each income observation from the median weighted by the median itself according to the following formula, where income is our new comparable measure:

$$income = \log\left(1 - \frac{incomeISSP - median}{median}\right)$$

The new variable "income" is interpreted by zero as being equal to the median income and each negative and positive distance is mirrored around zero. If an individual earns six times the median he or she is equally distant from zero on the positive axes as someone who earns one sixth of the median is on the negative axes.

There are two shortcomings of using income as a variable. First of all in the survey the question asks what the personal net income is, not what the net earnings are. The personal net income is however not exactly the same as the net earnings; the variable that we are interested in. However, the data is often used as earnings data (cf. Blau 1992; Kelley & Evans 1993) and the correlation between actual earnings and personal net income is expected to be high. A second shortcoming is that the reported income in the survey is not the income of the first job but the income at present. Because of career promotion those who have been longer in the labor market are expected to have a higher pay off. To overcome this problem we control for years of work experience.

Our main independent variable in models 1 and 2, years of schooling, is used for both the absolute and relative measure of education. We decided to use years of education as it is better comparable across respondents from the same graduation cohorts but different survey years than educational degree: the variable that measures the level of educational degree changes over time in the ISSP. Furthermore, for dividing individuals in percentiles years of education makes more sense than the five categories of educational level provided by the ISSP. Only for those countries and survey years where the variable was measured as an interval variable the data was used in our sample. For the absolute measure the amount of years one spends in education is used. This measure stays the same across time and context[7]. For the

[7] This is not to say that years of education has the same predictive value across countries and years: educational systems differ heavily across countries what could lead to different predictive power of years of education (see Bol & Van de Werfhorst 2011). This is however not a problem for our design since we only compare the absolute measure with the relative measure. If there is a measurement error there is no reason to expect it to be bigger for the absolute and the relative measure.

relative measure of education years of schooling is recoded into percentiles and individuals are ranked according to the number of years they spent in education relative to the years spent by the individuals in the same cohort. If someone has twenty years of schooling while all others only have ten years of schooling this person will be placed in the top percentile, while it will be in the lowest percentile if all others have more than twenty years of education. By converting years of schooling into a ranked variable we measure the position of someone relative to others in the same graduation cohort.

In the two regressions we control for gender and experience. Gender is coded 1 for females. Experience is an important control since we use a design where individuals are gathered by cohort and the amount of work experience differs across the observations in each group. It is for this reason that we use experience as independent variable; in this way the increase in income due to work experience is controlled for. Experience is the number of years an individual is out of full time education.

Macro level variables

The dependent variable is the difference φ in model fit between the two models with individual data (equation 1 and 2). Each country and graduation year combination gets a score which indicates which of the two measures has more predictive power: a negative difference indicates that the predictive power of the absolute measure is higher while a positive difference indicates that the relative measure is more important for predicting personal income. We only use the graduation years when the micro model regressions were estimated with at least 25 observations.

Our main independent variable is the expansion of education measured with the number of students enrolled in tertiary education as a percentage of the total enrollment. This measure is used often as the indicator of expansion (Schofer & Meyer 2005). The data of this measure was taken from the Cross National Time-series Data Archive (CNTDA) by Banks (2008). The enrollment data in the CNTDA is mainly based on UNESCO statistical yearbooks with the advantage that it goes back to the 19th century for some countries. In our design we only use the enrollment data from 1951 onwards.

We add several other independent variables as controls. Since the theory of skill-biased technological change is dominant in many fields we need to control for it.

It could be the case that employers select more on the basis of relative position because the skills that are demanded are more subject to change. The argument that the demand for more trainable skills leads to labor market rewards on relative position could therefore be explained by differences in technological change as well. Since not all countries invest equally in technological change, there is some variation that needs to be controlled for if we want to show that it is actually educational expansion and not the importance of technological development that influences the importance of the relative value of education. Data of the investment in R&D is unfortunately only available since the late 1970s. As a proxy for this measure we use the number of patents per 1000 persons that is applied for in that year[8] (World Bank data 2010).

A second control concerns the changes in the dominance of the tertiary (service) sector: how did the labor market actually changed during the era of educational expansion? In the secondary sector the connection between education and skills is more obvious and therefore employers are expected to select more on one's absolute educational position. In the service sector the match between education and skills is less obvious and rewarding on the basis of one's relative position is therefore more likely to happen. It is important to rule this alternative explanation out as well, as we argue that it is educational expansion which enhanced rewarding on the basis of relative position. To do this we add the amount of employees in the secondary sector as a percentage of total employment, based on data from the CNTDA (Banks 2008). Although it would make more sense to add the percentage of employees working in the tertiary sector, this variable is too heavily correlated with educational expansion and causes multicollinearity. The next best solution is therefore to add the percentage of workers in the secondary sector, which correlates less strong, and negatively, with educational expansion.

Finally, our theoretical assumption is that the demand of workforce is equal across time. This is however not the case, in times of economic crises the supply might outreach the demand more than in times of economic prosperity. Especially in times of economic crises employers should select more on the basis of relative position, as the group of potential employees to select from increases. It is therefore important to control for the economic position of a country in a certain time as well to be sure that we study the effect of educational expansion on the importance of the

[8] The data is retrieved from the online database of the World Bank (data.worldbank.org).

relative educational position. We take the two year difference in GDP (Banks 2008) as a control for economic growth[9]. Although this is not a perfect variable of changes in the demand for labor, it indicates the economic prosperity of a country and partially reflects the decrease or increase in supply and demand. An overview of these variables can be found in table 1.

[Table 1 about here]

5.2 Survey year design

An assumption in our first design is that graduates mainly compete with those who graduated in the same two year cohort as they did. This is in reality not always the case; even an individual who has been graduated for thirty years can compete for a job. We do expect that the strongest competition is between job seekers who just finished their education. To control for this shortcoming we check our results in a survey year design as well. The sample is reduced to 29 countries as the number of waves a country needs to participate in is higher to generate some results. Only those who are employed and are between 25 and 65 are included in the sample, a total of 127.916 observations. We will run two three level multi level random intercept models with countries as the highest level (*k*), survey years as the intermediate level (*j*) and individuals as the lowest level (*i*):

$$\text{inc}_{ijk} = \alpha_{ijk} + \beta_1 \text{ed\_abs}_{ijk} + \beta_2 \text{ed\_exp}_{jk} + \beta_3 \text{ed\_abs}_{ijk} \text{X} \, \text{educ\_exp}_{jk} + u_k + w_{jk} + e_{ijk} \quad \textbf{(6)}$$

$$\text{inc}_{ijk} = \alpha_{ijk} + \beta_1 \text{ed\_rel}_{ijk} + \beta_2 \text{ed\_exp}_{jk} + \beta_3 \text{ed\_rel}_{ijk} \text{X} \, \text{educ\_exp}_{jk} + u_k + w_{jk} + e_{ijk} \quad \textbf{(7)}$$

where u_k is the country level error term, w_{jk} the survey year level error term and e_{ijk} the individual level error term. We run separate models because the two variables correlate far from perfect (0.86), the correlation might lead to wrong estimates because of multicollinearity. Most important in these models are the cross level interactions (β_3) as they signal if the effect of the relative and absolute measure on income changed with educational expansion. We expect that the first interaction is negative (educational expansion leads to a decreasing effect of years of education on income), while the

[9] The use of this measure assumes that all growth is translated into jobs, which might not be the case. We decided to use growth in GDP over (un)employment rates as this data does not goes as far back. In the models based on survey years we did however include unemployment rates (appendix A).

second interaction is positive (educational expansion leads to an increase of the effect size of the relative measure).

Variables

Most variables show great similarity with the variables used in the first design. Our dependent variable in this model is personal net income, operationalized as the logarithm of the by the median standardized distance to the median of that specific survey. The control variables are gender (female=1), marital status, age, experience and experience squared. Absolute educational level is measured as the total years in full time education. Relative educational level is the percentile of the educational distribution an individual is in based on survey year instead of graduation year.

At the country level we add several familiar variables as well. Educational expansion is measured as the percentage of students in tertiary education as a share of total student population. The control variables economic growth, the number of patents applied for per 1.000.000 persons and secondary sector employment have the same data source. From the World Bank data (2010) we also add the level of unemployment. However, if we want to use these variables as controls we have to add all cross level interaction terms between these macro level variables on the one hand and the relative and the absolute educational variables on the other hand.

5. Results

Did the expansion of education influence the way employers reward? We present two different types of results; first the results of cohort design and secondly the results of the survey year design.

Cohort design

In table 2 the results of the fixed effects OLS regression are presented. In all models country dummies were added to control for country differences.

[Table 2 about here]

In model 2 the percentage of persons enrolled in tertiary education is added and has a positive effect on the dependent variable. This means that as the number of students enrolled in tertiary education increases, the relative measure of education becomes a better predictor for income. The effect is significant and remains significant in model 3 where the variable for economic growth is added. We find no significant effect for the economic growth, and our assumption that with less economic growth selection would be based more on one's relative position is not confirmed by the data. The second control variable is added in model 4 but does not alter the effect of the percentage of tertiary enrolled students on our dependent variable as well. In the final model the number of patents per 1000 persons is added but is found to be non significant. Most important is that the effect of educational expansion remains stable when we add several control variables. However, the number of observations differs over the models as the data for especially the number of patents and those who are employed in the secondary sector is limited. This makes the r-square of the models hard to compare: while it looks like the final model is superior, this is due to the lower number of observations. In appendix A the results are shown with the same observations for each model. Here we can see that the r-square did not improve after adding the economic growth. In the models with equal number of observations the results remain robust: educational expansion has a positive effect on the extent to which the relative measure of education pays off.

In the multilevel random intercept models (table 3) we find more or less the same results. An advantage of this method is that we can see how much variation is explained between countries (σu) and between years within countries (σe). The Variance Partition Coefficient (VPC) tells us which part of variation takes place at the country level.

[Table 3 about here]

The effects we find in the multilevel random intercept analysis are the same as in the fixed effects models[10]. Although the effect sizes are slightly higher, the overall picture remains the same: educational expansion has a significant and positive effect on the importance of an individual's relative educational position for labor market returns.

[10] We also ran the multilevel random intercept models for a constant number of observations. The results remain the same and the estimates of this model can be found in appendix B.

All control variables are insignificant and alter the effect of educational expansion only slightly in the size of the effect. The results found in the fixed effects models seem to be robust. We can furthermore see that there is quite some variation between countries: in the first model fifteen percent of the total variation is due to country differences. In the final model more than one fifth of the variation takes place between countries, implying that adding the over time varying control variables explained quite some of the variance existing between time within countries. Our results clearly show that, even by adding several control variables, the effect of educational expansion on the importance of relative position on labor market returns is positive and significant.

Survey year design

We estimated two series of models; one with the absolute measure of education as the main independent variable (table 4) and on with the relative measure of education as the main independent variable (table 5).

[Table 4 about here]

In the first model of table, we see that years of education has a strong, significant, effect on income, as expected. In the following models we add educational expansion (model 2) and, most important, the interaction between educational expansion and years of education (model 3). Educational expansion has a negative effect, which is hard to interpret but might point to the fact that education has lost significance as a determinant for income. More interesting is the finding in the third model, where we find a significant and negative interaction effect between educational expansion and years of education. This shows that as education expands the effect of years of education on income decreases. Even when adding several control variables (economic growth, number of patents, secondary sector employment and level of unemployment) and their interactions with years of education, this finding remains the same. As education expands, the effect of years of education on income loses importance. Although in model 4 to 8 the strength of this interaction slightly changes, the direction and significance remain. This finding does not yet confirm our hypothesis, as we are not sure what the interaction between the relative measure and educational expansion tells us.

[Table 5 about here]

The results of the multilevel regressions with the relative educational measure as the main independent measure are shown in table 5. In the first model we find a strong positive effect of the relative educational position on income. When adding educational expansion in model 2 we find, just as in table 4, a negative effect. It can be interpreted concordantly, although it is important to note that the size and significance of the negative effect are slightly smaller than in the multilevel regressions with the absolute measure of education. The most important model is, again, model 3, where we add the interaction term between the relative educational position and educational expansion. In contrast to years of education, the relative measure has a positive interaction with educational expansion. This shows that as education expands the effect of the relative educational position on income increases. The effect remains stable in three out of four remaining models and becomes not significant in model 7 where the employment in the secondary sector is added. A reason for this might be the strong correlation between educational expansion and secondary sector employment, with the second variable absorbing the effects of educational expansion. Nevertheless, the interaction effect remains stable and positive in all other models.

If we compare the marginal effects of years of education and the relative educational position on income graphically the difference becomes clear: where figure 4 shows a downward trend, figure 5 shows an upward trend.

[Figure 2 about here]
[Figure 3 about here]

These two graphs summarize the results found by both models: as education expands the relative educational measure becomes more important. In the cohort design, where we looked at the difference in predictive power of the two measures, we saw that educational expansion has a positive and significant effect on the importance of the relative educational position. In the survey year design the results pointed towards the same direction, giving strong support for our main hypothesis that educational expansion altered the mechanism by which education pays off.

6. Summary and conclusions

During the 20th century education developed from being restricted to those from higher social strata to a mass institution which is open for most. Governments promote education, and especially higher education, heavily as they perceive it as the way to economic prosperity. The explanation for why education expands differ; some argue that educational expansion is a function of a growing complexity in society while others argue that it is merely a myth kept alive by social actors.

Research on the outcomes of educational expansion on the country level focus on economic growth, where the results are inconclusive. On the individual level most researched looked at changes in the strength of the relation between education and rewards. An important gap remained; how does educational expansion altered the mechanism by which education pays off? We took a first step by studying how educational expansion influenced the way employers reward education: for its absolute or its relative value. The main hypothesis was that educational expansion made selection on the basis of absolute educational level hard; the increase in the number of school leavers urged the employer to opt for a way of selection which is more and more based on one's relative educational position. The competition amongst school leavers intensifies as the number of school leavers increases. For the countries in our data we found convincing evidence that between 1951 and 2003 this is the case. As the percentage of students enrolled in higher education increased, the relative position of one's education became a better explanation for income, implicating that employers reward more on the basis of relative educational position as education expands. There is a systematic movement towards education becoming more positional.

These results confirm our hypothesis; although it remains unclear which of the three theory-driven mechanisms resulted in this relationship. The institutionalists would argue that the myth of the knowledge economy led to a disproportional increase in supply of higher educated. For employers the actual level of education becomes less relevant, while the relative position gains importance. From a perspective of displacement on would explain these results by saying that educational expansion led to an intensified competition for less jobs. On top of this employers more and more look for those who have the least training costs and thereby increasing the importance of the relative educational position over the absolute educational level.

A final theoretical explanation for our results can be found in the fact that educational expansion marginalized the lower educated. Employers are, in the mass educated society, only interested in those with the diffuse group of higher educated. Again labor market returns are more likely to be based on relative position than absolute level. In this article we are unable to distinguish between these theories as it would require more detailed data, something that is at least now not available for such a large number of countries and surveys.

Our results also question the often presupposed relationship between educational expansion and economic growth. While the leading idea is that expansion creates a larger human capital stock and therefore more economic growth, our results show that selection takes less and less place on the basis of absolute level of education and thus human capital. This seems contradictory: with the increase of human capital, its importance as selection criteria for employers decreases. From our study we cannot conclude that educational expansion did not lead to a growth in human capital as we do not have the data to control for this factor. What we can argue, however, is that the common mechanism by which education, and therefore educational expansion, is expected to pay off differs between time and context. To see educational expansion as something that has only positive outcomes is unidimensional and a more structural look on when it is especially beneficial is necessary.

There are however several new questions evolving from our results. Which of the three proposed theories explains the found effects? Distinguishing between these three theories would be possible with more specific data and, preferably, employer surveys as well. A more important task that remains on the table is to explain country differences. First of all country differences in the initial importance or unimportance of the relative measure over the absolute measure of education. In this paper we merely focused on the slope and paid, also because of measurement problems, little attention to country differences in the starting level of the differences. Why has the relative measure more explanatory power in some countries than in others? Secondly, country differences in the slope need to be investigated more thoroughly. Why is the transition to more importance of the relative measure stronger in some countries then others? Future research needs to look at these country disparities and connect them to structural institutional indicators.

Educational expansion had tremendous effects on the economy and society at large. While most studies only focus on the changes in effect strengths, we showed

that the expansion of education changed the mechanism by which education pays off as well. As education expands it becomes more and more positional.

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APPENDICES

Appendix A: Fixed effects model with stable number of observations

	(1)	(2)	(3)	(4)	(5)
% tertiary enrollment		0.0349*	0.0656***	0.0633**	0.0655**
		[0.0199]	[0.0209]	[0.0274]	[0.0277]
Country dummies		*yes*	*yes*	*yes*	*yes*
Growth in GDP per capita			-5.96e-07	-5.95e-07	-5.83e-07
			[4.57e-07]	[4.57e-07]	[4.58e-07]
% employed in secondary sector				-3.88e-05	-9.59e-06
				[0.000292]	[0.000298]
Number of patents per 1000 persons					-2.40e-06
					[4.71e-06]
Constant	0.00164*	0.000579	-0.000907	0.000516	0.000119
	[0.000975]	[0.00529]	[0.00534]	[0.0120]	[0.0120]
Observations	473	473	473	473	473
R-squared	0.000	0.282	0.305	0.305	0.305

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Appendix B: Multilevel random intercept regression with stable number of observations

	(1)	(2)	(3)	(4)	(5)
% tertiary enrollment		0.0713***	0.0751***	0.0776***	0.0806***
		[0.0195]	[0.0198]	[0.0231]	[0.0235]
Growth in GDP per capita			-4.84e-07	-4.85e-07	-4.65e-07
			[4.51e-07]	[4.51e-07]	[4.52e-07]
% employed in secondary sector				4.38e-05	9.14e-05
				[0.000208]	[0.000219]
Number of patents per 1000 persons					-2.26e-06
					[3.40e-06]
Constant	0.00110	-0.00579**	-0.00565***	-0.00665	-0.00860
	[0.00205]	[0.00269]	[0.00195]	[0.00511]	[0.00855]
σe	0.0003503	0.0003435	0.0003422	0.0003423	0.0003421
	[0.0000235]	[0.0000231]	[0.000023]	[0.000023]	[0.000023]
σu	0.0001058	0.0000896	0.0000913	0.000091	0.0000904
	[0.0000327]	[0.0000285]	[0.000029]	[0.000029]	[0.0000288]
VPC	0.29	0.21	0.21	0.21	0.21
Log likelihood	1185	1191	1192	1192	1192
Test against model		1	2	3	4
Df		1	1	1	1
Chi-squared		12.99	1.15	0.04	0.44
Significance		0.00	0.28	0.83	0.50
Observations	473	473	473	473	473
Number of groups	34	34	34	34	34

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

TABLES

Table 1: Summary of data

Variable	Observations	Mean	Std. Dev.	Min	Max
Difference in model fit relative/absolute measure	873	-0.0006362	0.0211465	-0.10304	0.1433816
% tertiary enrollment	897	0.0853734	0.0533718	0.0077519	0.2913374
Growth in GDP per capita	842	672	1611	-7893	10577
% employeed in secondary sector	791	31.27	8.24	6.9	53.9
Number of patents per 1.000.000 persons	578	296	446	0.22	2822

Table 2: Fixed effects OLS regression with the difference in model fit as dependent variable

	(1)	(2)	(3)	(4)	(5)
% tertiary enrollment		0.0308**	0.0637***	0.0573***	0.0655**
		[0.0141]	[0.0162]	[0.0172]	[0.0277]
Country dummies		*yes*	*yes*	*yes*	*yes*
Growth in GDP per capita			-5.11e-07	-4.98e-07	-5.83e-07
			[4.48e-07]	[4.34e-07]	[4.58e-07]
% employeed in secondary sector				-5.72e-05	-9.59e-06
				[0.000160]	[0.000298]
Number of patents per 1.000.000 persons					-2.40e-06
					[4.71e-06]
Constant	-0.000636	-0.00109	-0.00212	0.000235	0.000119
	[0.000716]	[0.00399]	[0.00414]	[0.00684]	[0.0120]
Observations	873	862	785	683	473
R-squared	0.000	0.192	0.220	0.253	0.305

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 3: Multilevel random intercept regression with the difference in model fit as dependent variable

	(1)	(2)	(3)	(4)	(5)
% tertiary enrollment		0.0377***	0.0691***	0.0681***	0.0806***
		[0.0137]	[0.0157]	[0.0164]	[0.0235]
Growth in GDP per capita			-3.89e-07	-3.94e-07	-4.65e-07
			[4.44e-07]	[4.30e-07]	[4.52e-07]
% employed in secondary sector				3.21e-05	9.14e-05
				[0.000133]	[0.000219]
Number of patents per 1.000.000 persons					-2.26e-08
					[3.40e-08]
Constant	-0.000764	-0.00391**	-0.00565***	-0.00665	-0.00860
	[0.00150]	[0.00186]	[0.00195]	[0.00511]	[0.00855]
Σe	0.0003798	0.003812	0.0003635	0.0003267	0.0003421
	[0.0000186]	[0.0000188]	[0.0000188]	[0.0000182]	[0.00023]
Σu	0.0000665	0.0000608	0.0000644	0.0000696	0.0000904
	[0.0000192]	[0.000018]	[0.0000192]	[0.0000211]	[0.0000288]
VPC	0.15	0.15	0.15	0.175	0.209
Observations	873	862	785	683	473
Number of groups	37	37	36	36	34

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Three level random intercept models for *absolute* educational position with income as dependent variable.[11]

	0	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Indvidual level variables								
Years of education		0.0405***	0.0426***	0.0491***	0.0468***	0.0507***	0.0882***	0.0564***
		[0.00109]	[0.00119]	[0.00207]	[0.00211]	[0.00219]	[0.00435]	[0.00277]
Country-year variables								
% Tertiary enrollment			-0.394***	0.273	0.287	0.586***	1.175***	0.658***
			[0.0881]	[0.195]	[0.195]	[0.205]	[0.214]	[0.208]
Growth in GDP per capita					-0.0108***			
					[0.00306]			
Number of patents per 1000000 persons						-0.142***		
						[0.0383]		
% employed in secondary sector							0.0190***	
							[0.00243]	
% Unemployed								-0.00344
								[0.00324]
Cross-level interactions								
% Tertiary enrollment * Years of education				-0.0458***	-0.0491***	-0.0667***	-0.112***	-0.0776***
				[0.0120]	[0.0120]	[0.0126]	[0.0134]	[0.0129]
Growth in GDP * Years of education					0.00111***			
Patents * Years of education						0.00563***		
						[0.00168]		
% secondary sector * Years of education							-0.00104***	
							[0.000111]	
% Unemployed * Years of education								-0.0000845
								[0.000174]
Constant	-0.0522***	-1.099***	-1.023***	-1.072***	-1.044***	-1.063***	-1.650***	-1.076***
	[0.0128]	[0.0259]	[0.0305]	[0.0332]	[0.0342]	[0.0344]	[0.0804]	[0.0452]
σ^2u (country)	0.00418***	0.00987***	0.00894***	0.00929***	0.00949***	0.00758***	0.00851***	0.0105***
	[0.000611]	[0.00139]	[0.00127]	[0.00131]	[0.00134]	[0.00111]	[0.00121]	[0.00151]
σ^2u (year)	0.00423***	0.00625***	0.00627***	0.00625***	0.00625***	0.00635***	0.00624***	0.00615***
	[0.000237]	[0.000309]	[0.000310]	[0.000309]	[0.000309]	[0.000326]	[0.000317]	[0.000316]
σ^2e	0.371***	0.299***	0.299***	0.299***	0.299***	0.302***	0.302***	0.307***
	[0.000858]	[0.000695]	[0.000695]	[0.000695]	[0.000694]	[0.000725]	[0.000717]	[0.000738]
Log likelihood	-86993	-76368	-76358	-76351	-76333	-71708	-73124	-72409
Number of groups (country)	29	29	29	29	29	29	29	29
Number of groups (year)	329	329	329	329	329	307	314	312
N	127916	127330	126843	126843	126843	116220	118435	114232

Standard errors in brackets
* p<0.10, ** p<0.05, *** p<0.01

[11] These results are controlled for age, gender, experience and marital status.

Table 5: Three level random intercept models for *relative* educational position with income as dependent variable.[12]

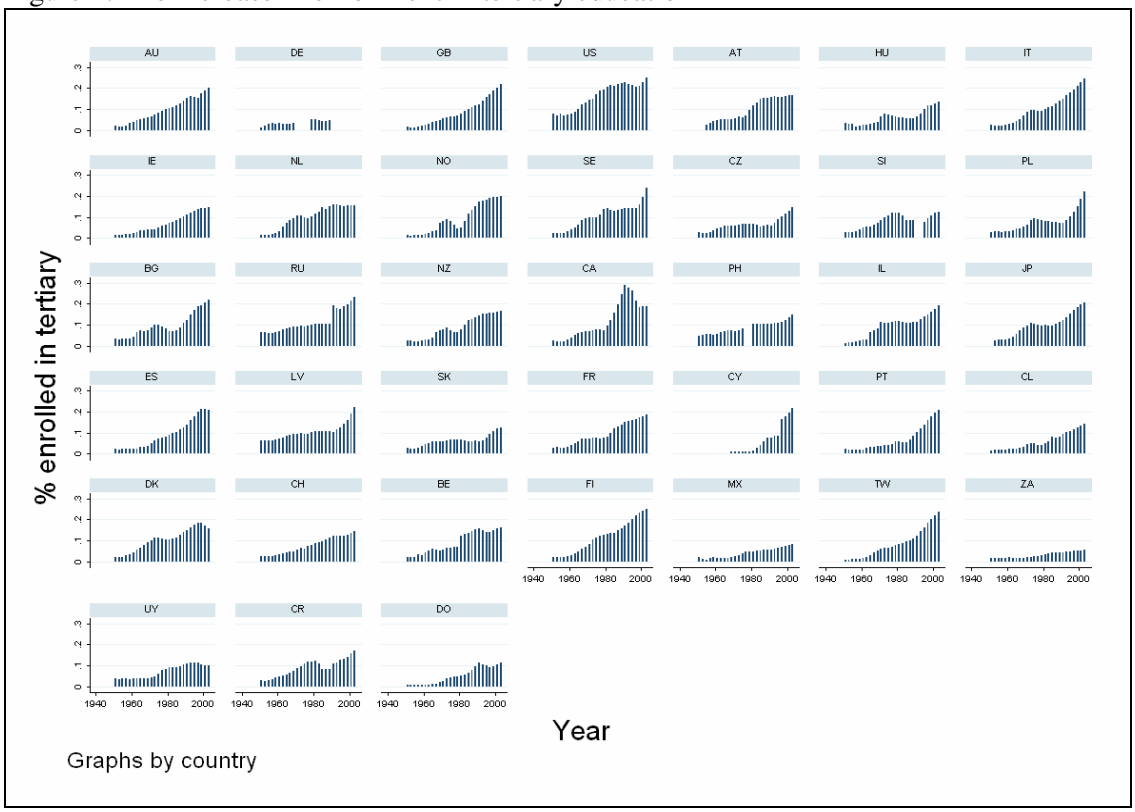
	0	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Indvidual level variables								
Relative educational position		0.00526***	0.00534***	0.00465***	0.00441***	0.00492***	0.00859***	0.00454***
		[0.000114]	[0.000119]	[0.000214]	[0.000219]	[0.000230]	[0.000489]	[0.000303]
Country-year variables								
% Tertiary enrollment			-0.207**	-0.576***	-0.579***	-0.496***	-0.180	-0.512***
			[0.0824]	[0.126]	[0.126]	[0.131]	[0.136]	[0.134]
Growth in GDP per capita					-0.00305			
					[0.00193]			
Number of patents per 1000 persons						-0.0589**		
						[0.0233]		
% employed in secondary sector							0.00783***	
							[0.00175]	
% Unemployed								-0.00947***
								[0.00256]
Cross-level interactions								
% Tertiary enrollment * Relative education				0.00567***	0.00529***	0.00404***	-0.00176	0.00392**
				[0.00146]	[0.00146]	[0.00154]	[0.00165]	[0.00159]
Growth in GDP * Relative education					0.000115***			
					[0.0000207]			
Patents * Relative education						-0.0000551		
						[0.000157]		
% secondary sector * Relative education							-0.000104***	
							[0.0000127]	
% Unemployed * Relative education								0.0000630***
								[0.0000209]
Constant	-0.0522***	-0.845***	-0.804***	-0.783***	-0.774***	-0.764***	-0.995***	-0.711***
	[0.0128]	[0.0239]	[0.0288]	[0.0292]	[0.0297]	[0.0296]	[0.0607]	[0.0381]
σ^2u (country)	0.00418***	0.00511***	0.00485***	0.00479***	0.00486***	0.00323***	0.00429***	0.00617***
	[0.000611]	[0.000739]	[0.000709]	[0.000701]	[0.000710]	[0.000505]	[0.000640]	[0.000935]
σ^2u (year)	0.00423***	0.00480***	0.00487***	0.00490***	0.00483***	0.00483***	0.00495***	0.00455***
	[0.000237]	[0.000250]	[0.000253]	[0.000254]	[0.000251]	[0.000261]	[0.000263]	[0.000249]
σ^2e	0.371***	0.297***	0.297***	0.297***	0.297***	0.300***	0.300***	0.305***
	[0.000858]	[0.000690]	[0.000690]	[0.000690]	[0.000690]	[0.000720]	[0.000712]	[0.000733]
Log likelihood	-86993	-77959	-76002	-75992	-75975	-71368	-72768	-71727
Number of groups (country)	29	29	29	29	29	29	29	29
Number of groups (year)	329	329	329	329	329	307	314	312
N	127916	127330	126843	126843	126843	116220	118435	114232

Standard errors in brackets
* p<0.10, ** p<0.05, *** p<0.01

[12] These results are controlled for age, gender, experience and marital status.

FIGURES

Figure 1: The increase in enrollment in tertiary education



*Each line indicates a different country from our sample.

Figure 2: Marginal effects of years of education on income as education expands.

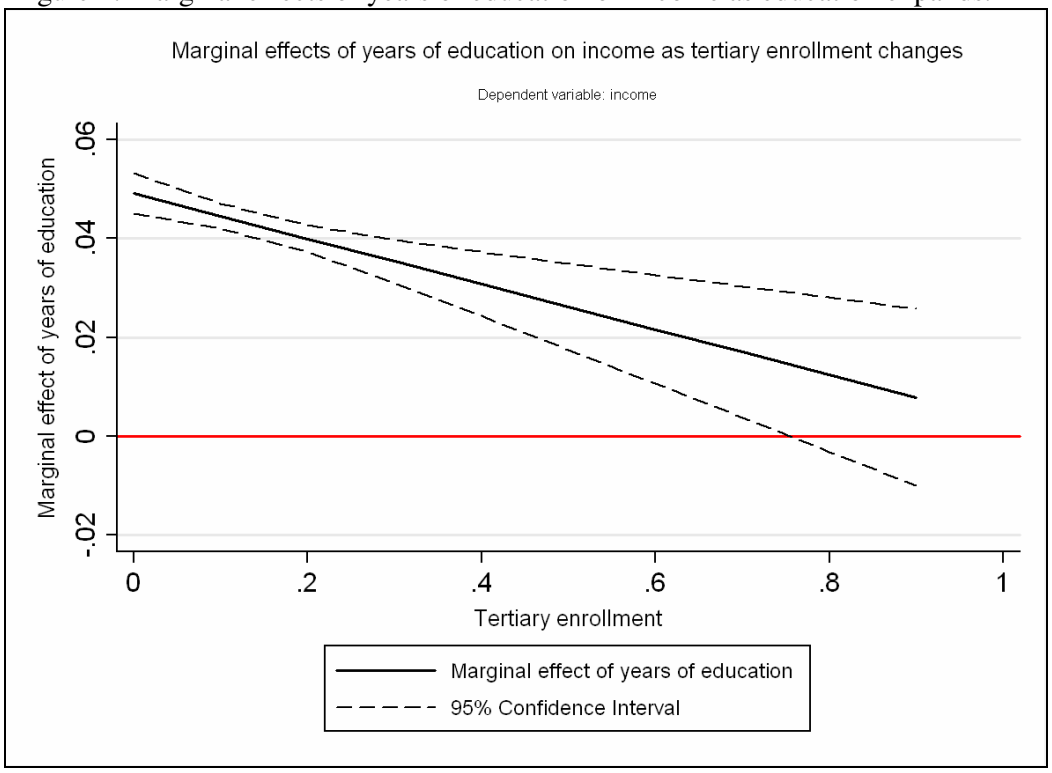


Figure 3: Marginal effects of relative education on income as education expands.