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1. Introduction

Education is an important determinant of wages and wage distribution. According to Pereira and Martins (2000), education impacts on the distribution of wages in different ways. First, the price of skills acquired through education and reflected in the returns to education impacts on the spread of wages. These inter-educational wage level differentials cause what is referred to as between group dispersion, an extensively discussed topic in the literature. Second, wage dispersion, to an extending amount, exists within educational groups. The question of the effect of education on within group inequality is important since it can predict the impact of education policy on overall inequality. Concerning these within group wage differences Prasad (2000) uses micro data from an extensive German panel data set (German socio-economic panel: GSOEP) to estimate quantile regressions for Mincer-earnings equations. According to Prasad (2000) the relationship between wage distribution and returns to education is positive for university graduates. A negative relationship is determined for the other two educational groups: employees with vocational training and those who completed an apprenticeship. Pereira and Martins (2000) point out that, in contrast to the results of Prasad (2000), lower quantiles are generally associated

with higher returns to education. According to Ammermüller and Weber (2003) wage inequality in Germany within educational groups decreases with higher educational attainment as the spread of wages is smaller within higher educational levels. According to Martins and Pereira (2004) this is a necessary condition for higher education to impact negatively on overall wage inequality. Pereira and Martins (2000) stress the uniqueness of this fact compared to other Western countries. They estimate quantile regressions of Mincer-earnings equations to analyse differences in returns to education across the wage distribution and across time for Austria, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the UK. According to Pereira and Martins (2000) four different patterns emerge: In Portugal education has an increasingly positive effect upon within-educational group wage dispersion, the best (worst) paid at each educational level receive higher (lower) returns from education. Moreover, this differential has risen over time. Second, for Austria, Finland, France, Ireland, the Netherlands, Norway, Spain, Sweden, Switzerland and the UK, a positive but stable relation between education and within-educational group dispersion is estimated. The third group comprises Denmark and Italy, where the researchers find a neutral impact of education on within-educational group dispersion. There are no notable differences in the returns to education across wage distribution. Finally, for Germany and Greece a negative relationship between returns to education and wage distribution emerges. It can be summarized that in most European countries dispersion in earnings increases with educational level. Pereira and Martins (2000) conclude that concerning within group wage dispersion, education does not reduce wage inequality. A different picture emerges in developing economies. Patrinos et al. (2006) estimate the patterns of returns to education for a mix of East Asian and Latin American countries. They first examine the returns along wage distribution as well as the pattern of returns within educational groups for each country. In contrast to the results mentioned for Europe they find evidence of decreasing returns along wage distribution for low-income countries (Mongolia, Cambodia, Vietnam, Indonesia, Thailand, and the Philippines). A clearly opposite pattern emerges for the case of Singapore (a high-income country). For the Latin American countries the results are more heterogeneous. Argentina and Chile show patterns similar to high income countries, while the other Latin American countries show mixed patterns.

There is a plethora of different research results that confirm a rise in wage inequality while stressing the importance of a more differentiated analysis of within educational group disparity

since investment in education is widely regarded as a means to reduce inequality, so the importance of this issue is very obvious. The results for developing economies show that relying on the pattern of return for Western economies when developing policies can be dangerous. When returns are higher at the top end of the wage distribution, as reported for most of the European countries, then investing in education would increase inequality. If the pattern is reversed, as it is in many developing economies, investing in education can be an effective means of reducing income inequality. We aim to conduct a comparative analysis of the dispersion of returns to education within education groups and across quantiles between Germany and China, the transition country with the highest growth rates. We expect significant differences since these two countries are examples of a transition and a high-income country, respectively. We use the method of quantile regression to gain a deeper insight into the within group inequality component of total inequality. We also add various socio-economic variables to the standard Mincer equation to gauge their effect on income distribution. After discussing the empirical method we provide detailed estimates of quantile returns to education for Germany and urban China.

2. Income generation and estimation techniques

Most of the empirical work that relates education to earnings is still based on Mincer's (1974) human capital earnings function. In this model the log of individual earnings (y) in a given period can be separated into an additive function of a linear education term and a squared experience term (Card (1999)):

$$\text{Log } y = a + bS + cX + dX^2 + e$$

with S representing the years of completed education, X representing the number of years an individual has worked since completing school, and the residual e . Where there is no information on actual working experience, Mincer proposes using "potential experience", which is assumed to be the number of years an individual of age A could have worked if they enrolled at age 6, so school ended after exactly S years. "Potential experience" is calculated as follows: $X = A - S - 6$ (Card (1999)). In the early literature on Mincer's approach the earnings function was usually estimated by an ordinary least squares estimation (OLS). One main deficit is that the OLS

regression relies on the mean distribution of the dependent variable. It estimates the mean effect of education for the average individual and thus disregards variations in returns within educational groups. Quantile regression, by contrast, allows the return to vary within educational groups. While OLS estimates the wage effects of education on the mean of the conditional wage distribution, quantile regression measures the effects of education at different points of the wage distribution. Thus, differences in quantile returns can be used to measure the dispersion of return within educational groups since they represent the wage differentials between individuals at the same educational level but in different quantiles of the conditional wage distribution (Budria and Pereira (2005)). Koenker and Basset (1978) introduced the quantile regression model. The quantile regression formula according to Buchinsky (1994) is:

$$\ln w_i = X_i \beta_\theta + e_{\theta i},$$

$$\text{Quant}_\theta(\ln w_i | X_i) = X_i \beta_\theta$$

where X_i is the vector of exogenous variables and β_θ is the vector of parameters. $\text{Quant}_\theta(\ln w_i | X_i) = X_i \beta_\theta$ is the θ conditional quantile of $\ln w$ given X . The θ regression quantile, $0 < \theta < 1$, is defined as the solution to the problem:

$$\min_{\beta \in R^k} \left\{ \sum_{i: y_i \geq X_i \beta} \theta | \ln w_i - X_i \beta_\theta | + \sum_{i: y_i < X_i \beta} (1 - \theta) | \ln w_i - X_i \beta_\theta | \right\}$$

This problem can be solved using linear programming methods. The standard errors for the vector of coefficients can be obtained by using the bootstrap method described in Buchinsky (1998). For a detailed view of the factors that generate within group inequalities as well as the progression of returns and socio-economic factors along the wage spectrum we employ the quantile regression method. For an overall view on inequality and income generation we also use a regular OLS regression.

For our empirical analysis we use the 2005 wave of the German Socio-Economic Panel (GSOEP). The Chinese data is drawn from the 2002 wave of the China Household Income Project (CHIP). Due to data quality considerations and our research question we restrict our

analysis to data from urban China. We also restrict our samples to the working-age population aged 16 to 65.

3. Patterns in Germany and China

We employ the quantile regression method and ordinary least squares regression to compare the progression of education returns and other socio-economic factors over the wage distribution. This allows us to compare in detail the within group effects that generate income and cause disparity in both countries.

In our model we use the following dependent variables:

Variable	Description
<i>exp</i>	Experience
<i>expsq</i>	Squared value of experience
<i>middle</i>	Indicator for secondary education
<i>high</i>	Indicator for higher education
<i>male</i>	Indicator for male gender
<i>married</i>	Indicator for marriage
<i>party</i>	Indicator for party membership (China only)
<i>political</i>	Indicator for political participation (Germany only)
<i>ssector</i>	Indicator for work unit in the secondary sector
<i>tsector</i>	Indicator for work unit in the tertiary sector
<i>self employed</i>	Indicator for self employment
<i>soe</i>	Indicator for employment in a state owned company (Germany only)
<i>soe1</i>	Indicator for employment in a provincial level state owned company (China only)
<i>soe2</i>	Indicator for employment in a local state owned company (China only)
<i>rural</i>	Indicator for rural hukou registration (China only)

We regress these variables on the logarithm of hourly wages. *Exp* and *expsq* are the typical proxies for potential experience. Since only very few Germans do not complete primary education we chose to use all lower education (up to nine years of schooling) as our base reference level for better comparability. *Middle* is the proxy for education up to twelfth grade,

while *high* includes everything above twelve years of schooling. The dummy variables *male* and *married* capture the influence of gender and marriage, respectively. For Germany the *political* variable applies to people who are politically active. The corresponding variable for China measures membership of a political party. To assess the impact of the sector of employment we included dummy variables for secondary and tertiary sectors using the primary sector as our baseline reference. Since we anticipate self-employment and state ownership of the company to impact on individual income we include indicator variables for these cases, too. Discrimination of rural urban migrants is a common and well documented phenomenon in China, so to account for this factor we include the rural dummy for individuals with rural hukou (registration).

We compiled the results as follows. To see the relative importance of each factors in each country we computed the standardized beta coefficients. They yield a standardized measure of the relative importance of each factor, which makes them directly comparable within each regression. We ranked these coefficients by relative importance in each country and have listed them in column one. To compare the direction of the influence of each variable on income we list the sign of the regular OLS regression coefficient in column two. We have also listed the progression of the variable across income quantiles for each country to grasp its effect on within group income inequality. A variable that positively influences within group inequality is marked with a ++, or -- if it negatively influences inequality. Three signs indicate that the variable has an especially strong impact on wage inequality.

The regression results can be summed up as follows¹:

Variable	OLS Relative Impact	OLS Direction	China Inequality Trend	Germany Inequality Trend
	Germany vs China	Germany/China	Low income/High income	Low income/High income
<i>exp</i>	1/2	+/+	--	--
<i>expsq</i>	2/3	-/-	++	++
<i>middle</i>	4/4	+/+	++	--
<i>high</i>	3/1	+/+	--	--
<i>male</i>	6/7	+/+	--	--
<i>married</i>	8/11	+/+	--	--
<i>party/pol</i>	11/6*	+*/+	--	=
<i>ssector</i>	5/8	+/-	--	--

¹ Results that are not based on statistically significant coefficients are asterisked.

<i>tsector</i>	7/13*	+/+*	=	--
<i>self employed</i>	9/5	-/-	++	+++
<i>soe</i>	10	-/n.a.	n.a.	++
<i>soe1</i>	10	n.a./+	--	n.a.
<i>soe2</i>	12*	n.a./-	---	n.a.
<i>rural</i>	9	n.a./-	++	n.a.

If we look at the relative impact of the OLS coefficients in Germany and China it is obvious that higher education, in particular, is ranked differently while middle education is ranked equally. In China higher education appears to be of more significance than in Germany, which would indicate a general trend towards higher returns to higher education in developing countries. Another significant difference is the influence of the sector of employment. Both the secondary and the tertiary dummy variables have a much greater impact on personal income in Germany than in China, while the secondary sector dummy variable impacts negatively on Chinese income and positively on German income. Self employment, by contrast, is far more important in China than in Germany when it comes to personal income; on average it tends to have a negative influence on income. For marital status we recognize a stronger positive impact in Germany than in China. The other variables do not deviate much in the relative ranking. The China specific variables are all significant except the local state owned company dummy. Both party membership and working for a provincial level state owned company increase personal income. Rural registration, by contrast, depresses income.

If we look at the influence of the various factors within groups and across the wage distribution it emerges that many variables have the same effect on within group income and income inequality in both countries. However, there are some notable exceptions. Generally most variables have a negative effect on within group inequality, meaning that their positive impact on income is greater in the smaller quantiles than in the higher ones. The factor with the strongest positive impact on inequality for both countries is self employment. Self employed workers suffer from this fact if they are in the lower quantiles, but benefit from it in the higher ones. For China we also observe that rural registration, too, drives inequality. Rural registered individuals in the higher quantiles are far less discriminated against than their peers in the lower quantiles. The hukou policy hence most strongly discriminates against people on lower wages and in simpler

jobs. The impact of state ownership of companies diverges in both countries. In China it tends to have a negative impact on inequality while the opposite seems true in Germany. Also, the effect of education differs greatly between both countries. While the distribution of returns to education for both education groups is skewed to the left and therefore decreases within group inequality in Germany, which corresponds to other results in the literature, this is only true for China in the case of higher education. Secondary education, by contrast, increases inequality in China.

We have plotted the distribution of the coefficient values over wage distribution for the three most important variables to enable a clearer comparison of both countries:

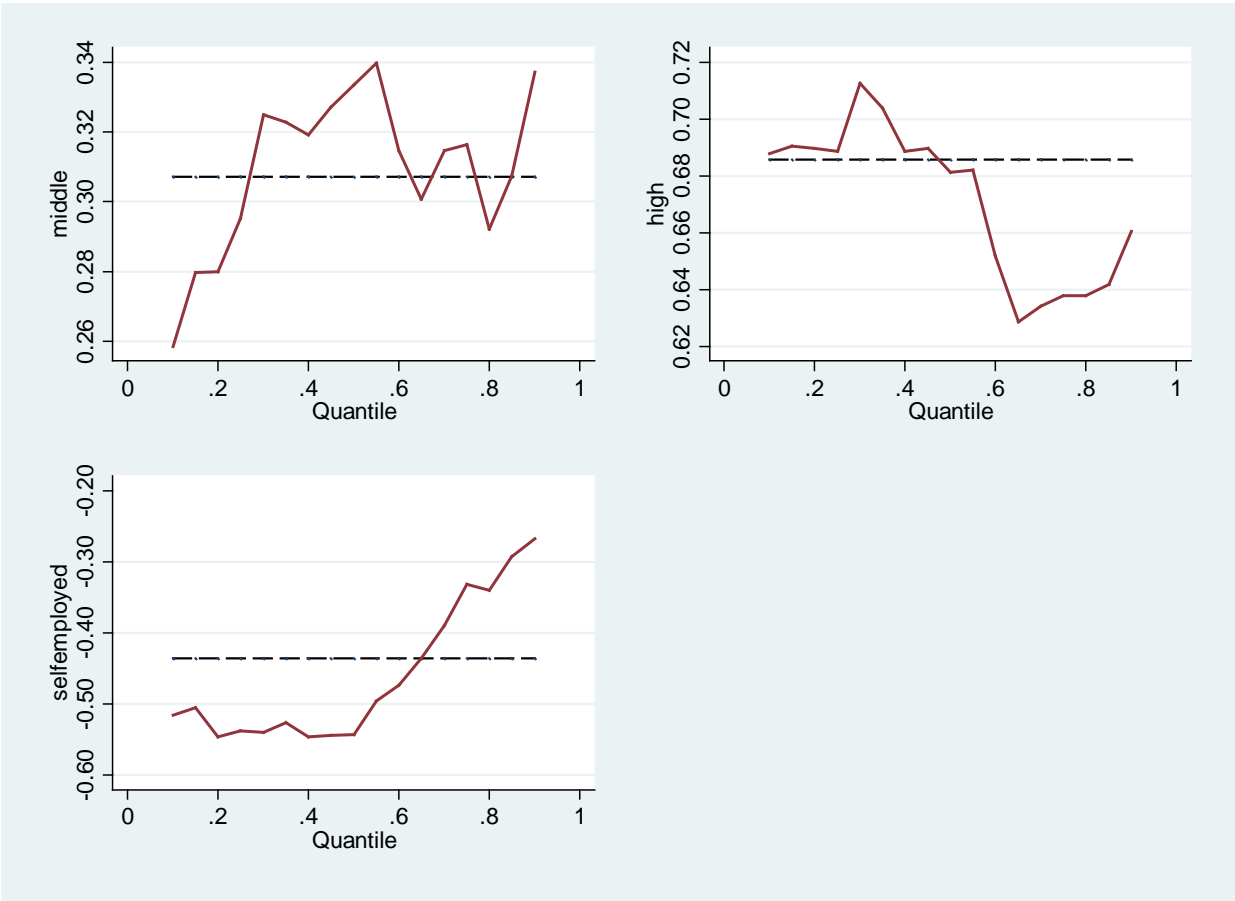


Figure 1: Coefficients over quantiles in China

For China it is clear that the returns to education for people with secondary education are distributed in a way that increases within group inequality. Those in the lowest quantile receive a return of 0.26 while those in the highest quantile achieve 0.34. A similar inequality-increasing effect is present for self employed workers. Those in the lowest quantile suffer far less from self

employment than those in the higher quantiles. Unlike secondary education, the return to higher education is lower for those in the higher quantiles and therefore decreases inequality. Differing patterns can be observed for Germany:

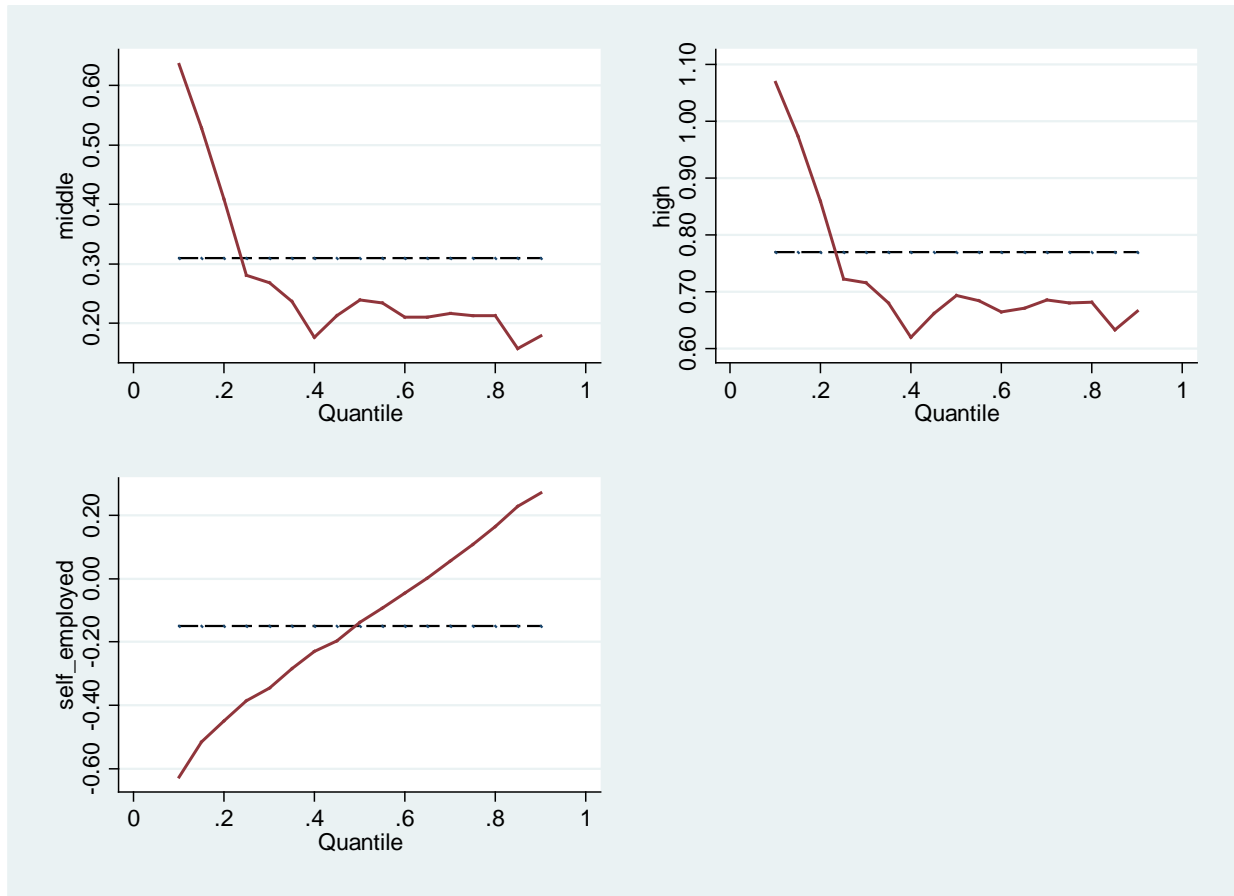


Figure 2: Coefficients over quantiles in Germany

For Germany we see declining returns for both secondary and higher education with rising quantiles. Both types of education have a significantly negative effect on inequality. The positive effect of self employment in Germany is greater than in China. The coefficient rises in a more or less linear fashion from around -0.6 in the lowest quantile to around +2.2 in the highest quantile. We conclude that people who are self employed in the lower quantiles normally have to engage in self employment or quasi self employment because they may have no other choice to earn a living. People in the higher quantiles are more likely to be traditional entrepreneurs or freelance professionals (lawyers, medics etc.).

4. Conclusion

In summary it can be stated that our general results for Germany correspond to the literature. In particular we observe a negative impact of education on within group inequality. We also detect a fairly strong positive impact on inequality of self employment. The China-Germany comparison produces differing results. While many variables have the same impact and are similar in magnitude, some diverge. The influence of the sector of the work unit is quite different in Germany. While in Germany both sectors receive a bonus over the primary sector, in China the secondary sector has a negative influence while the tertiary is insignificant. However, relative significance is much weaker in China. The most significant differences emerge when measuring the effect of education on within group inequality. Unlike in Germany, only higher education has a negative effect on inequality in China. It follows that policies to promote higher education in China will not succeed in reducing income inequality. The effects of self employment point in the same inequality-increasing directions in both countries, yet its effects are more severe in Germany. The use of self employment schemes as a means to improve the situation of lower-paid workers and decrease income inequality seems ill-advised in either country. Concerning the China-specific variables (party membership, registration status and provincial level state owned enterprises) it is evident that all of these factors have an increasing effect on inequality and would be a suitable target for policies that aim to tackle income inequality.

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