University of Warwick

Does Human Capital Tell the Whole Story?

The Role of Institutions in Regional Development Revisited

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Empirical research project

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1 Introduction

Institutions have been a prominent topic in development economics ever since the first study of Acemoglu, Johnson and Robinson (2001) showed that extractive historical institutions affect long-run socio-economic development. Recent empirical evidence indicates that institutions account for a large share in cross-country income differences (Acemoglu, Johnson and Robinson, 2001; Acemoglu, Johnson and Robinson, 2002; Nunn, 2008; Rodrik, Subramanian and Trebbi, 2004; Michalopoulos and Papaioannou, 2013). At the same time, institutions remain a broad and somewhat vague concept, comprising many different factors, ranging from the enforcement of the law to the provision of public goods. In a cross-country investigation Acemoglu and Robinson (2005) run a horserace between different types of institutions and show that property rights matter most for development. However, as property rights are mostly fixed at the national level, it can be questioned whether institutions play the same role in explaining differences in development across regions.

This question is explored by Gennaioli et al. (2013). They take regional data from 110 countries and find that the average education level of the local population explains the major share of regional income differences. Variation in the quality of local institutions does not have a significant effect on regional development. However the main drawback of their approach is that the methodology does not account for the reverse causality between both human capital and institutions and development: once regions achieve a higher level of income, they can afford to invest more in the education as well as in better courts, better trained judges etc., and thereby building better institutions.

Therefore this paper aims to reinvestigate this topic by applying a more appropriate methodology to the regional data; instrumental variable strategy is used to account for the endogeneity bias. Due to limited availability of data on the regional level, we can instrument for human capital but not for institutions. The instrument is the average level of educational attainment of the population aged 65 years and older, who no longer receive schooling, which makes the variable exogenous to current regional income per capita. Drawing on cross-sectional data from 444 regions from 28 countries, we find positive and significant associations between both human capital and institutional quality and regional income. Nevertheless there remains the concern that the exclusion restriction of the IV methodology may not be satisfied, as some long-run factors (such as regional productivity) may be correlated with both the level of education of the older population and current regional income. Therefore the estimates should be interpreted as associations rather than causal effects. Future research could improve upon this by taking a more appropriate instrumental variable in the cross-country regional setting.

The rest of the paper proceeds as follows. Section 2 presents the main data and reports descriptive statistics illustrating the relationship between institutions, human capital and development. Also the empirical strategy is detailed. Section 3 discusses the estimation results, followed by sensitivity checks examining whether there are differential effects for developing and developed countries. Finally, section 4 concludes and highlights directions for future research.

2 Data and Methodology

2.1 Data

In order to analyse the relationship between human capital, institutions and regional development, this paper employs cross-sectional regional data from 444 regions in 28 countries, gathered from various sources by Gennaioli et al. (2013). Descriptive statistics are given in Table I, in which the observations are at the regional level.

Table I: Summary statistics

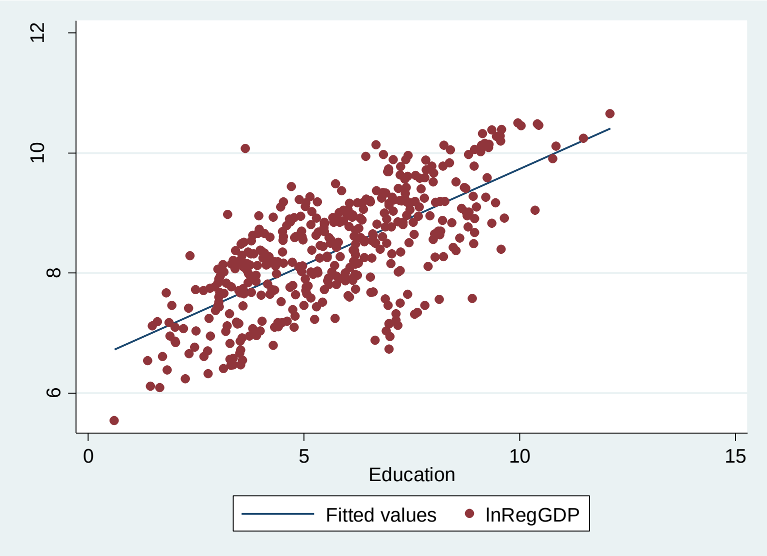
Variable	Obs.	Mean	St. Dev.	Median	Min	Max
Ln regional GDP	432	8.367588	.9610962	8.371279	5.540066	10.65218
Education	431	5.725456	2.120729	5.717945	.6157495	12.10083
Education 65+	443	2.224023	1.608351	1.730296	.1153846	9.885102
Institutional quality	213	-.0101099	.1041019	-.0049946	-.2716998	.3085922
Temperature	435	18.75787	7.892545	21.32477	-5.793468	28.262
Distance coast	436	.8396156	.1483935	.8814902	.3487194	.9995317
Ln oil production	436	.1201749	.4001186	0	0	2.676627
Ln population	436	14.32193	1.807572	14.24019	9.138823	19.00424
No. of ethnic groups	435	1.178206	.734102	1.098612	0	3.218876

Notes: This table reports descriptive statistics for the data that is used to analyze the relationship between human capital, institutions and regional development. Definitions and data sources of the main variables (regional GDP, education and institutions) are discussed in the main text. Regarding the other variables, temperature is the average temperature during the period 1950–2000 originally from the WorldClim database. Distance coast represents the inverse distance to the ocean. Production and reserves of oil are measured in 2000, originally from the WorldClim database. Population represents log of the number of inhabitants in that region in 2005. Number of ethnic groups that inhabited each region are measured in 1964.

The main variable of interest is regional GDP per capita, which we use in log terms. Regional income per capita is stated in current purchasing-power-parity (PPP) dollars in order to facilitate comparison across regions in different countries. For each region, Gennaioli et al. computed average years of schooling as the weighted sum of the years of school required to achieve each educational level, where the weights are the fraction of the population aged 15 and older that has completed each level of education. Data on educational attainment originally comes from different sources: EPDC Data Center, Eurostat, National Statistics

Offices and IPUMS. The same has been done for the educational attainment of the population of 65 years and over. Figure I below shows a strong linear correlation between the average educational attainment of the population and regional income per capita.

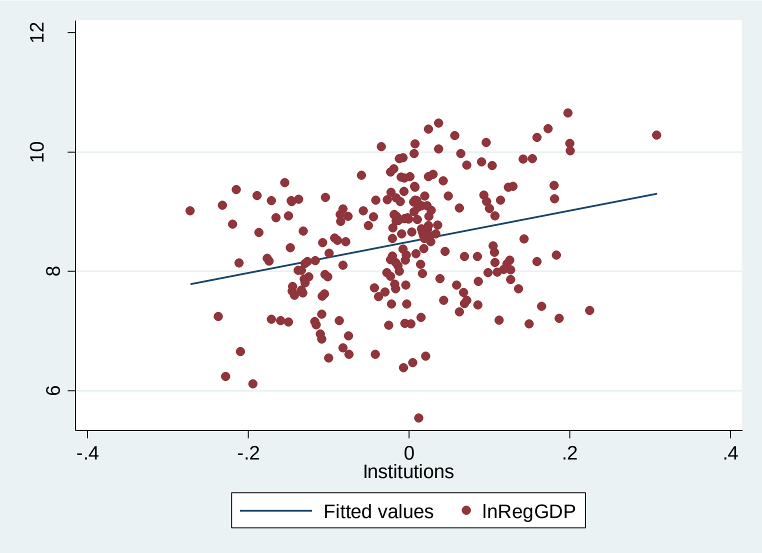
Figure I: Educational attainment and regional income per capita



Notes: This figure represents a scatterplot of the correlation between education and regional income per capita. Education is measured in the average years of schooling of the population, whereas regional GDP per capita is in logs at current purchasing-power-parity (PPP) dollars.

In order to measure institutions at the regional level, survey assessments of the business environment in the World Bank Enterprise Surveys are used. Gennaioli et al. created an index of the quality of institutions based on seven variables from the World Bank Enterprise Survey and one from the subnational World Bank Doing Business reports. However we need to keep in mind that this is a subjective measure of institutions, as it relies on self-reported values by local businesses. Cultural differences may cause systematic differences in answers across firms in different countries. Therefore measurement error may be an issue. Figure II shows that an increase in the index that measures institutional quality is associated with a higher regional GDP per capita.

Figure II: Institutional quality and regional income per capita



Notes: This figure represents a scatterplot of the correlation between institutions and regional income per capita. Institutional quality is an index based on seven variables from the World Bank Enterprise Survey and one from the subnational World Bank Doing Business reports. Regional GDP per capita is in logs at current purchasing-power-parity (PPP) dollars.

2.2 Empirical framework

This paper aims to estimate the effects of human capital and institutions on income per capita in a regional context. The basic model uses OLS and is denoted in the following estimating equation:

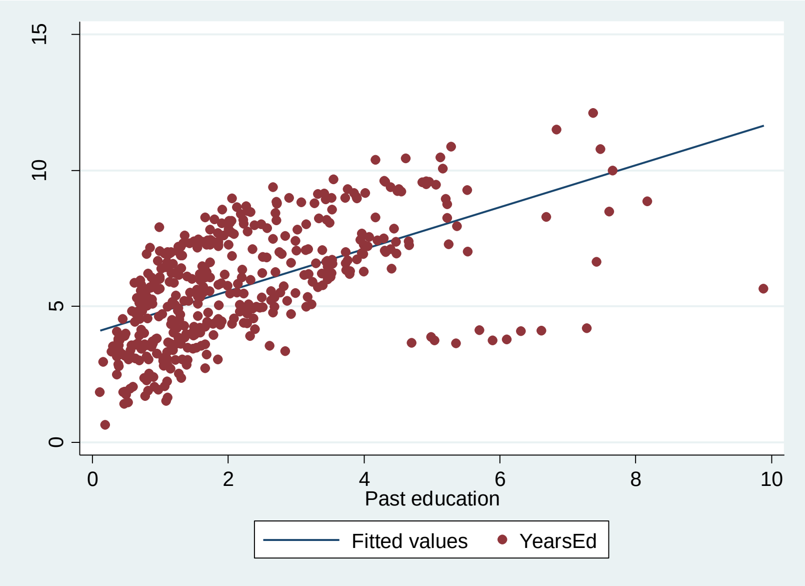
(1) $$y_{i,c} = \alpha + \gamma \, \text{Edu}_{i,c} + \Phi \, \text{Inst}_{i} + \lambda \, \text{X}_{i,c} + \varepsilon_{i,c}$$

The dependent variable $y_{i,c}$ represents regional income per capita in region i in country c. α is the intercept of the equation. Edu denotes the average educational attainment (in years) of the population aged 15 and older in region i, whereas Inst measures the quality of the local institutions. Given the graphs I and II in the previous section, we expect the signs of γ and Φ to be positive.

X reflects a set of other factors that influence regional GDP as well. Both geographic and social control variables are included in the model. In particular, average temperature, the level of oil production (as it represents the natural resource endowments of a region) and distance to the ocean are included. The latter variable measures the costs of imports and exports and hence trade possibilities for the respective region. Regarding social variables, the number of inhabitants in that region is included. The number of ethnic groups is incorporated as a rough proxy of ethnic fractionalization. Finally, country dummies are part of the estimating equation, since a large share in regional income differences can be explained by national policies. This also avoids identification problems caused by unobserved country-specific factors. $\varepsilon_{i,c}$ represents the error term.

However the OLS estimates will yield biased results for the coefficients of institutions and education. Once regions grow richer, they can afford to invest more in the educational and institutional system and hence this growth will result in a higher level of human capital and institutional quality. The coefficients γ and Φ will pick up some effect of this reverse causality. In order to account for the endogenous relationship between education and regional income, we will run the same regression using Two Stage Least Squares (2SLS) methodology. Hereby we take average level of education of the population of 65 years and older (past education) as an instrument for the average educational attainment of the current population (current education). The level of educational attainment of the older population is fixed since these individuals no longer receive schooling. Therefore it is exogenous to current regional GDP per capita. The plot in Figure III below indicates that there is a strong (albeit not perfect) correlation between past education and current education. We cannot use an Instrumental Variable (IV) strategy for institutional quality due to limited availability of data on the regional level, and therefore need to keep in mind that the coefficient of institutions will represent an association rather than a causal effect.

Figure III: Past education and current education



Notes: This figure represents a scatterplot of the correlation between past education and current education. Current education denotes the average years of schooling of the population aged 15 and older, whereas past education represents the average years of schooling of the population aged 65 and older.

3 Empirical Results

3.1 Main results

The first stage results of the 2SLS estimation are documented Table AI in the Appendix. The value of the partial R-squared indicates that past education (average years of schooling of the population aged 65 and older) explains about 60% of the variation in current education (average years of schooling of the population aged 15 and older). The associated F-statistic of 266.836 is well above the commonly used threshold of 10, so we can rest assured that the instrument captures the endogenous variable sufficiently well.

Table II: Average effects of human capital and institutions on regional development

	(1) OLS	(2) OLS	(3) OLS	(4) IV
Education	0.384***	0.379***	0.379***	0.373***
	(0.0188)	(0.0193)	(0.0223)	(0.0261)
Institutional quality	0.887**	0.853**	0.854**	0.847***
	(0.276)	(0.273)	(0.273)	(0.250)
Geographic controls	No	Yes	Yes	Yes
Social controls	No	No	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Observations	210	210	210	210
No. of countries	28	28	28	28
Adjusted R-squared	0.924	0.926	0.926	0.926

Notes: This table represents the average effects of education and institutional quality on regional development. The dependent variable is the log of regional GDP per capita in current purchasing-power-parity (PPP) dollars. The two main independent variables are average years of schooling of the population and an index of the quality of institutions based on seven variables from the World Bank Enterprise Survey and one from the subnational World Bank Doing Business reports. In column (4) average years of schooling of the population is instrumented for using average level of education of the 65+ population. Geographic controls include the temperature, distance to the ocean and the log of the production of oil (if any in the region, 0 otherwise). Social controls include the log of the number of inhabitants and the number of ethnic groups (a measure for ethnic fractionalization). All specifications include country fixed effects. Standard errors in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level.

Table II reports cross-sectional least squares and 2SLS estimations of the effects of human capital and institutional quality on regional development. The values of the adjusted R-squared imply that the main model incorporating human capital, institutional quality, social and geographic controls and country fixed effects explains on average 92,6% of the variation in regional income. All columns include country fixed effects, as a large share in regional income differences can be explained by national policies and other unobserved country-specific factors. Column (2)-(4) control for the effect of geographical factors on regional income; respectively average temperature, distance to the coast and the log of the production of oil, if the region produces any oil. Social factors, respectively the log of the number of inhabitants in a region and the number of ethnic groups, are controlled for in column (3) and (4). The final column reports the estimates of the Instrumental Variable methodology, whereby educational attainment of the current population is instrumented for using the average level of schooling of the older population (65 years and older) in order to account for the endogenous relationship between regional income and education attainment.

The coefficient of the average effect of education on regional development remains very stable across different specifications and is a large: an increase of one year in the average level of schooling of the population results in an increase of approximately 38% in regional GDP, ceteris paribus. This is consistent with findings from Gennaioli et al. (2013). The education variable remains significant at the 1% level throughout the different estimates. The IV estimate is slightly lower, implying that there was an upward bias in the OLS estimate due to endogeneity.

The effect of institutions on regional development is less clear-cut however, since there remains an endogenous relation between institutional quality and regional income, which we cannot instrument for due to lack of data on the regional level. However the estimates indicate that there is a positive and significant association between the quality of local institutions and regional GDP per capita. Nevertheless corresponding standard errors are large, which could indicate presence of measurement error. This is a subjective measure of institutions, as it is constructed by self-reported values of the quality of the business environment by local firms. Gennaioli et al. report a significant association between institutions and development on the national level but do not find a significant effect of institutional quality on regional development.

We cannot check whether the instrument is uncorrelated with the error term since only one instrument is used for one endogenous regressor. However we can perform the Durbin and Wu-Hausman test in order to test for endogeneity and to see whether the IV estimates differ significantly from the OLS estimates. The results are reported in Table III below.

Table III: Results of the endogeneity tests Durbin and Wu-Hausman

	(1)	(2)
Tests	Test statistic	P-value
Durbin	0.109816	0.7404
Wu-Hausman	0.091038	0.7632

Notes: This table represents the test statistics of two endogeneity tests. The null hypothesis of both tests is that variables are exogenous, such that OLS estimates do not differ significantly from the IV estimates.

The estimated p-values of 0.7404 and 0.7632 imply that we cannot reject the null hypothesis of no significant difference between OLS and IV estimate. These results imply that the IV estimates still suffer from endogeneity bias, since they do not differ significantly from the OLS estimates. This raises the concern that the exclusion restriction may not be satisfied. In fact, some long-run factors (such as regional productivity) may be correlated with both the level of education of the older population and current regional income. Furthermore, apart from the fact that richer regions can afford to invest more in the human capital of their population, selective migration may be an issue; richer regions might attract more educated workers. This issue is not resolved by our current instrument. Therefore we should focus on the OLS estimates as our preferred model but should remain cautious with respect to the interpretation of the results, as the coefficients of education represent an association rather than a causal effect, just as with institutions.

Nevertheless the results (so far associations rather than causal effects) are consistent with the recent empirical evidence that show that institutions do matter for regional development. Michalopoulos and Papaioannou (2013) show that pre-colonial institutions have a long-run effect on regional development in Africa. Various studies investigate the same question in the context of a single country, exploiting local differences in colonization strategy as plausible exogenous variation in the allocation of historical institutions. Both Dell (2010) and Banerjee and Iyer (2005) find significant effects of a land tenure system, imposed in the time of colonization in Peru and India respectively, on contemporary regional development outcomes.

It can be questioned to what extent our variable used for institutions captures the theoretical concept well. The index of the local firms assessment of the business environment is quite subjective and may not reflect well the nature of and variation in local institutions due to different countries historical experiences, which are emphasized throughout the literature. Since institutions and education are highly correlated, it may be the case that the human capital variable picks up some effect of institutional quality on growth, if the institutional index variable does not capture the concept sufficiently well.

Finally the main regression model (estimation (3) in Table II) is found to adhere to the Gauss-Markov assumptions. Despite that the kernel density plot shows that the distribution of residuals is slightly skewed towards the right (see Figure AI in the Appendix), non-normality cannot be rejected at 5% level[1]. Hence we need not worry about non-normality of residuals. Regarding the variance of the residuals, judging by the graph (see Figure AII), it seems to be fairly constant across the fitted values. A more formal application of Whites test confirms that heteroskedasticity is not an issue, as with the reported p-value of 0.5091, we cannot reject the null hypothesis of homogenous variance of the error term. Finally when examining the variance inflation factor (VIF) values of the various coefficients, the results in Table AII suggest that the model does not suffer from multicollinearity. There no observed VIF values above the commonly used threshold value of 10.

3.2 Sensitivity checks

There may be concern that the strong and positive association between human capital and institutions and regional development are driven by strong effects for a certain subsample of the population of 28 countries. It could be the case that the high and significant OLS estimates of institutions are entirely attributable to developed and emerging countries, where institutions foster growth, while in developing countries institutions would have less or no impact on regional GDP per capita (or vice versa, increased regional income does not lead to an improvement in the quality of local institutions). In developing countries, corruption is wide-spread and institutional changes take place at a slow pace.

In order to test for a possible heterogeneity in effects, we split the sample into two categories, namely developed and emerging countries and developing countries, based on the World Bank country classifications. Running the same OLS estimate of equation (1) yields the results documented in Table IV.

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[1] Application of the Shapiro-Wilk W test for normal data yields a p-value of 0.05792.

Table IV: Similar effects of human capital and institutions on regional development across developed and developing countries

	(1) Developed and emerging countries	(2) Developing countries	(3) Full sample
Education	0.429***	0.331***	0.379***
	(0.0301)	(0.0402)	(0.0223)
Institutional quality	0.895*	0.537	0.854**
	(0.390)	(0.436)	(0.273)
Geographic controls	Yes	Yes	Yes
Social controls	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes
Observations	136	74	210
Adjusted R-squared	0.871	0.826	0.926

Notes: This table documents the OLS estimates of education and institutional quality on regional development. The dependent variable is the log of regional GDP per capita in current purchasing-power-parity (PPP) dollars. The two main independent variables are average years of schooling of the population aged 15 and over and an index of the quality of institutions based on variables from the WB Enterprise Survey and the subnational WB Doing Business reports. Column (1) presents the OLS estimates for developed and emerging countries only, while column (2) documents the results of the same analysis for developing countries only. Column (3) reports the OLS estimates for the full sample for comparison. Assignment of the terms developed country, emerging economy and developing country are based on the World Bank country classifications, which uses national GDP as the main criterion. All specifications include average temperature, distance to the ocean and the log of the production of oil (if any in the region, 0 otherwise), the log of the number of inhabitants, the number of ethnic groups (a measure for ethnic fractionalization) and country fixed effects. Standard errors in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Broadly, we find similar results for results for the association between education and regional development. The associated effect remains highly significant throughout the different specifications, albeit the effect is stronger for developed and emerging countries. The institutional quality variable is still positive but no longer significant when only developing countries are included in the analysis. This implies that there is no significant association between institutions and regional development for the majority world. Nevertheless there may be a significant errors in the measurement of the variable due to subjective responses by local firms. Also the small sample size increases the standard error. For developed and emerging countries the positive association between institutions and regional income remains significant and becomes slightly larger compared to the sample that includes all types of countries.

4 Conclusion

This paper investigates the role of human capital and institutions on regional development. It is difficult to disentangle the causal effect of both factors since once regions achieve a higher level of income, they can afford to invest more in the education as well as in better courts, better trained judges etc., and thereby building better institutions. This paper has attempted to address the endogeneity bias of the educational variable by using the average level of educational attainment of the population aged 65 years and older as an instrument for the average years of schooling of the population aged 15 years and over. The older population no longer receives schooling, which makes the instrumental variable exogenous to current regional income per capita.

Drawing on cross-sectional data from 444 regions from 28 countries, we find positive and significant associations between both education and institutional quality and regional income. This is consistent with findings from the empirical literature (Michalopoulos and Papaioannou 2013; Dell, 2010; Banerjee and Iyer, 2005). Nevertheless applied exogeneity tests cannot reject the null hypothesis of no significant difference between the OLS and IV results, implying that the IV estimates still suffer from endogeneity bias. This raises the concern that the exclusion restriction of the IV methodology may not be satisfied, as some long-run factors (such as regional productivity) may be correlated with both the level of education of the older population and current regional income. Therefore we cannot definitely pinpoint the causal effects of education and institutions on regional development and provide suitable policy recommendations. Future research could improve in this respect by employing an IV methodology with a more appropriate instrument, which is truly exogenous to current regional income in order to effectively address the endogeneity bias. Future research could also include other proxies for regional development such as poverty rates or light density at night, which would provide a good robustness check to confirm previous empirical findings regarding institutions and regional development.

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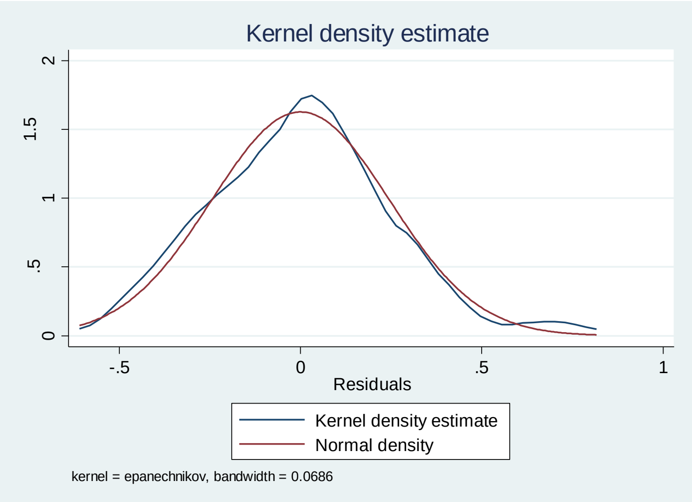
Appendix

Table AI: First stage test statistics

	(1) Coefficient	(2) F-statistic	(3) Partial R-squared	(4) Obs.
Past education	0.7371237*** (.0451251)	266.836	0.6039	210

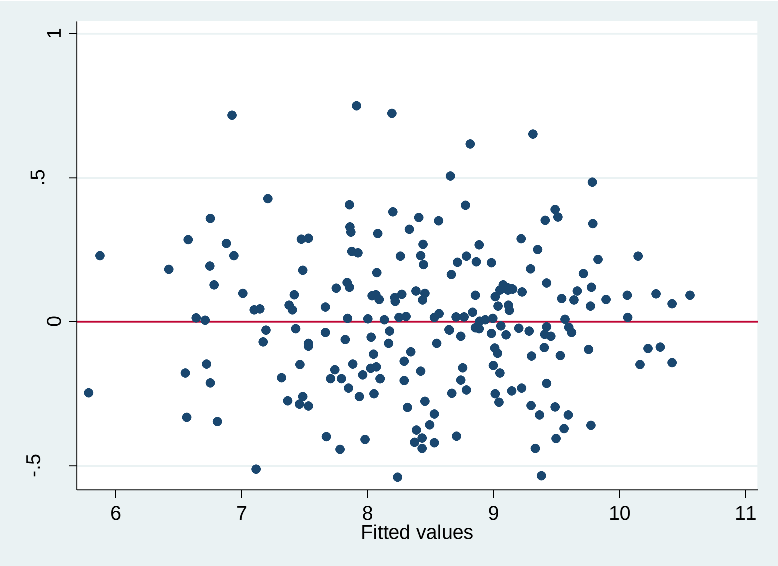
Notes: This table represents the test statistics of the first stage regression of the IV. The endogenous regressor of interest is current education (average years of schooling of the population aged 15 and older), while past education (average years of schooling of the population aged 65) is the instrument. Other regressors included in the first stage regression are include the institutional quality index, the temperature, distance to the ocean and the log of the production of oil (if any in the region, 0 otherwise), the log of the number of inhabitants, the number of ethnic groups and country fixed effects. The test statistics show that past education explains a large share of the variation in current education and the F-statistic is well above the common threshold value of 10. Standard errors in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Figure AI: Distribution of the residuals



Notes: This figure represents the kernel density plot of the residuals of the OLS estimation (1) in Section 2 and estimation results in column (3) of Table II in Section 3. Compared to the normal distribution, the distribution of the residuals is slightly skewed to the right.

Figure AII: Homoskedasticity



Notes: This figure represents the variance of the residuals of the OLS estimation (1) in Section 2 and estimation results in column (3) of Table II in Section 3. The variance of the residuals is fairly constant across the fitted values.

Table AII: VIF-values of the OLS regression

	(1)	(2)
	OLS estimate	VIF-value
Education	0.379***	6.94
	(17.02)	
Institutional quality	0.854**	2.35
	(3.13)	
Temperature	0.000168	5.49
	(0.03)	
Inverse distance to the coast	0.565*	2.84
	(2.57)	
Ln oil production	-0.0389	1.19
	(-0.32)	
Ln population	-0.0315	4.79

	(-1.22)	
No. of ethnic groups	0.00327	2.17
	(0.09)	
_Icode_2	0.179	3.02
	(0.85)	
_Icode_3	-0.0534	1.56
	(-0.22)	
_Icode_4	0.875***	5.43
	(5.39)	
_Icode_5	-0.428*	2.66
	(-2.17)	
_Icode_6	-0.338*	8.64
	(-2.15)	
_Icode_7	0.309	5.05
	(1.85)	
_Icode_8	-1.015***	2.43
	(-5.37)	
_Icode_9	-0.447*	1.89
	(-2.09)	
_Icode_10	0.00149	4.01
	(0.01)	
_Icode_11	-0.929***	2.32
	(-4.51)	
_Icode_12	-0.159	7.58
	(-0.88)	
_Icode_13	-0.736**	1.98
	(-2.74)	

_Icode_14	-0.950***	3.39
	(-5.34)	
_Icode_15	-0.208	2.74
	(-0.93)	
_Icode_16	0.132	8.58
	(0.88)	
_Icode_17	-1.717***	3.30
	(-7.80)	
_Icode_18	-0.561*	1.84
	(-2.17)	
_Icode_19	0.524*	2.63
	(2.39)	
_Icode_20	-0.215	1.86
	(-0.83)	
_Icode_21	-0.623**	2.08
	(-3.19)	
_Icode_22	-1.141***	2.00
	(-5.18)	
_Icode_23	-0.792***	2.83
	(-4.24)	
_Icode_24	0.385	2.92
	(1.86)	
_Icode_25	-0.905***	3.06
	(-5.02)	
_Icode_26	-0.417	2.55
	(-1.93)	
_Icode_27	0.0328	1.90

	(0.15)	
_Icode_28	-0.945***	2.56
	(-4.87)	
Constant	6.460***	
	(13.81)	
Observations	210	
Mean VIF-value	3.43	

Notes: This figure represents the variance of the residuals of the OLS estimation (1) in Section 2 and estimation results in column (3) of Table II in Section 3. Included variables are average years of schooling of the population aged 15 and older, the institutional quality index, the temperature, distance to the ocean and the log of the production of oil (if any in the region, 0 otherwise), the log of the number of inhabitants, the number of ethnic groups and the I_code denote dummies for country fixed effects. The VIF-values of the coefficients do not surpass the threshold value of 10 at any point, implying that are no issues of multicollinearity in the OLS estimates. Standard errors in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.