Rich by Nature, Poor by Choice?

Do Natural Capital Rich Countries Indeed Neglect Education?

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ABSTRACT

A widely known paradox in economics is the so called resource curse. This implies the phenomenon that resource rich countries on average show lower GDP growth rates than other countries. One debated reason for this effect is the neglection of education by governments of resource rich countries. This transmission channel has however not been thoroughly analyzed so far. This paper will contribute to fill this gap in the literature. In this study panel data for up to 170 countries for the period 1970-2008 will be analyzed asking the question whether resource rich countries indeed neglect education and thus stay poor by choice. It will be shown that this is not the case. In general resource wealth has no significant effect on education. However when excluding high income countries, oil reserves have a significant positive effect on the secondary enrollment rates.

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I. INTRODUCTION

One of the most essential questions in economics is the one on the determinants of economic growth. Why do countries show such different patterns of growth? How could countries boost their growth to catch up to more developed countries? How does it come that countries with very good pre-conditions with regards to available natural resources, on average grow slower than other countries?

The last question refers to the so called resource curse. With some exceptions, like Norway or Botswana, it can be shown (see Sachs and Warner, 1995) that resource rich countries (e.g. Nigeria or Venezuela) tend to grow slower than resource poor countries (e.g. "the Asian tigers"). This phenomenon, which contradicts economic intuition, has been intensively studied in search of the reasons behind it. The general assumption is that a certain factor X exists which influences growth and is influenced by the natural resource availability (Sachs and Warner, 2001).

Gylfason (2001) distinguishes four possible factors or transmission channels. The first and probably most discussed is the loss of competitiveness for the non-resource sector through a boom and thus price rise in the resource sector. This phenomenon is known as the "dutch disease". A second transmission channel might be rent-seeking by agents in the resource sector. This rent-seeking behavior possibly leads to corruption, distorted allocation of public expenditure and thus to inefficiency in the public sector. According to Murphy et al. (1993) rent seeking behavior is a self-empowering process leading to an increasing share of resources being allocated to the rent seeking sector instead of productive use of these resources. This leads to a reduction of productivity and in the end producers, rent seekers and the economy as a whole will end in an inferior situation than in the beginning. In this sense, Auty (2001) shows in a model that resource rich countries, which tend to have predatory leaders, will end in a growth collapse where physical and human capital will be destroyed. As third transmission channel Gylfason (2001) mentions a lack of incentives for the government to push for a sustainable, long term oriented and growth-enhancing economic policy. This is due to the misleading feeling of security given by income generated in the resource sector. Finally, the fourth transmission factor is education. Related to the before mentioned lack of incentives for growth enhancing economic policies, the government might also lose sight of the importance to invest in its people, namely in their education. Gylfason (2001) states *"Of the total effect of natural capital on growth, almost a half can […] be attributed to education […]"* (Gylfason, 2001, p. 856). However the argument of a short sighted government that does not want to invest in human capital, which is the main assumption behind this transmission channel, can also be questioned. Even if a government does not see the importance of education, it is not clear why, if it has sufficient income, as implied in the argument by Gylfason, it should actively decide to invest less in education. An assumption would be that it is rather the political system that matters. Studies have shown that resource rich countries tend to democratize more slowly and have a lower institutional quality (e.g. Ross, 2001, Sala-i-Martin and Subramanian, 2003). On the other hand systems where a bigger winning coalition is needed do provide more social services (Bueno de Mesquita et al., 2002). So the reason behind the negative relationship between natural resource abundance and education might be via institutions.

Although education plays such an important role for the economic performance of a country and hence neglecting education has long term negative effects on its development, this transmission channel has rather been neglected in the natural resource abundance literature so far. However as education plays such an important role, better analyses of this channel and proofs if these countries indeed knowingly impair their development are needed. This paper thus aims at subjecting this relationship between resource abundance and education to a more thorough analysis including the possible transmission via institutional quality. It will be shown that the commonly cited argument that governments of resource rich countries neglect education of their people does not hold. Indeed the study will show that in general the level of education in a society does not depend on the resource wealth of the respective country.

The paper is structured as follows. Section II will give an overview over the existing literature analyzing the transmission channels of the resource curse with a special focus towards those papers analyzing the human capital channel. Section III will then give a short overview over the used data and will be followed by the estimations in part IV. Finally the findings will be concluded in section V.

II. THE CURSE OF NATURAL RESOURCES

Paradoxically, countries that are well endowed with natural resources show on average lower growth rates than countries with less natural wealth. Annex 1 shows that only four out of the twelve member countries of the Organization of the Petroleum Exporting Countries (OPEC) had on average a higher growth of GDP per capita than the world and the low income countries in the period 1980 – 2009. Furthermore the average GDP per capita growth of the OPEC countries lies significantly below the average of both other groups.

In the following a short overview to the literature with regards to the resource curse, its impacts and transmission channels will be given to set the scene for the analysis. With this so called resource curse, economic literature has dealt already for some time. Thereby most of the literature focuses on the *dutch disease* going back to the adverse effects the discovery of natural gas in the Netherlands in 1959 had on the dutch manufacturing sector. The mechanism behind the *dutch disease* was initially modeled by Corden and Neary (1982). An economy with a tradable sector, including a resource manufacturing sector, a non-resource manufacturing sector, and a non-tradable service sector, will face a de-industrialization in case of a boom in the resource manufacturing sector. This will be caused by a higher demand of labor in the resource sector due to price increases. Labor demand will then be satisfied by a movement of labor from other manufacturing sectors, leading to a deindustrialization there. This effect will be enforced via an increasing labor demand in the service sector through increased income caused by the resource boom. Apart from the labor movement argument, the commonly used explanation for the dutch disease effect is an appreciation of the currency due to windfall income caused by a price boom in the resource sector or simply the discovery of natural resources. This increase in prices leads to a loss of competitiveness in the non-resource manufacturing sector since it has to compete with world prices. Furthermore the labor price increases, due to the resource boom, while productivity does not. So competitiveness decreases. This again leads to a deindustrialization effect, weakening the economy.

Sachs and Warner (1995) show for a sample of 97 developing countries between 1970 and 1989, that countries with a high share of primary exports to GDP on average reach lower growth rates than resource poor countries. This effect stays robust even after controlling for other characteristics as income or trade openness. In following papers Sachs and Warner (1997, 2001) further control for geographical and climate factors to eliminate the possibility that a so far omitted variable may have caused low growth rates. The argument would be that another factor, e.g., geography is the reason that countries with a positive geographical surrounding grew faster and have now such a high income that the share of natural resources to GDP is relatively small so they are less resource dependent. Whereas countries with an unfavorable geography show low growth rates and thus today have a higher share of natural resources with respect to their income because income is so small (Sachs and Warner, 2001), they would seem more resource abundant. The authors conclude that on average an increase of the share of primary exports to GDP of ten percentage points would cause a reduction of growth by 0.33 percentage point per year (Sachs and Warner, 1997, p.14). Sachs and Warner (1995, 1999, and 2001) further show some evidence for the existence of the *dutch disease* as reason for the resource curse. They focus on the aspect of price increases in the home economy due to the higher income generated by the resource sector. As explained before, the boom in the resource sector leads to rising income which increases the prices of products produced with these factors, e.g., labor. This price augmentation then reduces the competitiveness of the other sectors and leads to a specialization of the economy solely on the resource sector. Countries with a higher share of primary exports to GDP indeed face on average a higher price level.[1] Furthermore the authors show that manufacturing exports tend to have a lower share in GDP in resource rich countries, which might be due to the effect of lost competitiveness through higher input prices.

The destructive effect of natural resource abundance on institutional quality, the second of the before mentioned transmission channels, has also been evaluated by different studies. Sala-i-Martin and Subramanian (2003) show in a case study for Nigeria that rather corruption and bad institutions have been the channels for the resource curse than dutch disease effects. Boschini et al.'s (2007) cross country analysis focuses on the interaction effect between natural resources and institutional quality with respect to growth. They conclude that if institutional quality is low, the negative growth effect of resource abundance becomes more important the better extractable the resources are. On the other hand, if institutional quality is good, these kinds of resources lead to the highest growth effect. As resource measure they use primary exports as share of GNP, ore and metal exports as share of GDP, mineral production as share of GNP and gold, silver and diamond production as share of GDP.
The negative effect of oil resources on democratization has been evaluated by Ross (2001). He shows that this effect is not limited to countries of the Middle East but indeed refers to all countries while poor countries are especially vulnerable. In a more recent paper Tsui (2010) supports these findings by analyzing oil discoveries and the effect they have on the democratization process in the respective countries. He shows that the discovery of 100

[1] Sachs and Warner (2001).

million barrels of oil, about the endowment of Iraq, reduces the democratization by around 20% over a period of 30 years.

Only few studies so far have looked at the human capital transmission channel. The most influential ones are Gylfason (2001) and Brunnschweiler (2001). Both analyses show a significant and negative effect of natural resource abundance on education, measured in expected years of female schooling (Gylfason) and total secondary gross enrollment (Brunnschweiler). These two analyses are however mainly based on correlation coefficients. Brunschweiler (2001) gives no empirical evidence to this significant negative relationship by estimations including different control variables. Nevertheless she reports conditional correlation coefficients, controlled for the effect of GDP per capita on education. As the used control factor is the average effect of GDP on education it neglects differing effects between countries.

Gylfason (2001) also bases his analysis on correlations. Additionally he presents some estimation results, showing that a ten percentage point increase of the share of natural wealth in total wealth of a country reduces secondary enrollment by about one percentage point. Using the share of natural capital in natural wealth in the year 1994 to explain the expected average schooling years for the period 1980 to 1997 seems however questionable.

Papyrakis and Gerlagh (2004) provide estimations testing for the significance of the different possible transmission channels between resource abundance and economic growth. The study includes estimations for the effect natural resource abundance has on corruption, trade openness, investment, terms of trade and schooling. Natural resource abundance is measured as share of mineral production in GDP 1971 and schooling is measured as log of average number of years of schooling 1970-1989. Reporting the results for a cross country regression on only 39 countries, the result for education is not statistically significant. While for the larger sample (47 countries) the result is significant on the 5% level, results are not reported. The analysis uses cross country estimation where years of schooling depend on the resource abundance in 1971. Using the resource abundance measure for only one year however might lead to errors in the estimation as resource abundance measured is then very dependent on the actual size of GDP and the resource prices in the respective year. Furthermore Gerlagh and Papyrakis fall short of explaining why they prefer this measure, originally used by Sachs and Warner (2001) in a discussion paper. Sachs and Warner discuss the weaknesses of this measure and why they would prefer another measure then they ultimately use in their published paper. The authors discuss, that the measure then used by Gerlagh and Papyrakis has no good coverage of poor countries and often reports guesses rather than actual figures.

Other research has shown that the level of education in resource rich countries is decisive for the growth path they will achieve. Bravo-Ortega and Gregorio (2007) compare the development of Latin American resource rich countries to Scandinavian ones. While in the early years of the last century the per capita income was higher in Chile and Argentina than in the Scandinavian countries, in the following years they fell back in their development with regards to the Nordic countries. The authors trace this back to the difference of educational attainments between the two country groups. While the Scandinavian countries had reformed their education system and land distribution, the Latin American countries failed to do so

which led to an unequal access to schooling in the latter. Bravo-Ortega and Gregorio show that natural resource abundance in combination with low levels of human capital, i.e., education, will reduce economic growth in the respective country while higher levels of education will offset the negative effect of resource abundance and lead to higher growth rates. This result is on the one hand positive, showing that with a sufficient level of education the negative effect of natural resources will be outweighed. On the other side, taking into account the results of Gylfason (2001) and Brunnschweiler (2001) that resource rich countries underinvest in their human capital, natural resource countries are more probable to have lower economic growth rates then they are supposed to have.

Stijns (2006) gives new input to the literature on natural resources and human capital is provided. He focuses on different measures of natural resource abundance, stressing as well the argument that results will depend on the measure of natural resources. While his presentation and criticism of a whole bunch of possible measures gives a good overview, the paper falls short to provide a thorough analysis on the relationship between these measures. Instead, Stijns as Birdsall and Brunnschweiler limits his analysis to the provision of linear correlations between measures.[2] These correlations show a mixed picture: most of the broad measures for resource abundance i.e., not reduced to metal and fuel resources show a significant negative effect on the different measures of education. The more focused resource measures however stay insignificant and change their signs.

In recent years a growing number of studies appeared that contradict the story of the resource curse. They argue that natural resources have a positive impact. This seems more intuitive given that the existence of natural resources means a higher wealth of the country.
Lederman and Maloney (2008) revise the resource curse literature. Referring to Leamy (1985) they use as proxy for resource abundance natural resource exports not as share of GDP but per worker. Further they include trade openness measures and estimate the impact of resource abundance not only on growth but on institutional quality as well. As measure for institutional quality they use constraints on the executive power provided by the polity IV database (Jagger and Marshall, 2002). In their quantile regression analysis they show for static estimations that the poorest countries (lowest quantile) have experienced the biggest positive growth effect due to resource wealth, while in the dynamic case it has been the richest countries. Here an increase of natural resource exports per worker by 1% led on average to a 1.1-1.9 percentage point increase of annual growth of GDP per capita. Though the results differ between the static and dynamic model, in no specification a significant growth reducing effect can be found.
In a recent paper, Pineda and Rodriguez (2010) analyze the effect of resource abundance measured as resource exports per worker on human development measured by the variables included in the human development index. While for most of the variables a significant and positive effect of natural resource export can be shown, the effect for secondary gross enrollment stays mainly insignificant.

[2] In an early working paper version Stijns provides estimation results showing a positive effect of natural resources on government education expenditure. However these estimations are no longer included in the published version.

The analysis will amend this literature by testing weather there indeed exists a transmission channel from natural resource abundance to low growth rates via low education. The transmission channel as such (see Bravo-Ortega and Gregorio, 2007) will not be investigated but whether there is a causal link between natural resource abundance and low education. Thereby the findings by Ross (2001) and others who conclude that natural resource abundance does deteriorate institutional quality and democratization will be taken up. This will be done via including a political quality measure to see whether it is rather bad institutional quality then resource abundance that reduces education, if education levels are lower in resource rich countries after all.

III. DATA

Explanatory Variables[3]

The main variable of interest is a country's endowment with natural resources. Two indicators are used to account therefor: resource rents per capita and resource reserves per capita. Resource rents per capita are provided via the World Bank's "The Changing Wealth of Nations" (World Bank, 2010a) and now available in its World Development Indicators as well. Rents are calculated as unit rents multiplied by the volume of the commodity extracted, while unit rents are the difference between the price per unit of the commodity and its extraction costs per unit. The price of the commodity is calculated as a world average of the commodities price. As the extraction costs are not universally available on a yearly basis, country specific measures have been used when available and regional averages and interpolated prices otherwise. Resource rents as measure for resource abundance are increasingly used in the literature lately (e.g. see Bhattacharyya and Hodler, 2010, De Soysa and Neumayer, 2007, or Collier and Hoeffler, 2009). Oil rents and gas rents separately will be used. Oil rents as share of GDP range between zero (572 observations) and 101% of GDP over the used sample. The mean oil rent is around 4.49% of GDP for the whole sample and slightly lower (4.22%) in the sample excluding high income countries. Gas rents are lower in the sample, the sample mean lies only at 1.13% of GDP and the maximum at 75.87%. As the variance is relative high logarithms of natural resource rents are used in the estimation to smooth the distribution.

The second measure for resource abundance are proven oil and gas reserves. This measure is provided via *British Petroleum's* (BP) *Statistical Review of World Energy* (BP 2011). According to BP the reserves reported are "those quantities that geological and engineering information indicates with reasonable certainty can be recovered in the future from known reservoirs under existing economic and operating conditions" (BP 2011, p.6 and p.20). With respect to other resource measures this variable has on the one hand the advantage that it really measures a countries endowment with natural resources and not its dependence. On the other hand as it measures only the endowment and does not reflect the income generated via the resource sector as other measures do. However as the BP statistics only contains proved reserves that are extractable with given technologies and reasonable costs, it probably reflects well the potential wealth a country can generate.

[3] An overview of the used measures and their sources is provided in appendix 2. Appendix 3 & 4 show descriptive tables of the used variables.

The second important explanatory variable is institutional quality. As has been shown in several studies (e.g. Tsui, 2010), resource abundance reduces institutional quality and democratization. This reduction of institutional quality going hand in hand with resource abundance might be an alternative channel for the common assumption of low education levels in resource rich countries. Political science literature has shown that governments that face a bigger winning coalition invest more in public social services, including education (Bueno de Mesquita et al., 2002). To control for this relationship two different institution measures are separately included. The first is a dummy variable indicating whether a country is a democracy or a dictatorship (Cheibub et al. 2009). According to the measure a country is a democracy if both chief executive and the legislature are popularly elected or elected via a popular elected body, more than one opposition party is existent and a change in power via elections has taken place already. Obviously the number of democracies is in developing countries significantly lower than in high income countries. Thus the mean value of the democracy dummy lies for developing countries at 0.39 while for the whole sample it reaches a value of 0.53. So while among developing countries only in about 40% of the observations a democracy was in place, in the whole sample it was in more than half of the cases and among high income countries even in 86% of the observations. A positive influence of democracy on the level of education is assumed. The second measure used to take account for institutional quality is the years a chief executive last in office (Beck et al., 2001). The longer a chief executive is in office the less likely it is that democratic rules are in place and the incumbent face reelection risks. So a negative relationship between the time in office and the education level is assumed.

As further control variables GDP per capita and public education expenditure as share of GNI are included in the analysis. GDP per capita measures the economic development and ability of a country.[4] The variable shows an extreme range over the sample with a minimum of 84 USD per capita (Democratic Republic of the Congo) and a maximum of 71.724 USD (The Bermudas). In the estimations GDP per capita will be used in logarithms to take account of this high variance. Higher income should have a positive effect on the education level.
Public education expenditure is derived from the national adjusted saving rates of the World Bank (World Bank, 2010b). It captures total current education expenditure like wages but no physical investments. Thus the measure is to some kind incomplete nevertheless it should be a good proxy for total education expenditure. Though one would assume that higher education expenditure leads to higher education the reason for the high expenditure might as well be the low level of education so that higher education expenditure is related to low schooling rates. In this sense Colclough and Al-Samarrai (2000) show that there doesn't exist a predetermined relation between education expenditure and schooling rates. They compare government expenditure for education between South Asia and Sub-Saharan Africa. Though the expenditure for education is lower in South Asia than in Sub-Saharan Africa, the enrollment rates are higher in the former. Furthermore even when expenditure was declining in South Asia, enrollment rates were raising. Public education expenditure lies on average at 4% of

[4] It can be argued that GNI would be more relevant for resource rich countries as the extraction licenses are often owned by foreign enterprises. However the correlation between GDP and GNI is around 0.99. In addition GDP has a wider coverage so it is preferred over GNI.

GNI in the sample. The highest share has Moldova, a country out of the non-rich sample with 10.29% in the mid-1990s.

Dependent Variable

The level of education will be measured by secondary gross enrollment rates provided via the World Development Indicators of the World Bank (World Bank, 2010b). Gross enrollment rates measure the ratio of pupils in a certain school type divided by the number of children in the age cohort for being in this type of school. Thus the measure gives an indication of the ratio of pupils receiving secondary education, however it gives no information on the quality e.g. repetition and graduation rates. These are well known flaws of the measure; nevertheless it gives good indication of the level of education in a society and is widely available.[5] On average countries have a secondary enrollment rate of around 64%, while the highest is 156% (Australia) and the lowest 1.85% (Burkina Faso). A ratio above 100% can be reached, when pupils are enrolled in secondary education that are not part of the respective age cohort.

Descriptive Statistics

As Figure 1 to 4 in the appendix show, the distribution of secondary enrollment differs between countries generating rents out of the gas or oil sector and those without income from these sectors. Furthermore a big difference in the patterns of developing and high income countries can be observed. The mean secondary enrollment rate for oil and gas rent producing countries lies at 73% and 76% while the mean for countries without these rents lies at 55% and 53% respectively (see Table1). When restricting the sample to developing countries only, the difference in the means reduces to 60% (oil producers) versus 42% (non-oil-producers) and 61% (gas producers) versus 43% (non-gas-producers). These differences are statistically significant and indicate that resource rich countries in contrary to the usual assumption have higher education levels than the resource poor countries. This statistically significant difference holds as well for the difference between countries with and without oil and gas reserves. However when restricting the sample to high income countries the difference between the resource rich and poor countries reduces and becomes insignificant for oil rents and gas reserves while it stays significant for oil reserves and gas rents.

When taking a closer look at resource rich countries only, the picture changes however. Figure 5 and 6 in the appendix show the relationship between resource rents and education separately for the two resources. Figure 5 illustrates that the relationship between oil rents and secondary enrollment among the resource rich countries is significantly negative ($\beta = -0.04$). For the gas sample the correlation is still positive however no longer significant.

Still these plots show only correlations and do not control for other effects as a countries wealth in general or its institutional quality. Furthermore these plots do only allow to compare between countries and not the development within the countries. The following section therefore orients towards a more rigorous econometric analysis.

[5] The dataset provided by Barro and Lee (2010) has a very wide coverage as well and includes measures for school completion. However the data includes five year averages, which would significantly reduce the number of observations.

Table 1: Mean Secondary Enrollment

	Type of Resource Measure	No Resource Sample	Resource Sample	Difference
All Countries	Oil Rents	54.58%	72.57%	**-17.99*** **
	Gas Rents	52.54%	75.52%	**-22.98*** **
	Oil Reserves	64.46%	69.10%	**-4.64*** **
	Gas Reserves	62.55%	73.63%	**-11.08*** **
Developing Countries	Oil Rents	42.23%	60.31%	**-18.08*** **
	Gas Rents	43.25%	61.41%	**-18.16*** **
	Oil Reserves	50.35%	58.31%	-7.96***
	Gas Reserves	49.69%	60.21%	**-10.52*** **
High Income Countries	Oil Rents	94.95%	93.82%	1.13
	Gas Rents	90.96%	95.73%	**-4.77** **
	Oil Reserves	97.34%	90.38%	**6.96*** **
	Gas Reserves	95.86%	94.25%	1.61

IV. METHOD AND RESULTS

For evaluating whether the resource endowment of a country has an influence on its education level, in the following panel data for up to 170 countries during the three-year period from 1970 to 2008 are evaluated. Some of the data are missing for certain country year combinations causing an unbalanced panel and different sample sizes for the inclusion of different control variables. As price volatility in the resource sector is quiet high and hence the volatility of resource rents, three year averages have been taken to smooth these effects. This approach has the further advantage to increase the variance of the dependent variable as enrollment rates do not change heavily from one year to the next. Accounting for the time needed for changes in the explanatory variables to become effective on the secondary enrollment rate, the explanatory variables are lagged by one period. The level of education of a society develops over time. Thus secondary enrollment rates are partly explained by their past values.[6] For this reason a dynamic panel is applied included the values of the dependent variable in the two previous periods. As country specific time invariant aspects are not included in the analysis, e.g. religious foundation that may have explanatory power for the level of education in a society, country fixed effects are needed to control for these possible omitted variables. Using a dynamic model with country fixed effects and a small time period causes the risk of inconsistent OLS estimators as the lagged dependent variable is correlated with the fixed country effects and thus correlated with the error term (Nickel, 1981). To eliminate this problem a GMM approach is used. This has the further advantage to take account of possible endogeneity of the other explanatory variables. This is especially serious with the main explanatory variable. Resource rents might be influenced via the education

[6] There is no problem of unit roots according to the Fisher unit root test.

level of a country as this might influence the costs of production that pour into the construction of resource rent measure. For oil and gas reserves this risk is reduced as these figures report the discovered resources but still applies. The amount discovered might depend on labor costs and thus on education in the country as well. Further the exploration of new oil and gas fields implies huge initial investment costs. Investors might be reluctant to do these investments if they fear expropriation, political unrest or the like. These risks might reflect a general non-development friendly governance structure that is also related to lower education levels. Though controlling for institutional quality not all of these effects might be captured.[7]

The following analysis will thus be based on the GMM estimator as proposed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). The two-step estimator written by Roodman (2005) that includes finit-sample correction derived by Windmeijer (2005) is used. As problems of endogeneity arise as well to the other control variables, in addition to the lagged dependent variable the control variables are employed as endogenous as well. Due to the large number of internal instruments the instrument matrix becomes large. To keep the number of instruments reasonable small the instrument matrix is thus collapsed as proposed by Roodman (2006).

Table 2 shows the results for the regression employing oil and gas rents as measure for resource abundance. Model 1 to 4 refer to oil rents while model 5 to 8 to gas rents. The Arellano-Bond test of second order autocorrelation indicates for all models the absence of autocorrelation, as is required for consistent estimations. Further the Hansen test on the validity of the instruments test does not reject the specification of the models. Model 1 and 5 test the effect of oil and gas rents on secondary enrollment without controlling for institutional quality. Resource rents do not show a significant effect on the dependent variable. The following models then control as well for institutional quality, a possible factor that might influence the effect of resource income on education as resource rich countries tend to have a lower institutional quality. However including these control variables does not change the coefficient of the resource rents nor their significance. In none of the specification the resource rent measure is significant.
Model 3, 4, 7 and 8 exclude public education expenditure as control variable since it is not significant and reduces the sample size. As assumed, the general wealth of a country measured by its GDP per capita does positively influence the level of education. Likewise the effect for institutional quality is as supposed. Democratic countries achieve higher enrollments rates while a higher duration of the chief executive in power has a significant negative effect on education.

[7] The law and order index of the International Country Risk Group does cover to some extent these effects; however it significantly reduces the sample due to a huge number of countries that are not covered by the index.

Table 2: Oil and gas rents as share of GDP and secondary enrollment, GMM

Dep. Var.: Log Secondary Gross Enrollment	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log GDP p.c.	**0.039****	0.028	**0.046****	**0.048****	**0.038****	0.022	**0.037***	**0.048*****
	[0.043]	[0.186]	**[0.045]**	**[0.012]**	**[0.046]**	[0.284]	**[0.067]**	**[0.005]**
Log Oil Rent (% GDP)	0.001	0.000	0.001	0.001				
	[0.465]	[0.647]	[0.217]	[0.129]				
Log Gas Rent (% GDP)					0.001	0.001	0.000	-0.000
					[0.513]	[0.520]	[0.627]	[0.784]
Democracy		**0.059****	**0.060*****			**0.054****	**0.062*****	
		[0.014]	**[0.006]**			**[0.038]**	**[0.004]**	
Years in Office				**-0.003*****				**-0.003*****
				[0.003]				**[0.002]**
Log Education	-0.026	-0.039			-0.032	-0.035		
Expenditure (% GNI)	[0.471]	[0.303]			[0.399]	[0.354]		
Log Secondary Gross	**1.314*****	**1.370*****	**1.318*****	**1.317*****	**1.323*****	**1.370*****	**1.342*****	**1.334*****
Enrollment (t-1)	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**
Log Secondary Gross	**-0.392*****	**-0.434*****	**-0.413*****	**-0.412*****	**-0.398*****	**-0.430*****	**-0.421*****	**-0.413*****
Enrollment (t-2)	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**
Constant	0.095	0.093	0.035	0.077	0.098	0.127	0.032	-0.011
	[0.342]	[0.372]	[0.729]	[0.473]	[0.317]	[0.273]	[0.788]	[0.928]
Observations	1,127	1,103	1,194	1,178	1,127	1,103	1,194	1,178
Countries	167	163	170	163	167	163	170	163
Number of Instruments	62	74	62	61	62	74	62	61
Arellano-Bond (Pr>z)	0.312	0.376	0.697	0.618	0.307	0.354	0.630	0.605
Hansen Test (Pr>chi2)	0.662	0.491	0.276	0.218	0.571	0.343	0.267	0.295

Note: Sample includes all countries; controlled for country and time effects; standard errors are clustered at the country level; P-value in brackets *** p<0.01, ** p<0.05, * p<0.1

Table 3: Oil and gas rents as share of GDP and secondary enrollment, GMM, excluding high income countries

Dep. Var.: Log Secondary Gross Enrollment	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Log GDP p.c.	**0.108*****	**0.110*****	**0.122*****	**0.110*****	**0.107*****	**0.094*****	**0.109*****	**0.120*****
	[0.004]	**[0.001]**	**[0.000]**	**[0.000]**	**[0.003]**	**[0.002]**	**[0.000]**	**[0.000]**
Log Oil Rent (% GDP)	0.001	0.001	0.001	0.001				
	[0.322]	[0.308]	[0.121]	[0.320]				
Log Gas Rent (% GDP)					0.001	0.001	0.001	-0.000
					[0.500]	[0.332]	[0.334]	[0.985]
Democracy		0.044	0.039			0.045	0.036	
		[0.142]	[0.174]			[0.172]	[0.258]	
Years in Office				**-0.002***				**-0.003****
				[0.099]				**[0.028]**
Log Education	-0.021	-0.052			-0.026	-0.046		
Expenditure (% GNI)	[0.630]	[0.281]			[0.508]	[0.313]		
Log Secondary Gross	**1.233*****	**1.255*****	**1.221*****	**1.225*****	**1.222*****	**1.257*****	**1.249*****	**1.229*****
Enrollment (t-1)	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**
Log Secondary Gross	**-0.343*****	**-0.369*****	**-0.351*****	**-0.343*****	**-0.335*****	**-0.364*****	**-0.358*****	**-0.339*****
Enrollment (t-2)	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**
Constant	-0.227	-0.220	-0.299*	-0.234	-0.201	-0.128	-0.281	-0.342
	[0.307]	[0.282]	[0.077]	[0.198]	[0.392]	[0.546]	[0.163]	[0.139]
Observations	781	770	834	817	781	770	834	817
Countries	123	122	127	121	123	122	127	121
Number of Instruments	62	74	62	61	62	74	62	61
Arellano-Bond (Pr>z)	0.245	0.397	0.658	0.506	0.231	0.335	0.527	0.517
Hansen Test (Pr>chi2)	0.891	0.888	0.663	0.503	0.933	0.788	0.483	0.567

Note: Sample excluding high income countries; controlled for country and time effects; standard errors are clustered at the country level; P-value in brackets *** p<0.01, ** p<0.05, * p<0.1

As has been illustrated in section three, the is a significant difference both between education levels in high income countries and developing countries and the effect natural resources have on education in the two samples. A sample excluding high income countries is therefore used for the estimations in Table 3. The model specifications stay the same as in Table 2. Excluding high income countries reduces the sample to a maximum of 127 countries. The test for second order correlation and the Hansen test both again accept the model specification. Reducing the sample to non-high income countries however does not change the significance of the resource measures. In the restricted sample there is still no evidence for a significant influence of resource wealth on secondary enrollment. Further the restricted sample reveals that for this country group income is more important for secondary enrollment than for the sample including high income countries. Whereas for the whole sample an increase of GDP per capita by 1% leads to an increase of secondary enrollment between 0.04% and 0.05%, in the restricted sample the effect slightly more than doubles to 0.1%. On the other hand for the poorer sample institutional quality plays a less important role. The democracy dummy is no longer significant while the coefficient for years in office reduces for the oil sample. If the chief executive stays one year longer in office the secondary enrollment rate on average decreases by 0.3%.

The first results have not shown a significant effect of resource wealth on education. The results rather indicate that institutional quality and income are decisive for a countries level of education, whereas both are influenced via resource wealth. In the following as alternative resource measure proven oil and gas reserves will be used. This measure reflects the natural endowment of a country with the two resources. It does not take into account to what extent the resources are already extracted. It can be rather seen as a savings account indicating the exploitable wealth. However according to these data, the number of resource rich countries reduces. Thus the World Bank data report resource rents for countries no reserves are reported for by the BP statistics.
The results for the whole sample (Table 4) again show no significant effect of natural resources on secondary enrollment. Now even GDP per capita loses its explanatory power in almost all specifications. However the effect of democracy increases. Changing from autocracy to democracy increases the secondary enrollment rate by 6.6% to 7.9%. Again the longer the chief executive stays in office the lower the secondary enrollment rate will be. When restricting the sample to non-high income countries, the effect of oil reserves per capita becomes significant. As the results in Table 5 show, when controlling for institutional quality, oil reserves per capita have a significant positive influence on secondary enrollment. A doubling of proven oil reserves will hence increase secondary enrollment by around 0.3%. Though a doubling of proven reserves is not a change of extraordinary magnitude, the effect of oil reserves on education is rather small. In contrast, gas reserves do still stay insignificant in the reduced sample. However the regressions give further support to the results of Table 3. For poorer countries income is more important for education than the political system. Again GDP per capita is significant throughout all specifications while democracy stays insignificant.

Table 4: Oil and gas reserves p.c. and secondary enrollment, GMM

Dep. Var.: Secondary Gross Enrollment	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log GDP p.c.	0.029	0.005	0.020	0.028	**0.036***	0.019	0.013	0.034
	[0.290]	[0.821]	[0.352]	[0.144]	**[0.077]**	[0.305]	[0.539]	[0.104]
Log Oil Reserves p.c.	-0.000	0.001	0.001	0.002				
	[0.947]	[0.735]	[0.759]	[0.208]				
Log Gas Reserves p.c.					0.001	0.001	-0.000	0.000
					[0.813]	[0.796]	[0.947]	[0.960]
Democracy		**0.073****	**0.079*****			**0.076****	**0.066****	
		[0.031]	**[0.004]**			**[0.014]**	**[0.021]**	
Years in Office				**-0.003*****				**-0.002****
				[0.010]				**[0.028]**
Log Education	-0.019	-0.050			-0.015	-0.057		
Expenditure (% GNI)	[0.690]	[0.270]			[0.770]	[0.186]		
Log Secondary Gross	**1.414*****	**1.465*****	**1.398*****	**1.353*****	**1.427*****	**1.448*****	**1.479*****	**1.411*****
Enrollment (t-1)	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**
Log Secondary Gross	**-0.441*****	**-0.469*****	**-0.436*****	**-0.402*****	**-0.461*****	**-0.472*****	**-0.483*****	**-0.449*****
Enrollment (t-2)	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**
Constant	-0.080	0.046	0.006	0.090	-0.077	0.015	-0.115	-0.076
	[0.742]	[0.782]	[0.970]	[0.510]	[0.707]	[0.930]	[0.359]	[0.583]
Observations	955	935	1,011	995	951	933	1,009	993
Countries	164	160	168	161	164	160	168	161
Number of Instruments	57	69	57	56	57	69	57	56
Arellano-Bond (Pr>z)	0.993	0.889	0.480	0.693	0.924	0.825	0.468	0.641
Hansen Test (Pr>chi2)	0.351	0.487	0.128	0.129	0.462	0.629	0.158	0.197

Note: Sample includes all countries; controlled for country and year effects; P-value in brackets *** p<0.01, ** p<0.05, * p<0.1

Table 5: Oil and gas reserves p. c. and secondary enrollment, GMM, excluding high income countries

Dep. Var.: Secondary Gross Enrollment	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Log GDP p.c.	**0.080****	**0.086*****	**0.105*****	**0.093*****	**0.091****	**0.100*****	**0.081***
	[0.015]	**[0.007]**	**[0.004]**	**[0.004]**	**[0.014]**	**[0.000]**	**[0.055]**
Log Oil Reserves p.c.	0.002	**0.002***	**0.003*****	**0.003****			
	[0.124]	**[0.062]**	**[0.000]**	**[0.045]**			
Log Gas Reserves p.c.					0.003	0.003	0.003
					[0.218]	[0.132]	[0.447]
Democracy		0.043	0.035			0.031	
		[0.196]	[0.305]			[0.372]	
Years in Office				**-0.003****			**-0.003***
				[0.014]			**[0.059]**
Log Education	-0.007	-0.049			-0.064	**-0.086****	
Expenditure (% GNI)	[0.901]	[0.322]			[0.139]	**[0.031]**	
Log Secondary Gross	**1.227*****	**1.230*****	**1.216*****	**1.181*****	**1.174*****	**1.187*****	**1.245*****
Enrollment (t-1)	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**
Log Secondary Gross	**-0.326*****	**-0.333*****	**-0.338*****	**-0.306*****	**-0.297*****	**-0.314*****	**-0.349*****
Enrollment (t-2)	**[0.000]**	**[0.000]**	**[0.001]**	**[0.002]**	**[0.001]**	**[0.000]**	**[0.001]**
Constant	-0.026	-0.016	-0.114	0.023	0.077	0.054	0.018
	[0.840]	[0.895]	[0.331]	[0.895]	[0.777]	[0.818]	[0.973]
Observations	654	643	699	683	650	641	681
Countries	120	119	125	119	120	119	119
Number of Instruments	57	69	57	56	57	69	56
Arellano-Bond (Pr>z)	0.985	0.732	0.346	0.579	0.928	0.645	0.561
Hansen Test (Pr>chi2)	0.684	0.710	0.276	0.410	0.769	0.821	0.481

Note: Sample excludes high income countries; controlled for country and year effects; P-value in brackets *** p<0.01, ** p<0.05, * p<0.1

V. CONCLUSION

Do resource rich countries indeed neglect education and thus are poor by choice? As it was already argued in the beginning, it doesn't seem plausible, why governments should decide to not invest in education if they have sufficient income. However this question has so far not intensively been studied especially not with taking into account the possible institutions channel. The study at hand has investigated this question via a dataset for some 160 countries over a period of more than 30 years. Using two different measures for resource endowment, rents as share of GDP and reserves per capita, it contradicts in its findings the transmission channel formulated by Gylfason (2001). The analysis has shown that oil and gas rents do have no significant effect on secondary enrollment, neither in the sample including all countries nor in the restricted sample excluding high income countries. The same holds true for the respective resource reserves. Only in the sub-sample excluding high income countries, oil reserves per capita show a significant influence on secondary enrollment. However in contrast to the predominant assumption in the literature the effect is positive. A doubling of proven oil reserves thus increases secondary enrollment on average by 0.3%.

The results do further show that in poorer countries income plays a more important role for education than in the group of countries including high income countries. Increasing the GDP per capita by 10% leads to an increase of secondary gross enrollment of 1%. On the other hand democracy seems to be less important in poorer countries. However the results for the whole samples including high income countries do support the findings of Bueno de Mesquita et al. (2002). Accordingly turning from dictatorship to democracy increases secondary enrollment by up to 8%.

This analysis gives evidence that neglection of education is no transmission channel of the resource curse. Resource rich countries do not seem to hurt themselves and reduce their growth by not investing in the education of their population. However if oil wealth has a long term negative effect on democratization as has been shown by Ross (2001) and Tsui (2010), this in turn might in the long run have a negative effect on education. Then resource wealth would indeed indirectly via institutional quality influence the level of education. Nevertheless in the short term there is no evidence for a negative effect of natural resources on education.

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VII. ANNEX

Annex 1: Average GDP per Capita growth 1980-2009

Algeria	0.46%
Angola	2.67%
Ecuador	0.97%
Iran	0.93%
Iraq	2.80%
Kuwait	-1.40%
Libya	2.22%
Nigeria	0.77%
Qatar	3.44%
Saudi Arabia	-1.45%
United Arab Emirates	-1.23%
Venezuela	-0.17%
OPEC total	0.83%
World	1.32%
Low Income Countries	1.03%

Source: World Development Indicators 2010

Annex 2: Used variables and sources

Variable	Description	Source
Secondary Gross Enrollment	$\frac{\text{Number of pupils enrolled in secondary}}{\text{Number of pupils in age} - \text{class of secondary}}$	World Development Indicators, The World Bank (2010)
Oil and Gas Rents (% GDP)	Resource rents are calculated as: (Unit price – Extraction cost per unit) x Extracted volume Unit price is the world average price for the respective resource. Extraction prices are: 1)reported by the country or 2) imputed if not available for a given year 3)regional extraction costs if country specific information was not available	World Development Indicators, The World Bank (2010)
Oil and Gas Reserves per Capita	Proved reserves as reported by BP in its Statistical Energy Review 2011, transformed in million tonnes with respective conversion factor reported by BP. Million tonnes divided by total population	Statistical Energy Review, BP (2011); World Development Indicators, The World Bank (2010)
Democracy dummy	A country must fulfill all of the following four requirements to be coded as a democracy. 1. The chief executive must be chosen by popular election or by a body that was itself popularly elected. 2. The legislature must be popularly elected. 3. There must be more than one party competing in the elections. 4. An alternation in power under electoral rules identical to the ones that brought the incumbent to office must have taken place.	Cheibub et al. (2009)
Years in Office	Years the chief executive has been in office	The Database of Political Institutions , Keefer, (2010)
GDP per capita		World Development Indicators, The World Bank (2010)
Public Education Expenditure (% GNI)		World Development Indicators, The World Bank (2010)

Annex 3: Descriptive statistics, three year averages, whole sample

Variable		Mean	Std. Dev.	Min	Max	Obs.
Secondary Gross Enrollment	overall	64.26	32.93	1.85	156.70	N=1233
	between		31.64	3.62	152.32	n=178
	within		10.85	24.39	109.11	
GDP p.c.	overall	6836.15	9779.44	84.18	71724.76	N=1232
	between		9931.49	131.97	71724.76	n=178
	within		2484.55	-8267.17	27673.16	
Oil Rent (% GDP)	overall	4.49	11.29	0	101.28	N=1231
	between		13.28	0	94.54	n=177
	within		3.68	-18.20159	44.70	
Gas Rent (% GDP)	overall	1.13	4.56	0	75.87	N=1231
	between		4.43	0	40.79	n=177
	within		2.34	-23.34955	36.21	
Oil Reserves p.c.	overall	0.10	0.65	0	7.84	N=1135
	between		0.69	0	6.49	n=178
	within		0.17	-2.43	2.92	
Gas Reserves p.c.	overall	0.00	0.01	0	0.23	N=1132
	between		0.01	0	0.19	n=178
	within		0.00	-0.04	0.04	
Democracy	overall	0.53	0.49	0	1	N=1209
	between		0.44	0	1	n=171
	within		0.23	-0.31	1.33	
Years in Office	overall	7.52	7.64	1	45	N=1193
	between		6.41	1.67	38.00	n=163
	within		4.87	-16.94	35.47	
Education Expenditure (% GNI)	overall	4.14	1.65	0.58	10.78	N=1147
	between		1.52	1.12	9.37	n=168
	within		0.70	1.61	8.28	

Annex 4: Descriptive statistics, three year averages, non-high income sample

Variable		Mean	Std. Dev.	Min	Max	Obs.
Secondary Gross Enrollment	overall	51.10	28.91	1.85	112.62	N=857
	between		29.03	3.62	107.92	n=131
	within		10.51	16.04	95.95	
GDP p.c.	overall	1674.98	1695.44	84.18	9995.97	N=856
	between		1847.83	131.97	9995.97	n=131
	within		463.07	172.44	4329.87	
Oil Rent (% GDP)	overall	4.22	10.58	0.00	101.28	N=856
	between		12.62	0.00	94.54	n=131
	within		3.42	-18.47	33.73	
Gas Rent (% GDP)	overall	0.93	4.44	0.00	75.87	N=856
	between		4.24	0.00	40.79	n=131
	within		2.30	-23.55	36.01	
Oil Reserves p.c.	overall	0.02	0.07	0.00	0.98	N=783
	between		0.11	0.00	0.98	n=131
	within		0.02	-0.19	0.23	
Gas Reserves p.c.	overall	0.00	0.00	0.00	0.00	N=780
	between		0.00	0.00	0.00	n=131
	within		0.00	0.00	0.00	
Democracy	overall	0.39	0.48	0	1	N=845
	between		0.41	0	1	n=128
	within		0.26	-0.46	1.19	
Years in Office	overall	8.15	7.95	1	45	N=828
	between		6.60	1.67	38	n=121
	within		5.14	-16.31	36.10	
Education Expenditure (% GNI)	overall	3.86	1.67	0.58	10.78	N=796
	between		1.53	1.12	9.37	n=124
	within		0.74	1.33	8.00	

Figure 1: Histogram of secondary enrollment for countries without oil rents (0) and countries with oil rents (1) for all countries, developing countries and high income countries

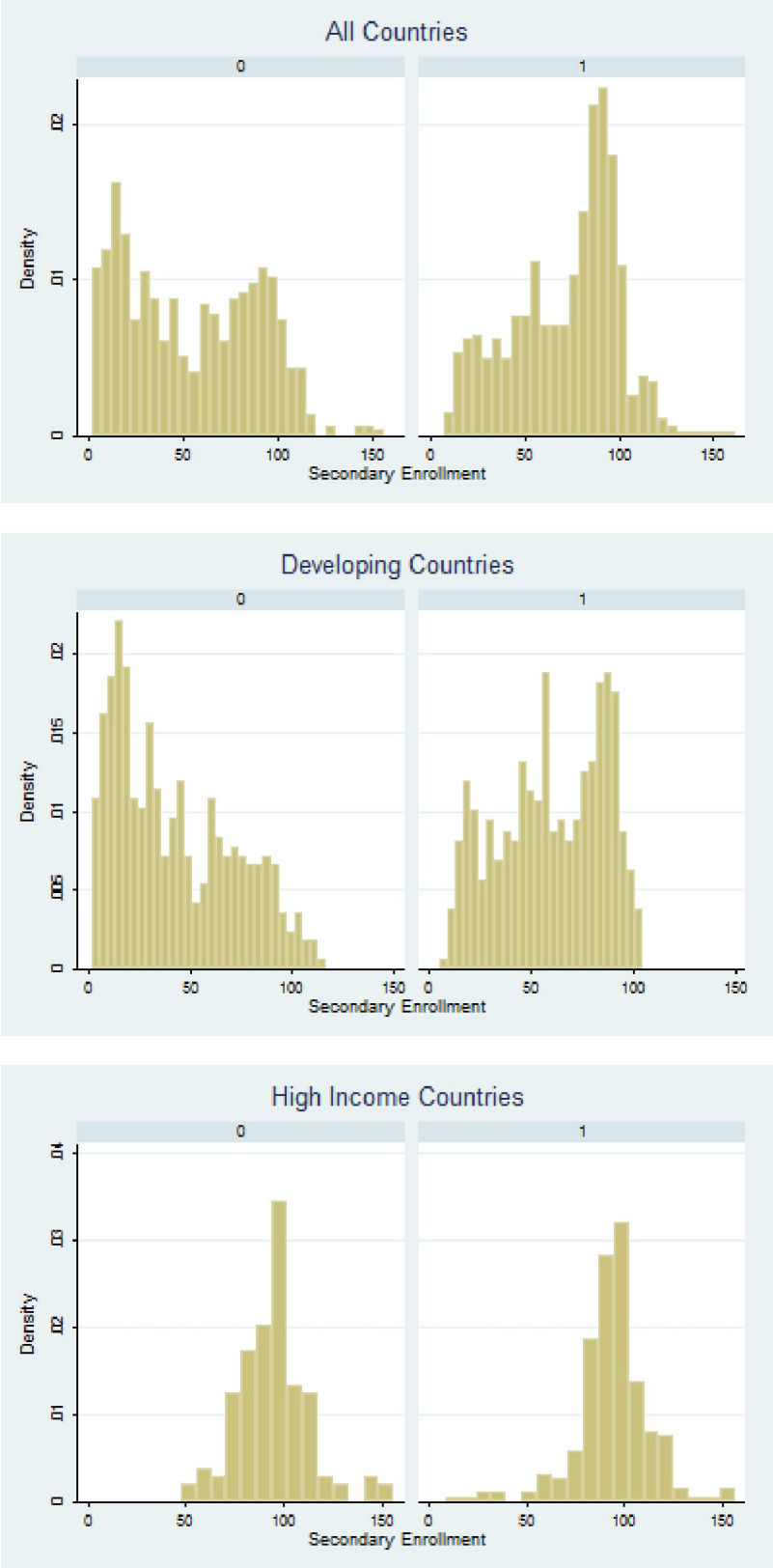

Figure 2: Histogram of secondary enrollment for countries without gas rents (0) and countries with gas rents (1) for all countries, developing countries and high income countries

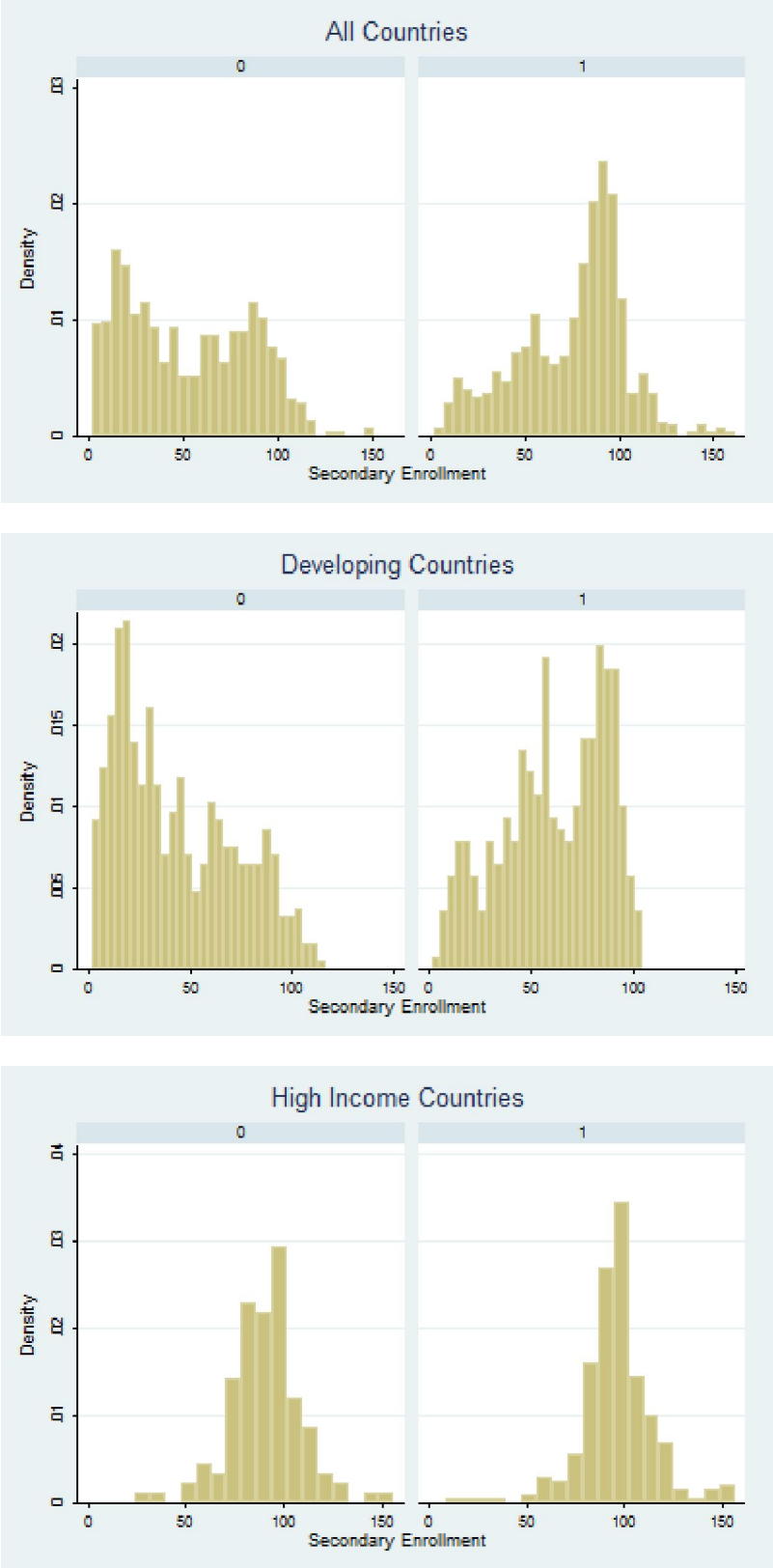

Figure 3: Histogram of secondary enrollment for countries without oil reserves (0) and countries with oil reserves (1) for all countries, developing countries and high income countries

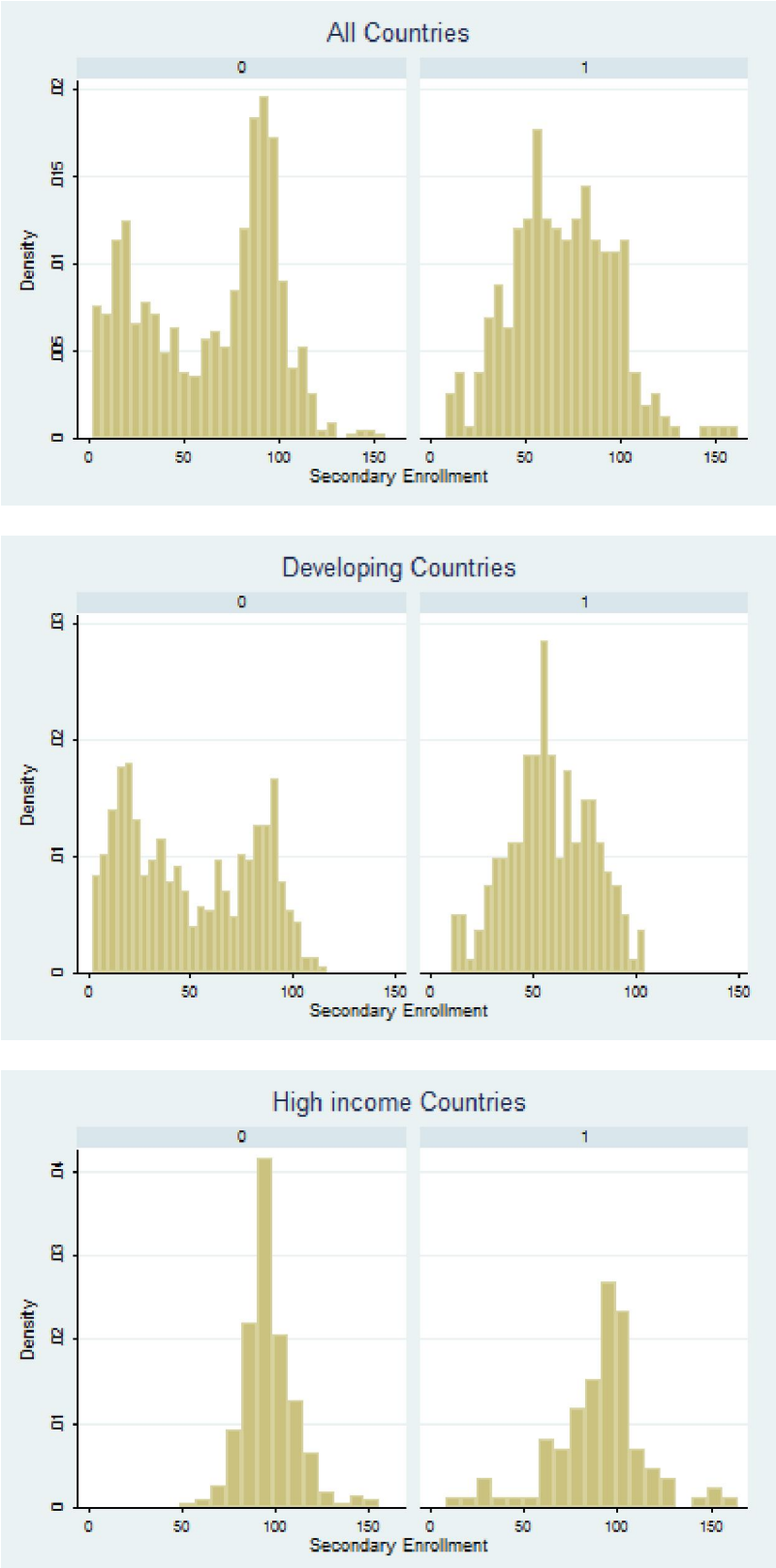

Figure 4: Histogram of secondary enrollment for countries without gas reserves (0) and countries with gas reserves (1) for all countries, developing countries and high income countries

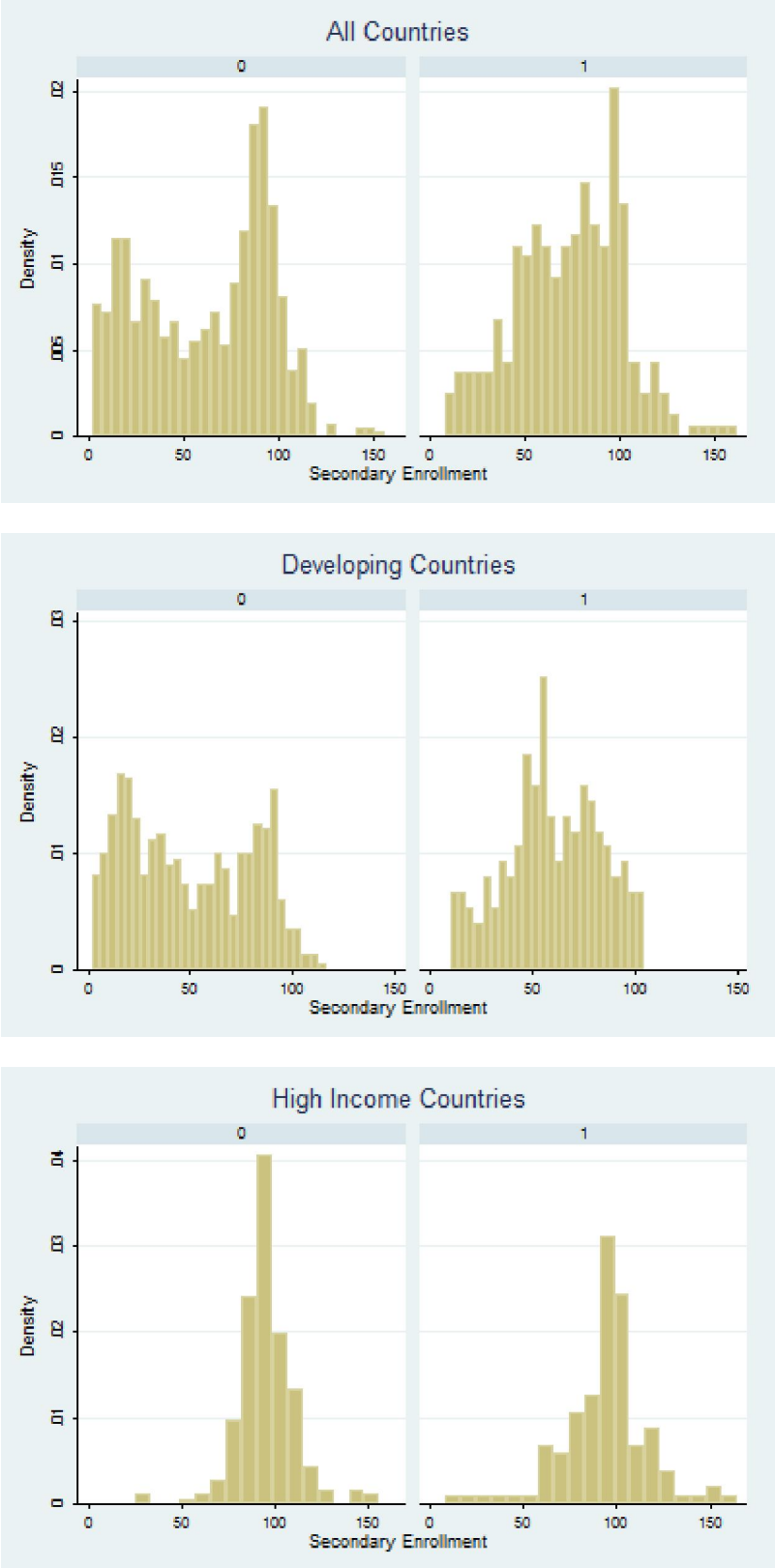

Figure 5: Scatterplot of log secondary enrollment and log oil rents to GDP

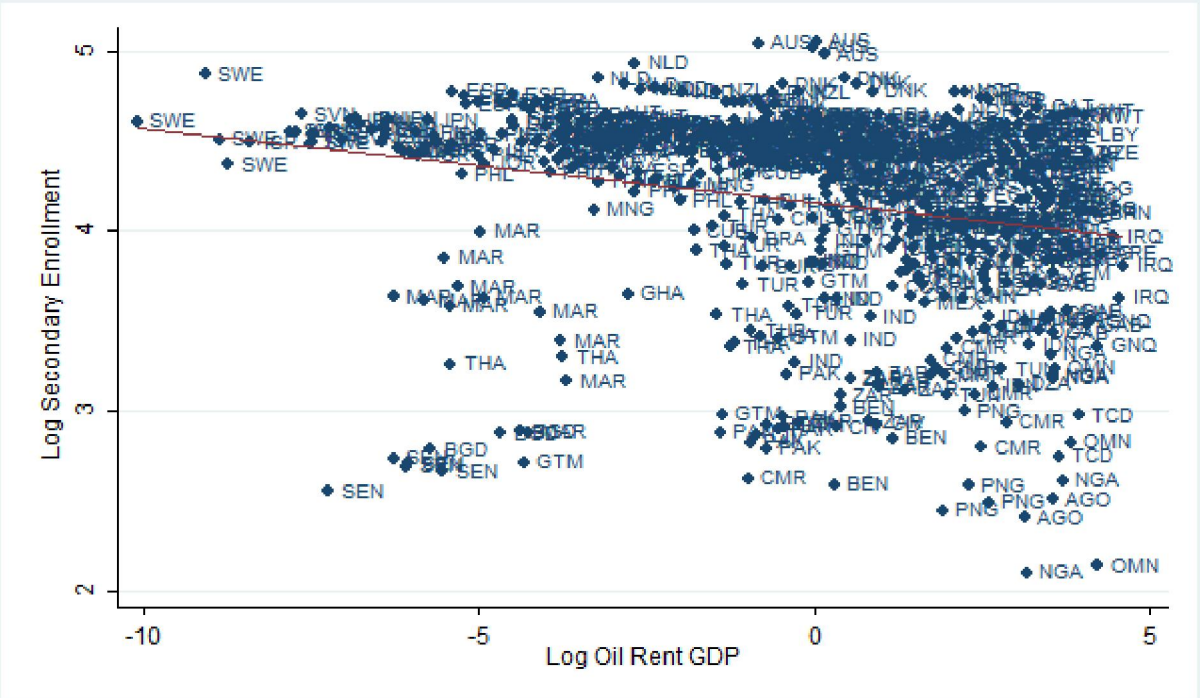

Figure 6: Scatterplot of log secondary enrollment and log gas rents per capita