Income Inequality and Natural Resources

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Abstract

The observation that countries highly endowed with natural resources often struggle with undesirable economic (e.g. low growth) and social problems has produced a large body of literature on the so-called resource curse over the last decades. One possible relationship that has been investigated is, whether resource abundance affects income inequality. This has been scrutinized to a much lesser extent than the effect on growth, and moreover, no agreement has been reached concerning the direction of the effect, given that it exists. This paper uses the Standardized World Income Inequality Database, the largest and probably most comparable dataset of Gini values, to determine the effect of resource abundance on income inequality. It dinstinguishes between a pure effect of resource abundance and an effect of resource intensity/dependence, a differentiation that has probably not received enough attention in the empirical resource curse literature in general. I examine whether resource abundance or resource intensity influences income inequality and whether the effect depends on the quality of institutions, which might turn a resource curse into a resource blessing. I find that neither resource abundance nor resource dependence influences income inequality significantly and that there is no effect of natural resouces that depends on the level of institutional quality.

Keywords: Inequality, institutional quality, point resources, resource curse, SWIID

Contents

1 Introduction

The question whether countries with access to a lot of natural resources might actually suffer from this natural wealth is one that has been debated heavily. Research has shown that abundance in natural resources is at least correlated with many undesirable developments such as lower growth, lower life expectancy or lower values in the Human Development Index. This so-called resource curse literature has vastly expanded over the last decades, and agreement on the potential negative consequences of resource abundance is widespread. However, not all indicators that might be connected to a lot of resources have received the same level of attention. This paper is going to examine the effect of natural resources on income inequality, a relationship that has been given far less attention than the impact on economic growth, for instance.

I test, empirically, the effect of point resources (locally concentrated resources such as fuels, metals, and minerals in contrast to diffuse resources such as agricultural products) on income inequality and whether it differs for varying extents of institutional quality. I distinguish between effects on income distribution of resource abundance and resource intensity. Therefore, I make use of a stock variable estimating the natural wealth of nations and a flow variable capturing natural resource exports. Consecutively, more and more control variables are added including interaction terms between natural resources and institutional quality to determine whether resources affect income inequality differently for varying levels of institutional quality. Thereby, I analyse whether countries with low institutional quality experience a "resource curse" while countries with high institutional quality experience a "resource blessing", an effect that has been demonstrated before for different indicators such as, for instance, growth. I contribute to the literature as this is the first paper to my knowledge that analyses the marginal effects of natural resources on income inequality for different levels of institutional quality for variables averaged over the observation period.

This paper is organized as follows. Section 2 gives an overview over both the theoretical and the empirical literature dealing with the resource curse in general and specifically its potential effect on income inequality. Section 3 describes the data and the empirical specification, section 4 presents the results, and section 5 concludes.

2 Literature Review

2.1 The Resource Curse in General

Among the literature dealing with potential negative consequences of ample endowment of natural resources, many studies have focused on the relationship between natural resources and growth. For instance, Sachs and Warner (1995) provide regressions of growth rates of developing countries in the 1970s and 1980s on resource abundance (measured by resource-based exports relative to GDP) and obtain a statistically significant negative impact. Sachs and Warner (1997) find the same negative relationship between natural resources and growth while Sachs and Warner (2001) provide evidence that this type of resource curse is not due to omitted geographic or climate variables. Doppelhofer et al. (2000) conduct a test determining the main driving variables of growth. They test 32 variables in total and find, among other variables, the fraction of primary exports to total exports to be robustly negatively related to growth, a result that was also reached in Sala-I-Martin (1997).

Over time, researchers also turned to the question how natural resource abundance affects other measures of well-being. For instance, Bulte et al. (2005) demonstrate a negative relationship between exports of point resources as a share of total exports and socially desirable indicators such as a high score on the Human Development Index or life expectancy. With respect to possible transmission channels, they find that resource abundance is typically connected to less productive institutions while countries with inefficient institutions tend to have lower values for the criteria mentioned above. Furthermore, there is at least some evidence that higher dependence on primary exports is connected to a higher likelihood of wars. Collier and Hoeffler (2002), for instance, conclude that dependence on primary exports increases the likelihood of conflicts (at least up to a certain point because a quadratic function was applied). A general anthology of this literature is given in Ross (2004) claiming that different types of commodities correlate with conflicts in different ways. For instance, he finds oil dependence to be linked to a high risk of the initiation of conflicts while agricultural commodities hardly have any connection to the initiation or duration of conflicts. In a way, this replicates the finding of Bulte et al. (2005) where it was also suggested that point resources are more prone to induce socially undesirable consequences.

The resource curse literature as a whole has grown quite large over the years and the examples I gave are merely a small fraction of the various relationships between natural resources and all sorts of social and economic indicators that have been covered. It should be noted though that the perception of natural resources as a curse is not unchallenged. First, research on so-called transmission channels has claimed and demonstrated empirically that natural resources might not have negative consequences per se, but only via different variables, which they affect negatively and which eventually lead to undesirable consequences. Papyrakis and Gerlagh (2004), for instance, discuss and investigate possible channels through which natural resource abundance could impede growth. They find that, although resource abundance affects growth rates negatively, once indirect effects (decreased investment following natural resource abundance is found to be the most important one) are removed, it affects growth rates positively. Gylfason (2001) investigates the same relationship and finds less schooling to be one of the channels through which resource abundance affects growth rates negatively.

Second, it has been argued by several authors that the effect of natural resources might depend on other variables (a resource curse might, for instance, be turned into a resource blessing in the presence of "good" institutions). For instance, Mehlum et. al. (2006) and Boschini et al. (2007) both find that the negative impact on growth disappears for a sufficient degree of institutional quality. And third, a crucial point is how natural resources are measured. It has been argued that many conventional variables measure rather resource dependence or intensity than resource abundance (examples include, for instance, Sachs and Warner (1995), Doppelhofer et al. (2000) (from above) that focus on export shares of natural resources as well as research on income inequality, which is discussed subsequently). Taking the share of natural resources in exports or GDP is criticized, for instance, in Brunnschweiler and Bulte (2008), as it might suffer from endogeneity (people decide how much to extract and how much time to spend on other activities). This would not be the case if the stock of natural resources was measured, which would lead to a variable that is as exogenous as it gets. Treating resource dependence (measured as GDP share of natural resource exports) as an endogenous variable, Brunnschweiler and Bulte find no effect on growth while resource abundance (subsoil asset estimates by the World Bank were used) is actually found to affect growth rates positively.

2.2 Resource Abundance and Wage Inequality

Turning to the potential effect of natural resources on income inequality, I am going to discuss both theoretical and empirical papers that deal with this relationship. Theoretically, Leamer et al. (1999) ask why Latin American countries have particularly high levels of wage inequality and hypothesize that having a product mix that relies mainly on natural resources (in this case land), as it is common for Latin American countries in contrast to Asian countries (that have a product mix that relies more on manufacturing), is responsible for increased wage inequality. The idea is that land-scarce countries (like many Asian ones) require a lot of machinery and thus, also a lot of human capital to build it. This human capital is distributed more equally among people than land and so is wage. Also, due to the shift to manufacturing, a sector in need of many educated workers, raw labor becomes scarcer, and workers get higher salaries.

Over time, this leads to a more equal distribution of income. Land-abundant Latin American countries, however, do not undergo this process and attract physical capital instead of human capital. Thus, the danger is that these countries will end up with a poor educational system (as a transmission channel since demand for human capital is low) and a lot of uneducated workers driving up wage inequality. Empirically, the authors also demonstrate that land abundant countries do have both a less educated workforce and higher levels of income inequality. Even though this theoretical argument is about land in the first place, the same rationale (attraction of physical capital instead of human capital) can be applied to the exploitation of point resources that are analysed in this paper.

A different, albeit related theory was expressed in Sokoloff and Engerman (2000). They compare Latin American development with North American development and argue that the initial situation in Latin America gave rise to more inequality. Many Latin American countries had large crop plantations and used a lot of unskilled labor (and many slaves). The plantations were quite large and used economies of scale while a large part of the population was black and enslaved leading to considerable inequality in wealth. The favored elites then installed institutions that guaranteed them privileges (for instance, Sokoloff and Engerman (2000) mention that throughout Spanish America the right to vote depended on land ownership), which made inequality persist till today. In the same way, the North American countries, USA and Canada, adopted institutions that preserved a more equal power distribution (the authors mention, for instance, USA and Canada investing more into their schooling systems to promote literacy in the 19th century while, on the other hand, many South American societies had much lower rates of literacy till the beginning of the 20th century). Therefore, their paper suggests that natural resource abundance affects inequality through the channel of institutions. Again, the argument refers mostly to land but the idea (a minority benefitting from natural resources initially and setting up institutions to preserve this structure) can be easily extended to point resources.

The idea that initial endowments influenced inequality, which then gave rise to the development of institutions that favored the upper class, is also expressed in Engerman and Sokoloff (2002) and Engerman and Sokoloff (2005). Spilimbergo et al. (1999) develop a model that is similar to Bourguignon and Morrisson‘s (1990) (which follows subsequently). Spilimbergo et al. distinguish between 3 factors of production (land, capital, and skills) and rely on the assumption that land and capital can be accumulated without a limit and hence, can be concentrated to the highest degree while this is impossible for skills. Thus, they predict that countries that rely more on land will have higher inequality than countries that are more skilled labor abundant. The empirical testing is not relevant for our purposes, since they do not test minerals and oil but only arable land, but theoretically, the same case could be made for these commodities as well. Next, I will turn to empirical testings of the relationship between natural resources and income inequality and give an overview of the findings reached in previous research.

Table 1: Empirical Testings of the Relationship between Resources and Income Inequality

	Years Covered	Countries Covered	Results	Method
Bourguignon (1990)	1970	35 (mostly developing countries)	Income inequality increasing effect of mineral exports	OLS
Gylfason (2002)	1965-1998	87	Income inequality increasing effect of natural wealth	Averages*
Buccellato (2009)	1980-2004	122	Income inequality increasing effect of share of ores and metals exports	FE/RE/BE
Fum (2010)	1990-2004	95	Income inequality decreasing (increasing) effect of natural wealth for ethnically homogenous (heterogenous) countries	Averages*
Goderis (2011)	1965-1999	90	Income inequality reducing effect of resource booms in the short run and neutral effect in the long run	Pooled OLS/FE
Carmignani (2013)	1970-2010	84 (mostly developing and emerging nations)	Inequality increasing effect of natural wealth	Averages*
Parcero (2015)	1975-2005	<= 173 (Unbalanced panel)	Income inequality decreasing effect of mineral and fossil fuel extraction relative to GDP	Pooled OLS

* the values were averaged leading to only one observation per country; OLS= Ordinary Least Squares; FE=Fixed Effects; RE=Random Effects; BE=Between Effects

The earliest empirical testing of natural resources affecting inequality that I could find stems from Bourguignon and Morrisson (1990). Their paper develops a theoretical framework where income inequality depends (among other variables) on natural resources and finds empirical support for it. Mineral exports (measured by a dummy that takes on the value 1 if a country has mineral exports exceeding 5% of its GDP) decreased the share of the lower 40% or 60% of the people and increased the share of the upper 20% in the data. The authors hypothesize that this might be a historical relict because mineral resources “have always been concentrated in very few hands in the past history of those countries where exports of mineral commodities played an import role. Nowadays, however, those resources are most often publicly appropriated” (Bourguignon and Morrisson (1990) p. 1124). The authors thus hypothesize that the outcome might be different for a country where natural resources were found only recently.

Goderis and Malone (2011) develop a theoretical model that predicts a fall in inequality in the year of a boom in natural resource exploitation. This effect is predicted to vanish over time driving up inequality to its earlier level again. Empirically, they construct a commodity export price index including commodity prices and commodity exports for a base year (1990) for each country to identify natural resource booms, thus assigning each country a specific index (see Deaton and Miller (1995) for another application and detailed description of this approach). Malone and Goderis find empirical support for their claim that resource booms (especially oil and minerals) have an inequality reducing effect in the short run in developing countries while being neutral in the long run.

Gylfason and Zoega (2002) propose the following relationship. Natural resource abundance leads to both higher inequality and lower growth. The authors assume that wages are more unequal in the primary sector while this sector is also less conducive to growth than manufacturing. Thus, the more time people spend in the primary sector, the lower will a country‘s growth be and the higher its inequality. The authors find statistical support for their hypothesis that natural resource abundance both reduces growth and increases inequality. Natural resources were measured as the share of natural capital in national wealth following Cameron (1998). This type of measurement by the World Bank is actually the predecessor of the variable I am going to use for resource abundance and will thus be discussed in more detail in the data section. Fum and Hudler (2010) claim that resource abundance has an inequality increasing effect if a country is "ethnically polarized" (2010, p.360) while it has an inequality decreasing effect in "ethnically homogenous societies" (p.360). The authors also find empirical support for this idea. Natural resource abundance was again measured by the World Bank estimates of natural wealth. Buccellato and Alessandrini (2009) estimate the relationship by using export shares of ores and metals as a proxy for natural resource abundance but with many gaps due to missing observations. They use fixed effect, random effect, and between effect estimations to find an inequality increasing effect of ore and metal exports, which is statistically significant in most specifications.

Carmignani (2013) hypothesizes that income inequality could be a transmission channel through which resource abundance affects human development. He finds a significant inequality increasing effect of resource abundance measured as "total stock of oil, coal, gas and mined minerals divided by total GDP in 1970" (Carmignani 2013 p. 417). A different result was reached in Parcero and Papyrakis (2015). Interestingly enough, they find mineral abundance (measured as mineral resource and fossil fuel extraction relative to GDP) to be connected to decreased Gini values. The authors then include a measure for the democratic quality of institutions as well as an interaction term between institutions and natural resources because "better" institutions could be connected to a higher degree of redistribution (for empirical support see Lee (2005), who finds democracy in connection with public sector size inequality reducing). Parcero and Papyrakis (2015) find not only that more mineral abundance leads to less inequality but also that this effect is even stronger the "better" the institutions are. This line of argument is a variation of the idea of a resource curse turning into a resource blessing in the presence of "good" institutions.

Finally, there have also been case studies testing whether resource booms have influenced inequality for specific countries. Examples include Zabsonré et al. (2015) (no statistically significant indication that gold exploitation has either increased or decreased inequality in Burkina Faso), Howie and Atakhanova (2014) (who conclude that a natural resource boom in Kazakstan (mainly oil findings beginning around 1990) had an inequality decreasing effect on wages) and Marchand (2015) (who finds that gains from an energy resource boom in Canada from the mid 1990s to the mid 2000s increased wages in both the lowest (lowering inequality) and the highest (increasing inequality) wage deciles, thereby having an ambiguous effect on inequality).

Looking at the research, I conclude that, if at all, no comprehensive agreement has been reached in regard to the direction of influence that natural resources have on income inequality. In the following, I will turn to my own empirical testing and discuss next, which variables should be included and how these should be measured.

3 Data and Methodology

3.1 Income Inequality

For measurement of inequality, I apply the arguably most straightforward indicator, namely the Gini coefficient, which is bounded between 0 and 100 (0: no inequality; 100: highest inequality). The Gini coefficient is derived from the Lorenz curve and computed in the following way. The x-axis covers quantiles of the share of people relative to the whole population while the y-axis covers the income share these people receive relative to the income the whole population receives. Thus, a series of points is generated that lie all below or on the 45° degree line. Connecting these points yields the Lorenz curve while computation of the area between this curve and the 45° degree line, relative to the lower triangle between the two axes and the 45° degree line yields the Gini coefficient. Thus, the more bowed this curve is, the higher the Gini coefficient, and the closer the curve is to the 45° line the lower the Gini coefficient reaching 0 for complete equality (that is, the Lorenz curve and the 45° degree line coincide).

Two potential weaknesses of the Gini coefficient deserve mentioning: First, the Gini does not uniquely identify a given income distribution because for every Gini there are infinitely many possible distributions that lead to its value (only the area between the two curves has to stay the same). Therefore, while countries with similar Ginis can be said to have a similar degree of inequality, a similar distribution is not necessarily the case. Second, the Gini will get larger the more quantiles are used. If we think of a Lorenz curve that consists of one point only, it will be kinked once. If additional quantiles are introduced, either further downward kinks are applied or the curve stays exactly the same. Therefore, increasing the number of points building the Lorenz curve will never decrease, but almost always increase the area between the curves and thus, the Gini coefficient. Therefore, the cruder the estimation of the Gini, the more will income inequality be underestimated. These weaknesses should serve as a warning. Nevertheless, due to the widespread application of the Gini as a measure of inequality, it will be applied in this paper as well.

Following Parcero and Papyrakis (2015), I use data on the net Gini from the Standardized World Income Inequality Database (SWIID) (Solt (2016a)), which might be the largest database concerning income inequality data. The SWIID summarizes and standardizes measurements of the Gini from different datasets. Measurement of income inequality obviously differs across countries, which raises questions about comparability. Solt (2016a) addresses this problem in the following way (as can be read in more detail in Solt (2016b) and Jenkins (2015)). He defines a base variable, namely the Gini data from the Luxemburg Income Study (LIS), to which all other measurement series are tried to be harmonized. Observations that occur in more than one series are used to determine the relationships between the different series by regression. The obtained coefficients are then used to estimate missing data (that is then comparable to LIS data).

To address the uncertainty in generating these missing values, he uses repeated Monte Carlo simulations that use coefficients and standard errors from the afore mentioned regressions and generates 1,000 Gini values for each observation (from which 100 are reported in the data set). Consequently, if these 100 numbers differ greatly, it reflects a high degree of uncertainty in transferring the actual Gini measurements used to the LIS analogous measurement. Finally, Solt creates a moving average over 5 years where the current year counts twice to smooth the data and to alleviate potential measurement errors. If one then goes on with regression analysis of the Gini, 100 different regressions would have to be computed, and the final coefficients of the model would be determined by averaging them. As Jenkins (2015) points out, the coefficients would be the same if one had simply used the mean values of the Ginis. However, the standard deviations would be slightly different. With the help of an example, Jenkins determines, however, that these differences are small. Due to the fact that I am unfamiliar with Monte Carlo regression systems I will use the mean values averaged over the observation period and consider the slight imprecision in the standard errors as a minor problem compared to the many rather strong assumptions that have to be made. Furthermore, as Jenkins (2015) points out, earlier papers have used the mean values as well (e.g. Acemoglu et al. (2013) or Ostry et al. (2014)).

3.2 Choice of Controls

The question which variables should be considered driving forces of income inequality has already been dealt with in literature without necessarily turning to natural resources as one of the possible causes. For instance, Barro (2000) suggests GDP, schooling, regional dummies (for Latin America and Sub-Saharan Africa which are significant in his specification, however, indicating that these countries share other omitted characteristics), indices for institutional quality, and trade openness as determinants of wage inequality while he dismisses ethnic and religious heterogeneity due to lacking significance. Several other papers have identified more or less the same variables as important determinants of inequality as well (e.g. Gregorio and Lee (2002)). With respect to the relationship of our interest, I will give an overview over the control variables that were used in the earlier papers discussed in section 2.

Table 2: Choice of Control Variables in Previous Literature

	GDP	Schooling	Population	Trade openness	Exp. Price Index	Inst.	Fragmentation	Agr. share	Landlocked
Bourguignon (1990)	x	x		x				x	
Gylfason (2002)	x								
Buccellato (2009)	x	x	x	x					
Fum (2010)	x	x	x	x		x	x		x
Goderis (2011)	x	x			x	x			
Carmignani (2013)	x					x	x		
Parcero (2015)	x			x		x	x	x	

These studies reveal a rather homogenous picture, the only slightly unusual variable being the landlocked-dummy from Fum and Hodler (2010). GDP should be included most likely as a control variable, as did all previously mentioned papers, and it makes intuitive sense (for example, it might be that countries with a higher GDP have more capacities for redistribution). Many papers also tested the inclusion of GDP squared due to Kuznet‘s (1955) famous idea that inequality might at first rise and then decline again as countries become more industrialized. I am going to apply GDP per capita from the World Development Indicators (World Bank (2016)) averaged over the observation period. The GDP values will be logged though, since it is customary in empirical literature on income inequality to transform GDP to its natural logarithm (e.g. Parcero and Papyrakis (2015), Fum and Hodler (2010), Buccellato and Alessandrini (2009) and Goderis and Malone (2011)) and in order to allow for non-linearity.

Schooling was included in the majority of empirical papers. Theoretical justifications for the inclusion of a variable measuring education could be found in Sokoloff and Engerman (2000) or Leamer et al. (1999) (see the explanations in the literature review) and also empirically, its impact on inequality has been established previously (e.g. Barro (2000), Gregorio and Lee (2002)). However, it is debatable which exact variable should be used in order to proxy schooling. Goderis and Malone (2011) use average years of primary schooling of the population aged 15 and over. Buccellato and Alessandrini (2009) use "the share of people enrolled in the secondary school as a proxy for the access to education infrastructures" (p.11). Bourguignon and Morrisson (1990) use the rate of secondary school enrolment in 1960. Barro (2000) uses 3 different variables, namely the average years of education for people 15 and older for primary, secondary, and tertiary education. He finds more years in primary and secondary education income decreasing but more years in tertiary education income increasing, which indicates that having a single linear variable for education might be inappropriate. I am going to use average years of schooling for people at the age of 25 and older from the Human Development Report (United Nations (2016)) and address Barro‘s finding by including the square of education to allow for an increase in education to have an income inequality decreasing effect for low values of education and an income inequality increasing effect for high levels of education. Data on education refers to the start of the observation period in 1990 (with a few exceptions due to missing data that are mentioned in table 8 of the Appendix and that I consider a negligible imprecision, since human capital should not change rapidly).

Quality of institutions has been included a lot in resource curse literature as it was hypothesized that institutions might turn a resource curse into a blessing (e.g. Mehlum et al. (2006) for growth and Parcero and Papyrakis (2015) for inequality). For our purposes, it is of special importance due to the fact that I am trying to determine whether powerful institutions alter the effect of natural resources on inequality. A popular source for measurement of institutions are the two variables political rights and civil liberties from Freedom House. They have been used a lot to proxy institutional quality both in general (e.g. Scully (1988), who uses the above mentioned indices to test whether institutional quality affects growth rates) and for research on inequality (e.g. Chong and Gradstein (2007) who estimate the relationship between institutions and inequality).

The two indices are bounded between 1 and 7 where 7 is the highest degree of civil liberties/political rights. (Initially, it is the other way round. I have rescaled the values so that higher scores represent higher quality) According to Freedom House, countries that receive high values in the political rights category are characterized by free and fair elections, a competitive party landscape, real power of the opposition and representation of the interests of minority groups (Freedom House (2016)). One way how a higher value of this variable might be linked to inequality is that economically disadvantaged groups can affect wage distribution by voting for parties that are in favor of a more redistributive tax system, thereby decreasing inequality. Countries that receive high values of civil liberties are characterized by a high degree of freedom of expression, assembly, religion, etc., functioning and independent legal enforcement, and equality of opportunity for different groups in the country (Freedom House (2016), which contains a detailed description of the indicators responsible for the values of PR and CL received by each country). Equality of opportunity is an obvious channel through which institutions could affect income inequality negatively, so once again, it might be that countries with higher values on this scale have lower levels of income inequality.

In general, institutions are thought of as “the rules of the game” in a country and are considered to change at a slow pace most of the time. Thus, I will take values from the start of the observation period in 1990 assuming that they are still a reasonably close approximation of the situation in the country at the end of the observation period. I will also construct interaction terms between institutional quality and resource abundance. It might be, that resource abundance has a different effect on income inequality in countries with poor institutions than in institutionally more developed ones. One possible transmission channel could be that institutionally weaker countries see a rise in income inequality in the presence of resource abundance, since the economically disadvantaged do not profit from resource rents due to missing redistribution while strong institutions enable an inequality decreasing effect as resource rents get redistributed.

Indices for ethnic fractionalization have been included in 3 recent papers and yielded statistically significant results in almost all specifications. I will use Montalvo and Reynal-Querol‘s (2005) ethnic fractionalization index, which captures the possibility that two randomly drawn individuals from a population have different ethnical backgrounds. The index is given by
$ethfrag_i = 1 - \sum_{i=1}^{N} \Pi_i^2$ where Π_i is the share of an ethnic group in country i relative to the whole population and N is the number of different groups in that country. Thus, the index is bounded between 0 and 1, 0 representing perfect homogeneity. This index has also been chosen in two of the above papers (Parcero and Papyrakis (2015) and Fum and Hodler (2010)) and is a popular proxy for ethnic fragmentation in general.

The openness to trade and exports might further influence inequality, even though it is hard to argue a priori in which direction the effect should be expected to work. General empirical research on determinants of inequality has reached contradicting results here. While Ezcurra and Rodríguez-Pose (2013) found that increased economic integration lead to more regional inequality, Asteriou et al. (2014) found that globalization had an equalizing effect on wages. In the papers concerning natural resources and inequality no clear picture is established either, with the coefficients for trade openness or export shares occurring with both signs and being insignificant in many specifications. Nevertheless, since the idea that countries with a higher integration into world markets might differ in their characteristics is appealing, this variable will be kept. The openness to trade will be measured in a straightforward way again as exports and imports relative to GDP (similar to Parcero and Papyrakis (2015) and Fum and Hodler (2010)) and will be taken from the World Development Indicators (World Bank (2016)).

Agricultural share of GDP is a further variable that could affect income inequality in either direction. One might expect agragrian societies to be more equal, which is Parcero and Papyrakis‘

(2015) reasoning for including this variable (even though they find hardly any evidence at all for any significant direction). On the other hand, strong theoretical cases can also be made for an effect going into the other direction (see Leamer et al. (1999) or Sokoloff and Engerman (2000) in the literature review). Due to the fact that agrarian societies might share specific characteristics though, I choose to use this variable. Data on value added in agriculture relative to GDP come from the World Development Indicators (World Bank (2016)) as well.

The Export Price Index variable is specific to Goderis and Malone‘s (2011) paper and will not be applied here, since it is used to capture resource booms, a phenomenon that is not relevant for my specification. Moreover, evidence that a dummy variable for landlockedness is needed is weak (Sylwester (2004) is Fum and Hodler‘s (2010) motivation to include it. However, only a very small subset of countries in Sylwester‘s dataset was landlocked, so this variable might measure something else that is specific to these countries). Consequently, I choose to discard this variable. Finally, since GDP per capita is already included, I choose to discard a variable measuring population as well, which is also done by the majority of the previously mentioned papers.

3.3 Natural Resources

Finally, a choice has to be made concerning how to measure natural resource abundance and intensity. This paper focuses on point natural resources (oil, minerals, metals etc.), since these might have a different effect than diffuse resources such as land or forests because ownership of large quantities is arguably easier to establish and more likely to happen. Moreover, I try to make a distinction between resource abundance and resource dependence. For resource abundance I will apply the more recent of the two papers presenting the World Bank estimates (Cameron (1998) and Jarvis et al. (2011)) due to the larger country set covered by the latter. These estimates have been used previously (I mentioned Fum and Hodler (2010), Gylfason and Zoega (2002) and Brunnschweiler and Bulte (2008) as examples), and I am going to use the values for subsoil assets, since these refer to oil, gas, coal, metals, and minerals, which are the point resources I try to analyse. Still, the variable obviously relies on estimates concerning the actual amount of natural resources a country has, how difficult it is to extract them, what the optimal speed of extraction is, etc. and is thus prone to estimation errors. Additionally, in some cases it is simply not known how large a country's resources are, so even cruder assumptions have to be made, (e.g. in the absence of data on reserves it is replaced by world and regional data). Furthermore, extraction is capped at 25 years for most natural resources (see Jarvis et al. (2011) (especially Appendix A) for a detailed description of how the measures of natural wealth are created).

Nevertheless, I consider this a much better proxy for resource abundance than the share of primary exports or primary extraction, which arguably does not even measure resource abundance at all. One further point that has to be discussed is the fact that the data is from 2005 while the observation period starts in 1990. Obviously, it cannot be claimed that resource abundance in 2005 affects income inequality in 1990. However, it can be argued that natural wealth does not change too rapidly over time (and if it changes due to price changes, at least countries with similar subsoil goods will experience similar changes). Brunnschweiler and Bulte (2008) use data from 1994 and have a dataset that even goes back to the 1970s. However, the authors emphasize that the assumption that natural wealth tends to not change too rapidly "is supported by a high positive correlation with resource production data for the early 1970s: the countries which produced the most at the beginning of our observation period still had the richest resource stocks in the 1990s" (p.253). Therefore, I consider it justified to apply measures of natural wealth that refer to the year 2005.

In order to measure resource dependence, I combine the share of fuel exports relative to merchandise exports and the share of ores and metal exports relative to merchandise exports from the WDI (World Bank (2016)) (covering crude fertilizer, minerals, metalliferous ores, scrap, and non-ferrous metals) and average this share over the whole time period. The selection of these specific two series was made to mirror the selection of goods in the abundance variable as close as possible (see Brunnschweiler and Bulte (2008) for a very similar variable choice to distinguish between these two). This kind of variable is a very "classical" way to measure resource abundance in the resource course literature. However, as explained, it is probably more reasonable to label this variable resource dependence. I am going to test whether the application of either of the two natural resource variables makes a difference with respect to the effects on income inequality.

3.4 Estimation Procedure

I estimate the following two equations

$$GINI_i = \beta_0 + \beta_1 * nwealth_i + \beta_2 * PR_i + \beta_3 * CL_i + \beta_4 * PR_i/CL_i * nwealth_i + \beta_5' v_i + \varepsilon_i \quad (1)$$

$$GINI_i = \beta_0 + \beta_1 * resexp_i + \beta_2 * PR_i + \beta_3 * CL_i + \beta_4 * PR_i/CL_i * resexp_i + \beta_5' v_i + \varepsilon_i \quad (2)$$

where the Gini of country i is a function of either of the two measures of resource abundance and resource dependence, nwealth and resexp, the variables for institutional quality, political rights and civil liberties and a term capturing the interaction between resources and either PR or CL. V is a vector capturing all remaining control variables that will be added piecewise as the model is enlarged. The coefficients that are of special importance are β_1 measuring the direct effect of natural resources on income inequality and β_4 measuring how natural resources additionally influence income inequality in connection with high or low values of political rights or civil liberties. In order to be able to determine marginal effects of natural resources, only one interaction term will be added at a time. Consequently, I test both whether the effect of natural resources on income inequality depends on the level of political rights and whether it depends on the level of civil liberties (see section 3.2 or Freedom House (2016) for determinants of the values for these indicators).

The observation period ranges from 1990 to 2012 and part of the problem of missing observations is solved by taking the average over these years. This makes it possible to include countries that reported the Gini or one of the control variables not for all years but with gaps and therefore would be lost if gaps occurred in different years or if lags were required. Furthermore, some of the control variables are treated as constants over the observation period and thus would not gain from treating each observation per year separately. Finally, when treating each observation individually, one would have to choose for each x-variable the length and number of lags to account for possible delayed effects. Therefore, I find it more reasonable to have one observation per country over the whole period in an OLS regression. Data availability is a major concern, since for many countries it is very difficult to obtain values for both the Gini and all explanatory variables. Especially the absence of rich oil exporting countries (such as Saudi-Arabia, Bahrain or Brunei) is potentially concerning, since their inclusion might lead to very different results. The data set eventually consists of 105 countries from all continents (a detailed list can be found in Table 9 of the Appendix) and is thus a balanced selection representing many different parts of the world.

4 Results and Discussion

4.1 Regression Results

Table 3 reports the regression results using the variable capturing natural resource abundance. I start out with the baseline regression estimating the effect of natural resource abundance (nwealth) on income inequality with solely the logarithm of GDP as an additional control variable. It is confirmed that richer countries tend to have lower inequality (possibly due to increased scope for redistribution), as an increase in GDP by 1 percent is connected to a drop of the Gini by approximately 0.02527 points (using the coefficient instead of the accurate formula). However, the effect of resource abundance is far away from any conventional level of significance. The second specification introduces education, trade openness, ethnic fragmentation, and the share of agriculture as additional control variables. While GDP keeps its negative and significant impact, natural wealth still fails to have any significant effect. The share of agriculture enters the equation with a negative sign and is highly significant, as an increase in the share of value added in agriculture relative to GDP by one percentage point is connected to a decrease in the Gini by 0.324 points. Trade openness and ethnic fragmentation have little explanatory power. Education does have different effects on income inequality depending on its level, however, not in the direction expected. My data shows significant coefficients that rising levels of schooling have an inequality increasing effect for low levels of education and an inequality decreasing effect on inequality for high levels of schooling, a finding that is contrary to Barro‘s (2000) result. The inflection point is where the partial derivative of the equation with respect to education equals zero. Consequently, the model estimates an inequality decreasing effect of education when education is higher than roughly 6.67 years.

Next, I introduce regional dummies for Sub-Saharan-Africa (SSA), Latin America (LA), and Arabian countries (AL because I define Arabia as membership in the Arab League) as well as for Europe, Australia and North America (EANA) to capture similarities between fully developed industrial countries. LA is significantly positive (meaning that Latin American countries are characterized by higher inequality) while EANA is significantly negative (meaning that Australia, Europe and North America are characterized by lower degrees of inequality). AL is insignificant and so is SSA (which, however, becomes significantly positive at the 5% level in the 3 following equations).

Inclusion of regional dummies makes the influence of the other variables less pronounced (the exception being nwealth, which is significantly negative at the 10% level. However, this result should probably be attributed to chance, given the absence of significance in all other specifications).

Next, the variables PR and CL capturing institutional quality are introduced. Neither of them is significant while none of the significant variables changes its sign. Looking at table 11 of the Appendix the high correlation between the institution variables might indicate collinearity driving up standard errors and thus leading to insignificant p-values. However, adding only one of the variables at a time does not lead to significant estimates either (and is not reported here). Moreover, I computed variance inflation factors and found them to be below 10 for both PR and CL. Therefore, I conclude that collinearity is probably not an issue. Finally, I test for effects of natural wealth that depend on the extent of institutional quality. Specification 5 tests inclusion of the interaction term between political rights and natural wealth (PRres1) while 6 contains the interaction term between civil liberties and natural wealth (CLres1). The marginal effect of an increase in natural wealth by 1 Dollar is now estimated as the coefficient of nwealth plus the coefficient of the interaction term times the value for political rights/civil liberties. Figure 1 and 2 report these marginal effects of natural wealth on income inequality for the different values of institutional quality. For both specifications, natural resources are predicted to decrease income inequality, the effect becoming smaller, however, with rising institutional quality. This is an unexpected finding as it contradicts the intuition of more powerful resources turning a resource curse into a resource blessing (given that one considers more equality a preferable outcome). Due to the fact that the 95% confidence interval includes 0, however, the marginal effect on natural wealth on income inequality is insignificant for all values of institutional quality for both cases.

A remark on the regional dummies is in order. Significance of regional dummies hints to the fact that important variables that take on similar values for geographically close (Latin America and Sub-Saharan Africa) or economically similar (Europe, North America and Australia) countries are missing. It is extremely difficult to define what these variables might be, since the ones used in this paper, which are identical to the ones used in previous empirical research, perform poorly in explaining income inequality. Evidence is strong that Sub-Saharan and Latin American countries have higher degrees of income inequality, while more industrialized countries have lower degrees (an effect that still persists, after controlling for many variables, such as GDP and institutional quality).

Table 4 contains precisely the same specifications, this time, however, including not nwealth but resexp as the variable of interest in order to measure the effects of natural resource dependence. The similarities to the previous results are astonishing. Just as resource abundance, exports of fuels, minerals, ores, and metals do a poor job in contributing to explain income inequality. The control variables behave more or less in the same manner as before (regarding both direction and significance). GDP and agricultural share are significantly related to lower Gini coefficients in the first specifications excluding regional dummies. Including them removes part of the significance, but GDP still remains significant at the 5% level. The mountain-shape of education is mostly maintained with varying levels of significance and the regional dummies are almost always highly significant (the exception being again Arabian countries). However, trade share, institutional quality and the variables of interest, resource exports and their interaction terms with political rights (PRres2) and civil liberties (CLres2) in the last 2 specifications remain insignificant (To be on the safe side, I computed variance inflation factors once more and found no worrying extent of collinearity). Again, marginal effects of resource dependence with respect to varying degrees of institutional quality for both political rights and civil liberties are reported in Figure 3 and 4. The result is very similar to the one obtained in the case of resource abundance. Natural wealth is found to be income inequality decreasing but to a lesser degree, the higher institutional quality is (for civil liberties it is even predicted to be inequality increasing for values 6 and 7). Again, however, the effects are far away from any conventional level of significance. While these results confirm that, in this case, distinguishing between resource dependence and abundance is not crucial, they also suggest, rather disappointingly, that neither of the variables affects income inequality significantly, neither by itself, nor in connection with different degrees of political rights or civil liberties.

Finally, I test whether these findings of no effects of either resource abundance or resource intensity on income inequality could be due to the inclusion of influential outliers that blur an effect that might be substantial otherwise. For this reason I perform robustness tests for both interaction terms and both resource variables by excluding countries that are influential, since they have either very high or very low values of resource abundance/intensity. Table 5 is concerned with resource abundance, where the first 3 specifications refer to the interaction of political rights and resource abundance while specifications 4 to 6 refer to the interaction between civil liberties and resource abundance. The first/fourth specification excludes countries that have subsoil assets per capita exceeding 20,000 USD, the second/fifth one excludes countries that have subsoil assets less than 100 Dollars per capita (and thus have only a negligible amount of natural resources), and the third/sixth specification includes a dummy variable (resabu) that takes on the value 1, if a country has subsoil assets exceeding 100 Dollars per capita (the same requirement as in 2). Thus, the effect is no longer measured as the amount of natural resources, but I test instead, whether there is an effect on income inequality for countries that have some level of resource abundance. This requires new interaction terms with the two measures of institutions and thus leads to the variables PRres3 and CLres3 instead of PRres1 and CLres1 in the last specifications. The differences to the initial set-up are negligible. The variables capturing resource abundance, institutions, and their interaction show similar behavior as before (the variable for resource abundance being negative and the interaction terms being positive with all of them being insignificant). Therefore, the missing significance in the initial set-up is probably not caused by influential outliers or due to the fact that a dummy variable captures effects of natural resources in a more appropriate way (I do not report marginal effects here due to lacking significance of the coefficients. The curves would resemble the ones before).

Table 6 refers to resource dependence, again 1 to 3 containing an interaction term between resource exports and political rights and 4 to 6 including an interaction term between resource exports and civil liberties. The first/fourth specification excludes observations that have resexp greater than 80, that is more than 80% of exports refer to fuels, ores, and metals. The second/fifth one excludes countries with resexp smaller than 3 and thus, countries that export these subsoil assets only in negligible quantities of less than 3%. The third/sixth specification uses a dummy variable (resdep) that takes on the value 1 if the share of exports of ores, metals, and fuels relative to merchandise exports exceeds 3% (the same requirement as in 2). It thus identifies countries that display some level of resource dependence and models this binarily, since it might be that countries, which depend on natural resources do differ in their income inequality, however not proportionally, so that a dummy captures the effect in a more appropriate way than the measure of total exports used so far (see Bourguignon and Morrisson (1990) for a similar measurement of natural resources). Again, the interaction terms have to be modified leading to an interaction term between political rights and resdep (PRres4) and one between civil liberties and resdep (CLres4) (For information on which countries are affected by the different exclusions see the list of countries in table 9 of the Appendix).

Again, exclusion of outliers into either direction and replacing the export share of natural resources by a dummy does not lead to a substantial gain in significance for the measures of natural resources or the interaction terms with institutions. Therefore, it can be concluded that neither natural resource abundance nor resource dependence has a significant influence on inequality, either with or without potential interaction effects with institutional quality.

Table 3: Effects of Resource Abundance

	(1)	(2)	(3)	(4)	(5)	(6)
lGDP	-2.527***	-5.019***	-2.141**	-2.527**	-2.438**	-2.264**
	(-5.899)	(-4.967)	(-2.137)	(-2.463)	(-2.270)	(-2.119)
nwealth	-3.88e-05	-2.15e-05	-4.27e-05*	-4.09e-05	-0.000143	-0.000323
	(-0.877)	(-0.896)	(-1.702)	(-1.514)	(-0.755)	(-1.484)
educ		2.922***	1.775*	1.880*	1.905*	1.943*
		(2.868)	(1.890)	(1.937)	(1.930)	(1.960)
educ2		-0.219***	-0.115	-0.125	-0.129	-0.136*
		(-2.719)	(-1.594)	(-1.629)	(-1.625)	(-1.694)
agr		-0.324**	-0.193	-0.180	-0.183	-0.185
		(-2.475)	(-1.501)	(-1.394)	(-1.403)	(-1.423)
trade		-0.000238	0.00333	0.00637	0.00591	0.00528
		(-0.0211)	(0.346)	(0.573)	(0.520)	(0.464)
ethf		3.075	1.047	1.284	1.459	1.783
		(1.052)	(0.438)	(0.531)	(0.592)	(0.726)
PR				0.673	0.635	0.665
				(0.872)	(0.797)	(0.851)
CL				0.113	0.106	0.0125
				(0.140)	(0.131)	(0.0156)
SSA			3.144	4.295**	4.255**	4.286**
			(1.656)	(2.484)	(2.463)	(2.459)
LA			6.022***	5.573***	5.504***	5.513***
			(3.997)	(3.486)	(3.411)	(3.428)
AL			-0.295	0.941	0.976	1.082
			(-0.104)	(0.321)	(0.332)	(0.366)
EANA			-9.301***	-9.682***	-9.809***	-10.04***
			(-3.965)	(-4.006)	(-3.980)	(-4.069)
PRres1					1.53e-05	
					(0.549)	
CLres1						4.26e-05
						(1.351)
Constant	59.79***	75.11***	53.75***	52.13***	51.73***	50.79***
	(17.43)	(7.641)	(5.872)	(5.600)	(5.450)	(5.334)
Observations	105	105	105	105	105	105
R-squared	0.261	0.453	0.617	0.627	0.627	0.630

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figure 1: Marginal Effects of Natural Resource Abundance for Different Levels of Political Rights

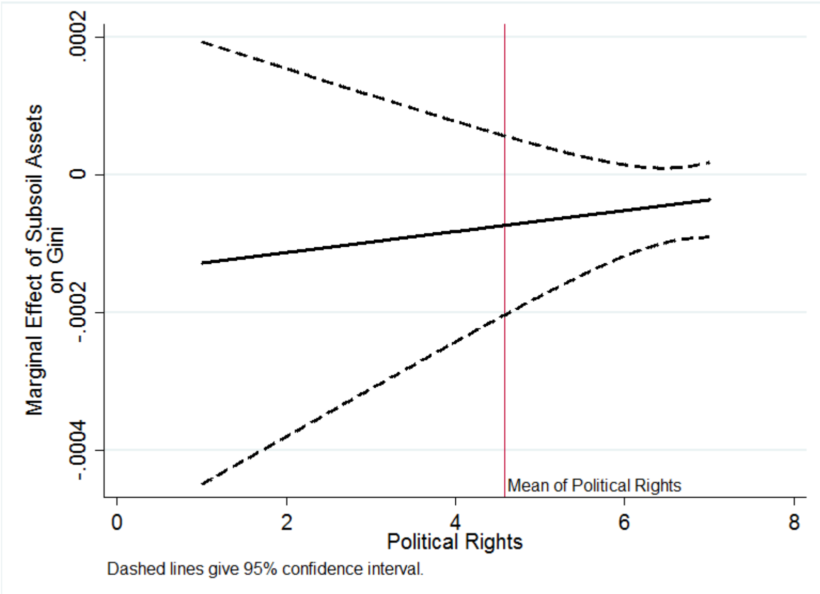

Figure 2: Marginal Effects of Natural Resource Abundance for Different Levels of Civil Liberties

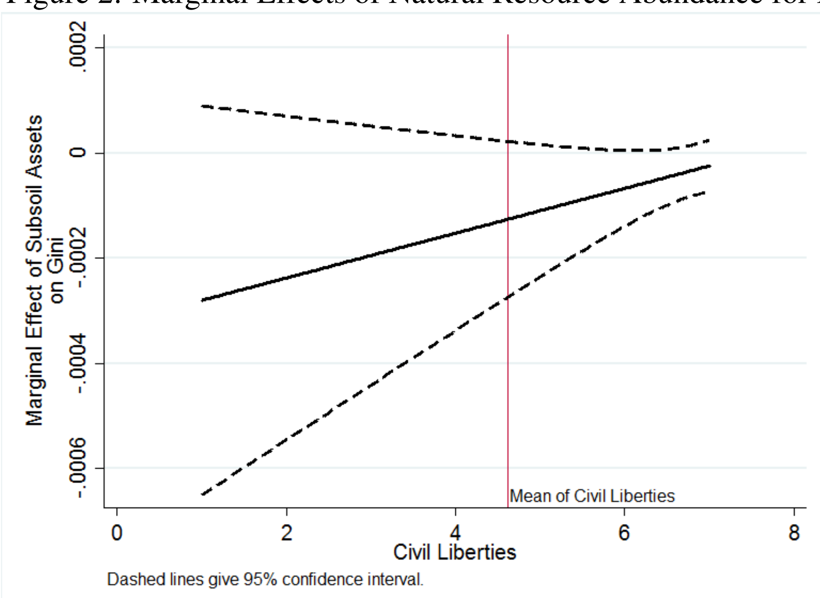

Table 4: Effects of Resource Dependence

	(1)	(2)	(3)	(4)	(5)	(6)
lGDP	-2.587***	-5.043***	-2.184**	-2.563**	-2.554**	-2.500**
	(-6.110)	(-5.002)	(-2.222)	(-2.538)	(-2.520)	(-2.478)
resexp	0.00561	-0.00464	-0.0202	-0.0179	-0.0353	-0.0721
	(0.208)	(-0.197)	(-0.766)	(-0.689)	(-0.684)	(-1.130)
ethf		3.090	1.490	1.669	1.711	1.826
		(1.027)	(0.585)	(0.661)	(0.684)	(0.734)
educ		2.962***	1.884*	1.976**	1.981**	2.011**
		(2.940)	(1.975)	(2.022)	(2.013)	(2.022)
educ2		-0.223***	-0.126*	-0.134*	-0.135*	-0.139*
		(-2.819)	(-1.747)	(-1.763)	(-1.761)	(-1.776)
agr		-0.323**	-0.195	-0.182	-0.185	-0.181
		(-2.481)	(-1.542)	(-1.431)	(-1.465)	(-1.438)
trade		-0.000261	0.00260	0.00592	0.00564	0.00591
		(-0.0227)	(0.262)	(0.521)	(0.503)	(0.531)
PR				0.703	0.624	0.713
				(0.898)	(0.763)	(0.897)
CL				0.0521	0.0510	-0.195
				(0.0635)	(0.0616)	(-0.221)
SSA			3.342*	4.457**	4.502**	4.604**
			(1.680)	(2.507)	(2.546)	(2.631)
LA			6.185***	5.716***	5.625***	5.633***
			(4.053)	(3.506)	(3.429)	(3.448)
AL			0.241	1.383	1.539	1.852
			(0.0760)	(0.437)	(0.475)	(0.565)
EANA			-9.184***	-9.547***	-9.499***	-9.412***
			(-4.045)	(-4.077)	(-4.044)	(-4.086)
PRres2					0.00413	
					(0.361)	
CLres2						0.0130
						(0.916)
Constant	60.01***	75.25***	53.90***	52.36***	52.70***	52.77***
	(16.39)	(7.658)	(5.975)	(5.711)	(5.786)	(5.908)
Observations	105	105	105	105	105	105
R-squared	0.258	0.452	0.617	0.626	0.627	0.629

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figure 3: Marginal Effects of Resource Exports for Different Levels of Political Rights

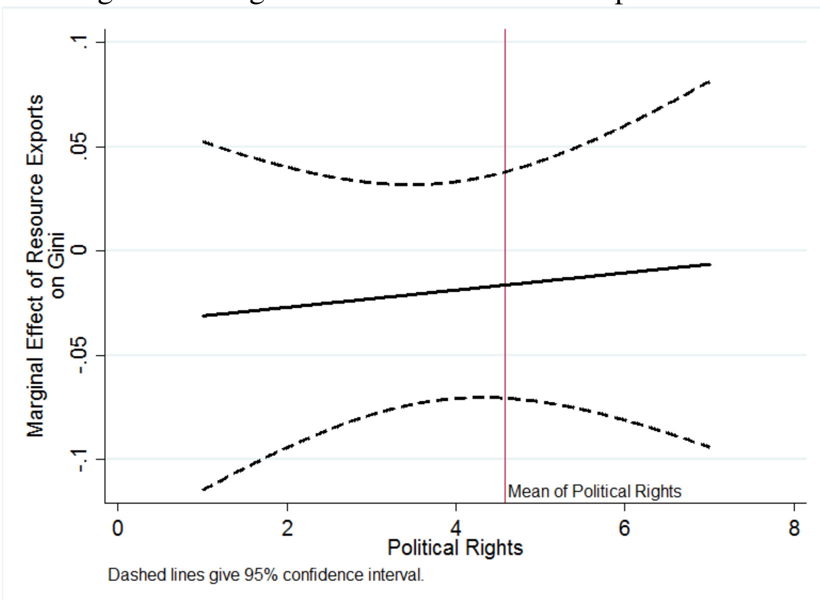

Figure 4: Marginal Effects of Resource Exports for Different Levels of Civil Liberties

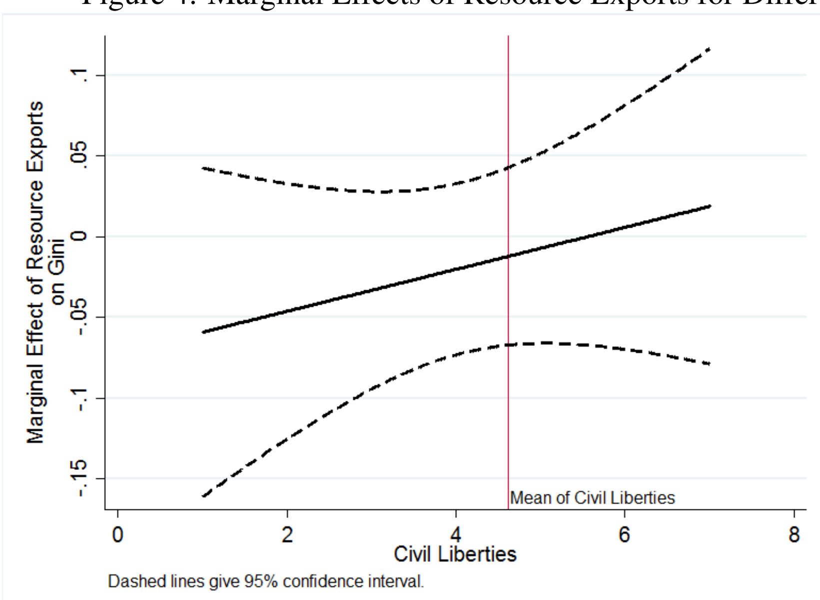

Table 5: Robustness Tests I

	(1)	(2)	(3)	(4)	(5)	(6)
lGDP	-2.175**	-2.389**	-2.592**	-2.128**	-2.075*	-2.570**
	(-2.048)	(-2.055)	(-2.609)	(-1.994)	(-1.858)	(-2.581)
nwealth	-0.000284	-0.000110		-0.000521	-0.000336	
	(-0.665)	(-0.487)		(-0.877)	(-1.448)	
ethf	1.628	2.002	1.302	1.652	2.785	1.372
	(0.620)	(0.596)	(0.540)	(0.629)	(0.849)	(0.570)
educ	2.159*	2.432*	2.062**	2.222**	2.374*	2.082**
	(1.988)	(1.921)	(2.137)	(1.999)	(1.905)	(2.151)
educ2	-0.165*	-0.147	-0.146*	-0.172*	-0.149	-0.150*
	(-1.717)	(-1.589)	(-1.882)	(-1.746)	(-1.610)	(-1.924)
agr	-0.180	-0.200	-0.187	-0.179	-0.215	-0.186
	(-1.380)	(-1.103)	(-1.530)	(-1.380)	(-1.185)	(-1.522)
trade	0.00664	-0.0150	0.00759	0.00621	-0.0119	0.00738
	(0.590)	(-0.747)	(0.718)	(0.550)	(-0.595)	(0.704)
PR	0.806	0.304	0.257	0.831	0.415	0.603
	(1.001)	(0.322)	(0.280)	(1.048)	(0.457)	(0.769)
CL	-0.0551	0.758	0.209	-0.125	0.465	-0.207
	(-0.0680)	(0.638)	(0.250)	(-0.156)	(0.395)	(-0.234)
SSA	4.355**	5.170**	3.888**	4.300**	5.144**	3.952**
	(2.264)	(2.234)	(2.097)	(2.246)	(2.220)	(2.175)
LA	5.336***	5.088***	5.341***	5.302***	4.963***	5.469***
	(3.168)	(3.303)	(3.430)	(3.172)	(3.294)	(3.437)
AL	0.802	-0.499	1.152	0.919	-0.211	1.149
	(0.266)	(-0.148)	(0.383)	(0.304)	(-0.0627)	(0.384)
EANA	-10.48***	-11.34***	-9.728***	-10.57***	-11.68***	-9.750***
	(-4.264)	(-3.748)	(-4.447)	(-4.296)	(-4.002)	(-4.482)
PRres1	5.83e-05	7.03e-06				
	(0.738)	(0.211)				
resabu			-2.680			-3.667
			(-0.932)			(-1.116)
PRres3			0.618			
			(1.108)			
CLres1				0.000103	4.07e-05	
				(0.981)	(1.194)	
CLres3						0.826
						(1.312)
Constant	49.53***	49.63***	53.73***	49.36***	48.26***	53.93***
	(5.189)	(5.136)	(5.947)	(5.166)	(5.112)	(5.943)
Observations	100	57	105	100	57	105
R-squared	0.622	0.772	0.629	0.623	0.776	0.630

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Robustness Tests II

	(1)	(2)	(3)	(4)	(5)	(6)
lGDP	-2.307**	-1.805*	-2.551**	-2.272**	-1.762*	-2.506**
	(-2.220)	(-1.853)	(-2.555)	(-2.191)	(-1.810)	(-2.502)
resexp	-0.0673	0.0277		-0.0880	-0.0113	
	(-1.012)	(0.596)		(-1.121)	(-0.225)	
ethf	1.543	2.301	2.235	1.639	2.271	2.246
	(0.610)	(0.995)	(1.010)	(0.648)	(0.983)	(1.008)
educ	1.890*	1.632*	1.990**	1.918*	1.610*	1.983**
	(1.798)	(1.756)	(2.084)	(1.829)	(1.723)	(2.060)
educ2	-0.139*	-0.124	-0.143*	-0.141*	-0.124	-0.144*
	(-1.670)	(-1.610)	(-1.851)	(-1.681)	(-1.594)	(-1.862)
agr	-0.193	-0.151	-0.187	-0.184	-0.155	-0.186
	(-1.504)	(-1.176)	(-1.534)	(-1.435)	(-1.213)	(-1.525)
trade	0.00667	-0.00735	0.00487	0.00741	-0.00732	0.00481
	(0.607)	(-0.625)	(0.445)	(0.669)	(-0.639)	(0.440)
PR	0.798	0.244	0.348	1.060	0.107	0.692
	(0.952)	(0.294)	(0.328)	(1.310)	(0.133)	(0.866)
CL	-0.208	0.577	0.210	-0.545	0.438	-0.222
	(-0.252)	(0.657)	(0.247)	(-0.623)	(0.500)	(-0.179)
SSA	5.120***	2.759	4.202**	5.094***	2.933	4.179**
	(2.900)	(1.222)	(2.408)	(2.870)	(1.311)	(2.381)
LA	5.527***	6.716***	5.684***	5.690***	6.588***	5.716***
	(3.281)	(4.292)	(3.492)	(3.351)	(4.285)	(3.498)
AL	2.806	-1.861	1.592	2.943	-1.630	1.546
	(0.771)	(-0.842)	(0.527)	(0.800)	(-0.739)	(0.513)
EANA	-9.928***	-9.993***	-9.051***	-9.855***	-9.713***	-9.068***
	(-4.155)	(-4.158)	(-4.169)	(-4.148)	(-4.142)	(-4.223)
PRres2	0.0169	-0.00580				
	(1.189)	(-0.530)				
resdep			-4.141			-4.618
			(-1.121)			(-0.943)
PRres4			0.421			
			(0.535)			
CLres2				0.0212	0.00315	
				(1.259)	(0.268)	
CLres4						0.515
						(0.520)
Constant	51.54***	47.64***	54.63***	51.26***	48.73***	54.79***
	(5.434)	(5.015)	(5.767)	(5.457)	(5.268)	(5.705)
Observations	100	84	105	100	84	105
R-squared	0.645	0.732	0.636	0.646	0.731	0.636

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.2 Critical Discussion

There are many possible reasons why the estimations suggest that natural resources have no effect on income inequality. First of all, the variables might not capture accurately what they are supposed to measure. As previously explained, the Gini is not a unique identifier of income inequality and very different distributions can lead to the same Gini coefficients. Therefore, it is still possible that countries that differ in natural resources have very different income distributions but similar Gini coefficients. Furthermore, the variable capturing natural wealth relies on the assumption that resource abundance has not changed significantly between 1990 (the beginning of the observation period) and 2005 (the year the estimates of natural wealth refer to). If this assumption was not fulfilled, I would have assumed that resources discovered in the future affect economic choices in the past, which is obviously impossible. Moreover, the measures of institutional quality are arbitrarily chosen (there are many sources of institutional quality measures) and not necessarily cardinally scaled. That is, while it is perfectly logical that a difference in 1 Dollar in GDP is the same for every level of GDP, it is a somewhat crude assumption that a change in political rights by 1 point from 1 to 2 is equivalent to a change from 6 to 7. This also affects the interaction terms and might thus lead to their insignificant values.

Another issue concerns data availability and quality. As previously mentioned, some of the countries with extremely high values of natural wealth per capita (e.g. Saudi-Arabia, Bahrain or Brunei) are missing in the dataset due to unavailability of one or more of the control variables. It is very well possible that the inclusion of these countries would change the outcome considerably. Furthermore, which countries are omitted due to missing data is probably not random, but will be highly correlated with, for instance, the quality of administration. As a lack of administrational quality might also affect redistribution negatively, it is possible that especially countries with high inequality were omitted leading to a dataset that is biased towards more equal countries. Furthermore, some of the series are not necessarily reliable. As previously mentioned, Gini coefficients are not computed in the same way everywhere. Solt‘s standardization procedure probably removes part of the problem, but still remains an approximation reflected by the 100 different values reported for each country-year. Additionally, data on natural resources rely heavily on estimates (as explained earlier) and could thus be affected by large estimation errors. Likewise, the set-up assumes a lin-

ear relationship between the variables. The fact that we did not find any relationship making this assumption does not necessarily imply that there is no relationship whatsoever.
Finally, one possible explanation for these results is that there simply is no effect of natural resources on income inequality.

5 Concluding Remarks

In this paper I have investigated whether natural resource abundance or dependence influences income inequality and how the effect depends on different levels of institutional quality. I find no significant result for either natural resource variable influencing income inequality significantly. This result is robust to the inclusion of some of the most commonly used control variables in the resource curse literature (GDP, education, ethnic fragmentation, agricultural intensity, trade openness, institutions and regional dummies). It is also robust to the exclusion of potential outliers and a change in the measurement of natural resources (using a dummy variable capturing countries that pass some threshold with respect to resource endowments or intensity instead of absolute values). Furthermore, I find no significant evidence that there is an effect of natural resources, which is influenced significantly by either the extent of political rights or the extent of civil liberties.

Apart from specific limitations in the variables, as discussed in section 4, the absence of the oil-rich Gulf States (caused mainly by missing data on Gini values) is worrying. An obvious extension to the specification would thus be a richer data set containing more countries once reliable estimates are available. Furthermore, even though commonly used variables were applied, the high significance of regional/cultural dummies suggests that these countries share characteristics that are connected to higher (Latin America and Sub-Saharan Africa) or lower (Europe, Australia and North America) inequality, even after controlling for GDP and institutional quality. Trying to find these further determinants of inequality is another obvious line of future research.

Moreover, this paper focused on point natural resources (the subsoil assets oil, minerals, metals, and ores) instead of natural resources in general (which would also include land and forests). Therefore, even though these natural resources were not found to influence income inequality significantly, this verdict does not need to apply to natural resources in general or to diffuse resources. Further research could therefore determine whether abundance in diffuse natural resources does have an effect on income distribution. Finally, distinguishing between resource abundance and resource dependence has, in my opinion, not received enough attention in the resource curse literature as a whole. In this specific case of income inequality this distinction did not change the outcome because both variables had negligible explanatory power. It could be tested in more detail, however, whether some of the other undesirable outcomes (such as lower values in the HDI or lower life expectancy) are not robust to the inclusion of a variable measuring actual resource abundance instead of dependence either, as has been demonstrated with respect to economic growth. In this way, it could be determined whether one of the greatest paradoxes in empirical economic research, the detrimental consequences of natural wealth, might only be caused by an unsuitable variable choice.

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Appendix

Table 7: List of Variables

Variable	Description
gini	Average of net Gini between 1990 and 2012, rescaled to 0-100. Source: SWIID
lGDP	natural logarithm of GDP per capita in 1990. Source: WDI
nwealth	estimated value of subsoil assets in US Dollar per person. Source: Jarvis et al. (2011)
resexp	share of exports of fuels, metals and ores relative to merchandise exports. Source: WDI
ethf	Degree of ethnic fragmentation where 0 represents total homogeneity and 1 maximum heterogeneity. Source: Montalvo & Reynal-Querol (2005)
educ	average number of years of education received by people at the age of 25 or older in 1990 if available, otherwise for earliest available year (see table 8 for details). Source: UN
agr	Share of value added in agriculture relative to GDP, averaged between 1990 and 2012. Source: WDI
trade	exports and imports relative to GDP, averaged between 1990 and 2012. Source: WDI
PR	Extent of political rights in 1990. Index from 1 to 7 where 1 represents fewest political rights. Source: Freedom House
CL	Extent of civil liberties in 1990. Index from 1 to 7 where 1 represents fewest civil liberties. Source: Freedom House
SSA	Dummy taking on the value 1 for Sub-Saharan African countries
LA	Dummy taking on the value 1 for Latin American countries
AL	Dummy taking on the value 1 if a country is member of the Arab League
EANA	Dummy taking on the value 1 for Australia and countries in Europe and Northern America
resabu	Dummy taking on the value 1 if nwealth>100
resdep	Dummy taking on the value 1 if resexp>3

Table 8: Observation Year for Average Education if 1990 was unavailable

country	year
Cape Verde	2000
Comoros	2005
Dominica	2000
Ethiopia	2000
Grenada	2010
Guinea	2005
Guinea-Bissau	2005
Madagsacar	2000
Nigeria	2005
Seychelles	2000
St. Lucia	2009
St. Vincent & Grenadines	2009

Table 9: List of Countries included

Algeria #	Argentina	Australia*	Austria
Bangladesh ##	Belgium**	Benin**	Bolivia
Botswana	Brazil	Burundi**	Cameroon
Canada	Cape Verde** ##	Centr. Afr. Republic**	Chile
China	Colombia	Comoros** ##	Costa Rica** ##
Cote d'Ivoire	Denmark	Dominica**	Dominican Republic
Ecuador	Egypt	El Salvador**	Ethiopia** ##
Fiji ##	Finland	France**	Gabon* #
Gambia**	Germany	Ghana**	Greece
Grenada** ##	Guatemala	Guinea	Guinea-Bissau** ##
Guyana	Honduras**	Iceland**	India
Indonesia	Iran #	Ireland ##	Italy
Jamaica	Japan** ##	Jordan**	Kenya**
Korea**	Lesotho** ##	Luxembourg**	Madagascar**
Malawi** ##	Malaysia	Mali** ##	Malta**
Mauritania	Mauritius** ##	Mexico	Morocco**
Mozambique	Nepal**	Netherlands	New Zealand
Nicaragua** ##	Niger**	Nigeria #	Norway*
Pakistan	Panama**	Papua New Guinea	Peru
Philippines	Poland	Portugal**	Rwanda**
Senegal**	Seychelles** ##	Singapore**	South Africa
Spain**	Sri Lanka** ##	St. Lucia** ##	St. Vincent & Gren.** ##
Sudan	Swaziland** ##	Sweden	Switzerland**
Syria	Thailand	Togo**	Trinidad & Tobago*
Tunisia	Turkey	Uganda**	United Kingdom
United States	Uruguay** ##	Venezuela* #	Zambia
Zimbabwe**			

* nwealth>20,000 ** nwealth<100

resexp>80 ## resexp<3

Table 10: Descriptive Statistics

	mean	st. deviation	min	max
gini	39.88	8.45	23.24	59.45
lGDP	7.83	1.65	4.97	10.84
nwealth	3454	11556	0	99706
resexp	20.76	24.79	0.09	97.05
ethf	0.45	0.28	0.01	0.93
educ	5.59	2.87	0.7	12.3
agr	15.25	13.5	0.11	52.31
trade	77.89	48.68	22.18	360.7
PR	4.58	2.17	1	7
CL	4.62	1.78	1	7

Table 11: Correlation Matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) gini	1									
(2) lGDP	-0.51	1								
(3) nwealth	-0.18	0.26	1							
(4) resexp	0.08	-0.13	0.45	1						
(5) ethf	0.31	-0.51	-0.04	0.29	1					
(6) educ	-0.38	0.84	0.23	-0.19	-0.45	1				
(7) agr	0.22	-0.84	-0.22	0.08	0.44	-0.75	1			
(8) trade	-0.03	0.24	-0.03	-0.19	-0.17	0.22	-0.27	1		
(9) PR	-0.29	0.77	0.18	-0.19	-0.42	0.70	-0.70	0.06	1	
(10) CL	-0.36	0.79	0.20	-0.22	-0.40	0.73	-0.69	0.15	0.92	1