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Abstract

Using the most recent available data on a sample of 40 developing countries, this paper addresses the effects of oil rent on inequality. Mobilizing a dynamic panel data specification over the period 1996–2008, the econometric results yield two important findings. First, there is a non-linear (U-shaped) relationship between oil rent and inequality. Specifically, oil rent lowers inequality in the short run. This effect then diminishes over time as the oil revenues increase. Our complementary finding is that the fall in income inequality as a result of the increase in the oil rent is fully absorbed by the increase in corruption. Further, the paper examines the channels of causality underlying this relationship. The graphical analysis shows the consistency of the data with the hypothesis according to which corruption, military expenditure, and inflation mediate the effect of oil rent on income inequality.

Key words: Oil rent, Inequality, Developing countries, Dynamic panel data, Corruption

JEL codes: O13, O15, Q32, D63

Introduction

Natural resource-rich developing countries face high poverty rates and exhibit high levels of inequality (Ndikumana and Boyce 2012). In these, a small portion of the population earns millions while the other portion wallows in abject poverty, lacking access to basic social services such as decent sanitation, clean drinking water, elementary schools, and health care (Schubert 2006). According to Gary and Karl (2003) and Schubert (2006), in oil-rich African countries (Nigeria, Angola, Equatorial Guinea, Chad, Sudan, Gabon, and the Republic of Congo), more than 50% of the population live on less than \$2 a day. For example, in Nigeria, the number of poor has risen, although oil rent has also increased (Ndikumana and Boyce 2012). From 1992 to 2010, the number of poor Nigerians (based on a daily-purchasing-power adjusted income threshold of \$2 per day) increased from 80 million to 130 million, even though oil rent nearly quadrupled from \$15 billion to \$58 billion (in constant 2010 dollars). As the second-largest oil producer in sub-Saharan Africa, the revenues from Angola's oil production are huge – accounting for 55% of its GDP, 94% of its exports, and some 80% of its overall government revenue. At the same time, however, Angola has extremely poor income distribution and almost 70% of the population lives on less than \$2 a day. Moreover, many Angolans lack access to basic health care and their life expectancy is barely 41 years (Kolstad, Wiig, and Williams 2008); from 2000 to 2004, 2 million people survived famine thanks only to help from the World Food Program (WFP) (Gary and Karl 2003). Despite Equatorial Guinea's large oil revenues, a baby born there has less chance of living to his or her fifth birthday than the average sub-Saharan African infant. In a classification of twenty countries that aims to present the rate of immunization against measles, Gabon and Equatorial Guinea are respectively ranked second and third.

These statistics provide evidence that the oil boom has done little to ameliorate the living conditions of the poor in oil-rich developing countries. A natural question that arises is: Why are so many countries poor even though they are rich in natural resources? This question has attracted a large body of research. The precursor was the Dutch disease, i.e. the statement that resource booms, through the appreciation of the real exchange rate, reduce the competitiveness of non-resource sectors, and correspondingly the TFP growth rates (Corden and Neary 1982; van Wijnbergen 1984; Krugman 1987).

More recent theories of resource booms highlight the importance of rent seeking and inequality (see Leamer et al. 1999; Torvik 2002; Gylfason and Zoega 2003; Lopez-Feldman, Mora, and Taylor 2006; Ross 2007; Goderis and Malone 2009; Fum and Hodler 2009). Many arguments are evoked. Leamer et al. (1999) argue that, since resource exploitation does not require much human capital, the labor force in resource-rich economies is unprepared for the emergence of human-capital-intensive manufacturing. As a result, these economies may experience higher income inequality for longer periods than resource-scarce economies. Sokoloff and Engerman (2000) instead point out how resource endowments affect inequality through the evolution of institutions. In countries where economies of scale led to unequal land ownership, the inequality was sustained by political institutions that favored the rich and excluded the poor. In other countries, however, the absence of economies of scale led to more equal land distribution and more egalitarian institutions. Gylfason and Zoega (2003) argue that resource dependence leads to both lower growth and increased inequality, and could therefore explain the inverse relationship between growth and inequality in cross-country data.

While these contributions have enhanced our understanding of the effect of oil rent on income inequality, they mostly fail to show clearly the empirical mechanisms of the link.

The main objective of this paper is to contribute to this research stream, by exploring the empirical effects of oil rent on income inequality. Our contribution is threefold. Firstly, using a sample of 40 developing countries and recent data on oil rent, this paper shows that there is a non-linear relationship between oil rent and inequality. Secondly, using data drawn from the World Governance Indicators (World Bank), we provide evidence of the conditional effect of corruption and governance effectiveness on the oil rent–inequality nexus. Finally, relying on the general method of moment estimator in the dynamic panel data model, this paper carefully addresses relevant issues of both endogenous and measurement error bias.

The paper proceeds as follows. Section 2 presents an overview of the literature. This section begins with a general framework of the resource curse with a specific emphasis on inequality. Later on, it gives some insights into the conditional effect of different channels on the oil rent–inequality nexus. Section 3 is concerned with the empirical evidence while section 4 discusses the estimation results. Section 5 explores the possible channels of causality and section 6 concludes.

2. Oil rent and income inequality: overview of the literature

2.1 A useful starting point: the oil curse with a specific emphasis on inequality

Since its first appearance in the English newspaper *The Economist* in 1977, the Dutch disease phenomenon has been analyzed in various ways, leading to abundant literature devoted to what is known as the resource curse theory. The main idea surrounding this theory is as follows: high oil revenues raise the exchange rates, promote an adverse balance of payments on the cost of imported goods when prices fall, boost wages for skilled labor – ultimately pricing workers out of the international market – and reduce the incentive to risk investment in non-oil sectors (Shubert 2006). In short, high oil revenues reduce the competitiveness of all the non-oil sectors, squeezing out vital sectors like agriculture and manufacturing and leaving oil as the only functioning revenue source. This view has been tested in the seminal paper of Sachs and Warner (1995), who find a negative relationship between dependence on natural resources and economic growth. Another channel through which natural resources could undermine development is the diversification of the economy. The resource curse may also arise via bad governance, rent seeking, and corruption (Tornell and Lane 1999; Torvick 2002; Mehlum, Moene, and Torvik 2006). As long as extracting oil remains a capital-intensive activity that requires a large amount of money and a few highly skilled workers, countries lacking both will be constrained to find these inputs abroad. The arrival of foreign oil companies and massive international loans creates the perfect rent-seeking environment, leading to a virtual flea market of corruption, patronage, and inequality (Shubert 2006). In the same vein, Torvick (2002) develops a simple model of rent seeking that explains why natural resource abundance may lower income and welfare. In such a model, a greater amount of natural resources increases the number of entrepreneurs engaged in rent seeking and reduces the number of entrepreneurs running productive firms. With a demand externality, it is shown that the drop in income as a result of this is higher than the increase in income from the natural resource. More natural resources thus lead to lower welfare. From this general viewpoint, several papers have addressed the relationship between oil rent and inequality in various ways.

The literature on the effect of oil rent on inequality is loosely related to that of natural resource endowment and inequality. The widespread view drawn from this literature argues that an abundance of natural resources could lead to high inequalities. In this vein, Leamer et al. (1999) argue that, since resource exploitation does not require much human capital, the labor force in resource-rich economies is unprepared for the emergence of human-capital-intensive manufacturing. As a result, these economies may experience higher income inequality for longer periods than resource-scarce economies. According to Gylfason and Zoega (2003), resource dependence leads to both lower growth and increased inequality, and could therefore explain the inverse relationship between growth and inequality in cross-country data.

Beside this skeptical view, some authors point out the fact that the relationship between resource rent and inequality could be non-monotonic. Accordingly, income inequality will fall in the short run or immediately after the boom and will then increase steadily over time as the economy grows, until the initial impact of the boom on inequality disappears (Ross 2007; Goderis and Malone 2009). They consider a two-sector growth model, in which learning-by-doing drives growth, to explain the time path of inequality following a resource boom. The non-traded sector uses unskilled labor more intensively than the traded sector. The resource sector of the model is represented as an exogenous gift of resource income. Both unskilled and skilled labor must earn marginal products, and assuming perfect factor mobility, the marginal product of each factor must be equal across sectors. They assume two main sources of changes in income inequality during resource booms: the unequal distribution of resource income and the shift of the factors of production to the non-traded sector, which uses unskilled labor intensively relative to the traded sector, due to the spending effect related to the resource income. Since they are interested in the effects of resource booms on the total income inequality, Goderis and Malone (2009) address the distribution of resource income among skilled and unskilled workers. In the short run, the productivity levels in each sector are constant. Thus, the effect of oil on inequality is only driven by the mobility of unskilled labor between the traded and the non-traded sector, the Gini coefficient of the resource sector, and the Gini coefficient of the non-resource sector. In this vein, Goderis and Malone (2009) demonstrate that in the short run, the oil boom induces a fall in the Gini coefficient of total income if and only if the share of unskilled labor in the non-traded sector exceeds the share of unskilled labor in the traded sector and the income inequality in the non-resource sector is above that of the resource (oil) sector.

In the long run, the assumption of constant total factor productivity is relaxed. The rate of productivity growth in each sector is determined by the effects of learning-by-doing (LBD) in both sectors, with the possibility of knowledge spillovers. According to Goderis and Malone (2009), under the conditions of balanced growth, the long-run effect of resource booms on total income inequality works solely through the induced increase in the proportion of resource income in the total income.

To sum up, the relationship between oil revenues and income inequality may be non-monotonic as far as the short-run pattern can differ from the long-run one. In the short run, this relationship is only driven by the factor mobility, specifically the difference in terms of unskilled labor between the traded and the non-traded sector. In the long run, the link works only through the share of oil revenues in the total income. The greater these revenues are in the total income, the higher is the income inequality. However, some authors argue that the oil–inequality nexus could be shaped by different channels, like the level of corruption in the oil-rich country (Andrés and Dobson 2010; Arezki and Brückner 2011), the level of inflation, or the labor force.

2.2 The channels in the oil rent–income inequality nexus

Many channels in the oil rent–income inequality nexus are identified in the economic literature. One of the major channels among them is corruption. Thus, abundant literature points out that the effect of oil revenues on inequality may work through the increase in corruption. In this vein, Ross (1999b) reviews the political aspects of why resource-rich countries tend to manage their economies poorly, arguing that state ownership of the resource industry leads politicians to abuse political power for private purposes. Corruption is a huge problem in many developing countries rich in oil and other natural resources, and is crucial in explaining why these countries perform poorly in terms of socio-economic development (Kolstad, Wiig, and Williams 2008). Leite and Weidmann (1999) establish a robust statistical relationship between countries' exports of oil, relative to the GNP, and the level of corruption for a sample of 72 countries in 1970. Similarly, Karl (2004) argues that countries that are dependent on oil are often characterized by corruption, poor governance, and a culture of rent seeking. More recently, using a panel of 29 sub-Saharan countries during the period from 1985 to 2007, Aresky and Gylfason (2011) find that higher resource rents lead to more corruption. With a sample of African countries, Omgba (2010) shows a negative correlation between oil rent and the control of corruption. Besides, using a sample of 31 oil-exporting countries over the period 1992–2005, Arezki and Brückner (2009) find that oil rent significantly increases corruption. Another example could be the case of Nigeria, where oil wealth has been wasted through corruption and other forms of rent seeking (Herbst and Olukoshi 1994). Indeed, in 1984, ten years after of the oil boom, the per capita income of the average Nigerian was no higher than in 1974. Besides, a wide range of papers provide evidence of a positive effect of corruption on income inequality (Gupta et al. 1998; Gyimah-Brempong 2002; Gyimah-Brempong and Muñoz de Camancho 2006; Dincer and Gunalp 2008; Vicente 2010). Consequently, to the extent that oil rent is positively associated with a high level of corruption and corruption may increase inequality, one may conclude that in the case of a high level of corruption, oil revenues lead to higher income inequality.

In contrast to the above, some authors find a negative or quadratic relationship between corruption and inequality (Chong and Calderón 2000; Li, Xu, and Zou 2000; Andrés and Dobson 2010). For instance, for the poor countries in the sample, they observe that a fall in corruption is associated with a rise in inequality. They explain the finding for poor countries in relation to the informal sector. In many poor countries, the informal sector is relatively large and its members are among the poorest. It is the main source of income for the poor, who cannot find jobs in the formal sector due to individual characteristics, institutional barriers, or labor market discrimination. Institutional reform and formalization generate additional costs for informal workers via improvements in tax collection, the imposition of new taxes, new regulations, and bureaucratic requirements. Since the informal sector mostly employs those in the lowest quintile of the income distribution, a rise in the institutional quality is likely to be translated into a fall in the absolute and relative income of this group. Sokoloff and Engerman (2000) also explain this result. Indeed, they point out the fact that resource endowments affect inequality through the evolution of institutions. Thus, in colonies where economies of scale led to unequal land ownership, the inequality was sustained by political institutions that favored the rich and excluded the poor. In other colonies, however, the absence of economies of scale led to more equal land distribution and more egalitarian institutions.

This view is shared by a recent paper by Andrés and Dobson (2010) on Latin America. Another explanation for this counterintuitive result relies on the fact that those poor countries with high levels of inequality and corruption may become trapped in inequality regardless of the development of their institutions. Thus, if we follow the above arguments, the relationship between oil rent and inequality may be quadratic. Specifically, one can observe a sharp decrease in inequality in the short run and a rise as far as oil revenues increase.
Finally, the literature is inconclusive regarding the effect of oil rent on inequality. Moreover, the influence of corruption on this relationship is not fully addressed.

The role of other channels in the oil rent and income inequalities relationship is not straightforward. Nevertheless, some authors find an effect of inflation on income inequalities or due to the oil rent. Thus, natural resource ownership exposes countries to volatility, particularly in commodity prices (Sala-i-Martin and Subramanian 2003), which could have an adverse impact on growth through an increase in inflation. Moreover, several works (Romer and Romer 1998; Bulir 2001; Easterly and Fischer 2001) present evidence correlating high rates of inflation with income inequality. Nevertheless, inflation does not appear to be greater in resource-rich countries than elsewhere (Gylfason 2001).

Another channel of causation from natural resource abundance to income inequalities is the labor force. In fact, the abundance of natural resources may lead to a less diversified economy. For instance, countries awash in oil money focus all their efforts on a single economic factor. Along the way, workers increasingly move into oil-related sectors. By failing to diversify their skills, however, they also become trapped in a cycle of dependence on oil. They fail to grow and in the process fail to modernize. Those who do acquire skilled jobs in the oil sector reap the benefits. Those who fail to do so are destined to a life as second- or even third-class citizens. Torvik (2002) suggests that natural resource rents divert entrepreneurial talent from productive activities to low-productive rent-seeking activities. He concludes that the fall in income due to this reallocation of entrepreneurs may outweigh the benefits of natural resource rents. Schubert (2006) also concludes that oil revenues, no matter how high and no matter how valuable for infrastructure construction in its initial stages, tend to be front-heavy and leave large sections of the labor force underemployed, causing long-term and massive income inequalities.

3. Graphical and estimation evidence on the link between oil rent and inequality in developing countries

3.1 Graphical evidence

The main objective of this subsection is to assess the pattern of the statistical link between oil rent and inequality in a sample of developing countries.[1] First, we study the cross-country correlation between oil rent and inequality in the whole sample of countries. Second, we try to determine whether countries with a high initial level of inequality benefit more from oil rent. Finally, we consider the top five oil-rich countries (within the sample) to check whether or not the pattern of the relationship between oil rent and inequality changes.

3.1.1. Is there a relationship between oil rent and inequality in developing countries?

Figure 1 plots the distribution of the average Gini coefficient and oil rent across five regions around the world: Africa, Asia, Latin America, Eastern Europe, and Western Europe.

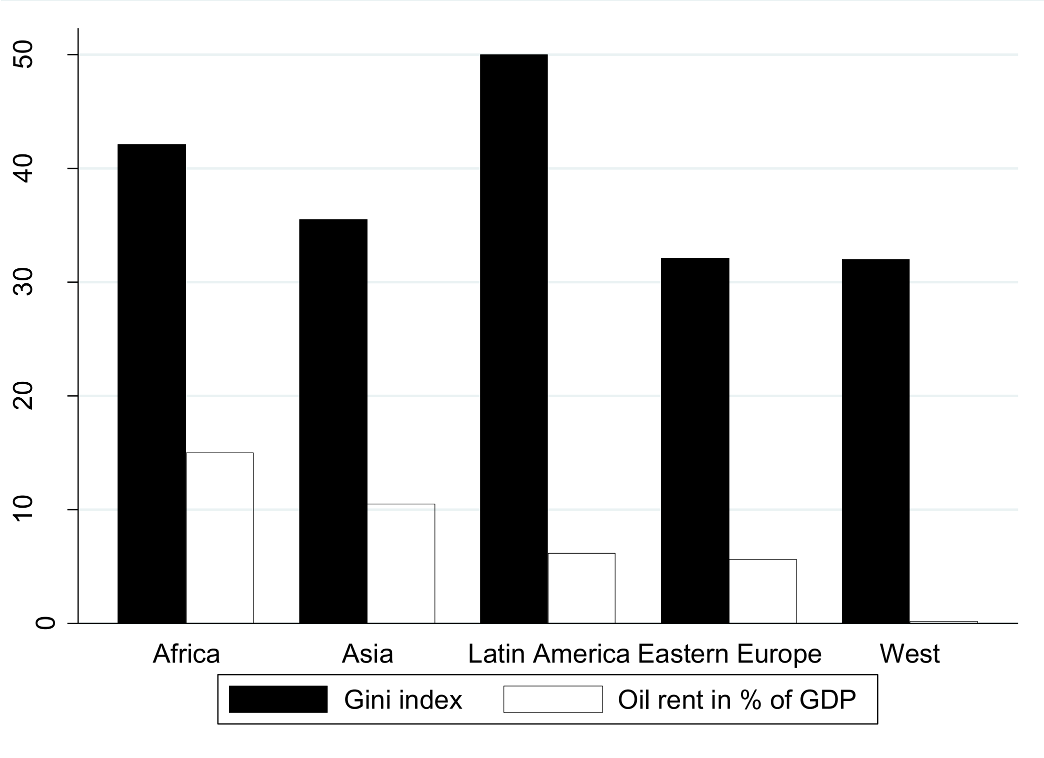
The interesting and suggestive feature of this figure is that Africa and Latin America exhibit the highest Gini coefficient with contrasted patterns in terms of the oil share in the GDP. In the same vein, one may notice that if the region with the highest level of inequality (Latin America) does not exhibit a high level of oil rent, the region with the lowest level of inequality (Western Europe) displays a low level of oil rent as a percentage of GDP. This observation may be seen as an insight that if oil abundance does not create inequalities, they might be exacerbated by the high inflow of related revenues.

Figure 2 portrays the relationship between the Gini coefficient index and the oil rent in the whole sample of developing countries. The graph suggests a steady negative correlation between oil rent and inequality. Looking at the behavior of some major oil-rich countries (Angola in Africa, Iran in Asia, Venezuela in Latin America, and Russia in Eastern Europe), we can see that these countries always exhibit a high level of inequality. However, when we consider Eastern Europe, the case of Azerbaijan is quietly striking in that this country presents a high level of oil rent as a percentage of GDP associated with a lower level of income inequality.

In a nutshell, an overview of the pattern of data suggests a negative association between oil rent and inequality in developing countries.

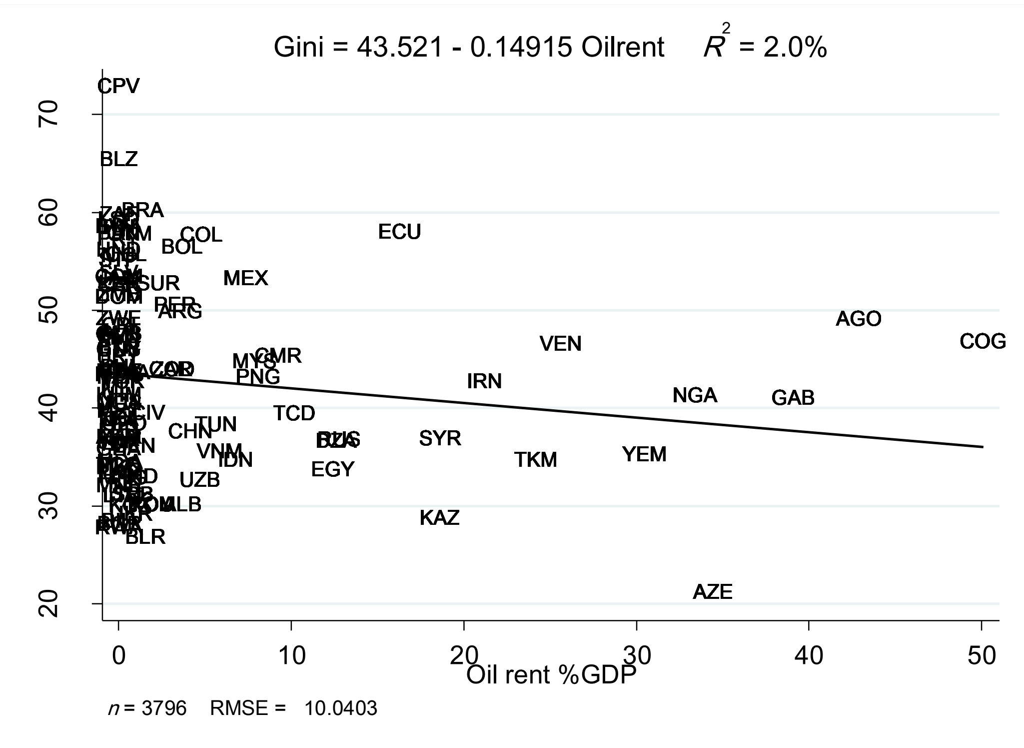
[1] A description of the data set used in this section will be presented later in the section devoted to the methodology.

<u>Figure 1</u>: Gini index and oil rent distribution across regions, 1990–2008



<u>Source</u>: Authors, based on the World Development Indicators, World Bank (2011)

<u>Figure 2</u>: Oil rent and inequality in developing countries, 1990–2008



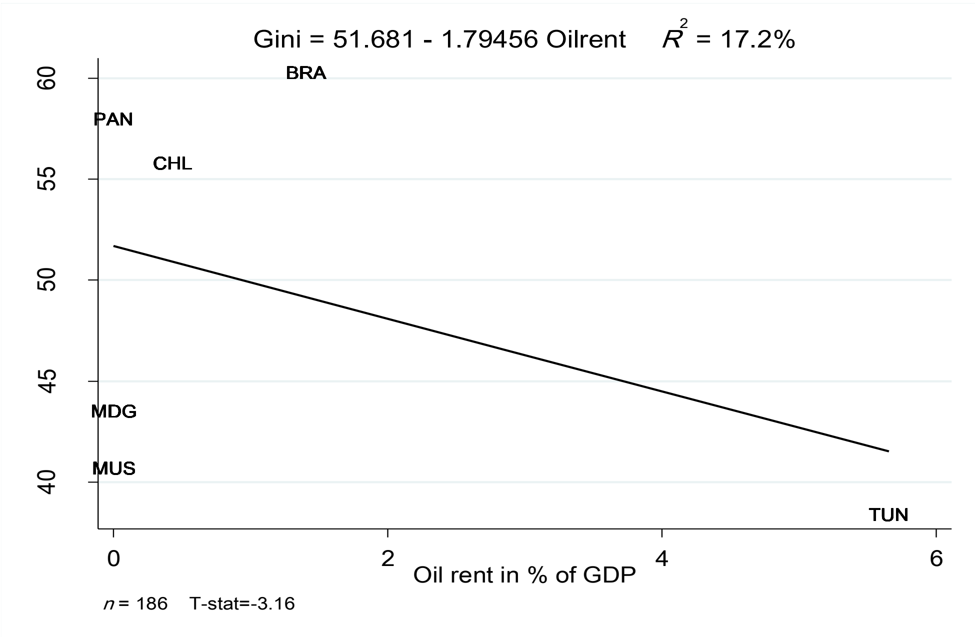
<u>Source</u>: Authors, based on the World Development Indicators, World Bank (2011)

3.1.2. Do countries with a high initial level of inequality benefit more from oil rent?

One of the prominent stylized facts about economic development is that there is an advantage of backwardness such that when comparing two otherwise similar countries, the one with the lower initial mean income will tend to achieve a higher rate of growth (Ravallion 2012). We follow this rationale while assessing whether countries with a high initial level of inequality take advantage of oil rent more than countries with a low or average level of inequality. Figure 3 plots the relationship between oil rent and inequality for the subsample of countries for which the level of initial inequality is above the median of the distribution (within the sample), that is, countries that exhibit an initial level of inequality greater than 42.81.

The figure shows a negative and significant correlation between oil rent and inequality for countries with a higher initial level of inequality. Nonetheless, to determine whether these countries benefit more from oil rent, we have to compare the correlation coefficients in Figure 2 with those in Figure 3. Looking at these two figures, while a 1-point increase in oil rent as a percentage of GDP leads to a 0.14-point decrease in inequality in the whole sample, a 1-point increase in oil rent as a percentage of GDP induces a fall in inequality by 1.17 points for the subsample of countries with a high level of initial inequality. Consequently, the graphical analysis suggests that countries with a high level of initial inequality may take greater advantage of an oil windfall.

Figure 3: Oil rent and initial level of inequality: subsample of countries with a high level of initial inequality



Source: Authors, based on the World Development Indicators, World Bank (2011)

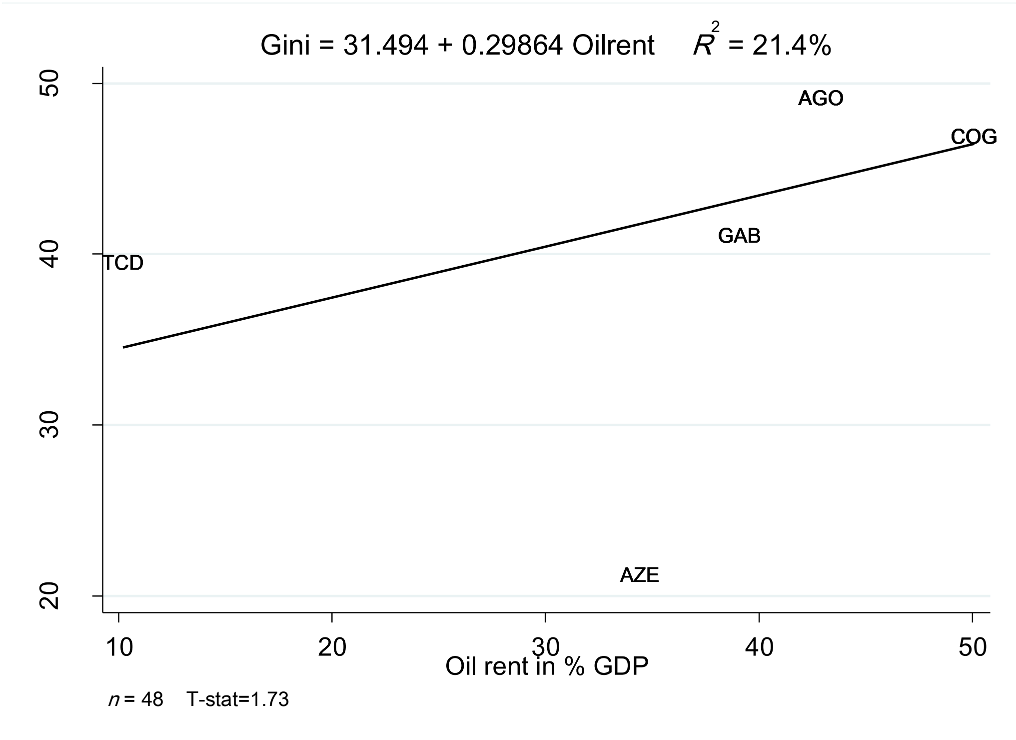
3.1.3. Do countries that are highly dependent on oil rent perform better in reducing inequality?

Based on the fact that an increase in oil rent tends to be associated with a decrease in inequality, we do expect this relationship to be more pronounced for countries at the top of the oil rent distribution. We study the cross-country correlation between the top oil-rich countries and inequality. Figure 4 portrays this relationship for countries for which the share of oil rent as a percentage of GDP represents more than 46%.[2]

According to Figure 4, the relationship between oil rent and inequality is positive for countries situated at the top of the oil rent distribution. This report shows that an oil windfall could be very detrimental to countries that are strongly dependent on this resource.

Altogether, the graphical analysis suggests that the nature of the relationship between oil rent and inequality is globally negative. However, this broad view hides some specific patterns related both to the level of initial inequality and to the size of the oil rent as a percentage of GDP.

Figure 4: Oil rent and inequality: top five of the distribution, 1990-2008



Source: Authors, based on the World Development Indicators, World Bank (2011)

3.2. Estimation strategy and data

The empirical literature on natural resources and inequality predominantly relies on cross-sectional regressions, which are unable to identify the dynamics of income inequality and tackle the issue of omitted variable bias. For this reason, we analyze the effect of oil rent on income inequality using a dynamic panel data model.

3.2.1. Estimation strategy

Our basic specification follows that of Goderis and Malone (2009). However, this specification is completed by a set of control variables currently used in inequality equations at the macroeconomic level (Deininger and Squire 1997; Chong and Calderón, 2000; Andrés and Dobson 2010). In this vein, we take into account the level of GDP, inflation, openness, demographic effects proxied by the labor force, initial level of inequality, primary completion

[2] This value corresponds to the endogenous threshold beyond which the relationship between oil rent and inequality becomes positive.

rate as a measure of human capital, and corruption, to control for the effect of governance. Our baseline dynamic panel data model takes the following form:

$$Gini_{it} = \alpha Gini_{it-1} + X'_{it}\beta + \delta Oil_{it} + \delta_1 Oil_{it}^2 + \mu_i + \varepsilon_{it} \qquad (1)$$

where $Gini_{it-1}, X$ are respectively the lagged variable of income inequality, the matrix of control variables described above. Oil is oil rent as a percentage of GDP whilst oil^2 is the square of oil rent to account for the non-linear effect of oil rent on income inequality, μ_i is the country fixed effect, and ε_{it} is the error term.

Two coefficients will draw our attention. First, we expect that δ will be significantly negative in order to confirm the hypothesis according to which oil rent reduces inequality in the early years of an oil revenue windfall. Second, we expect δ_1 to be significantly positive, which will confirm the positive effect of oil rent as far as oil revenues increase.

3.2.2. Data

Our final sample contains 40 countries over the period 1996–2008. This is mainly due to the fact that the corruption data used in this study are fully available over this short period of time. Moreover, for some oil-exporting countries, data on the Gini coefficient are missing. The data are yearly.[3]

The dependent variable is the Gini coefficient, which measures the intensity of inequality within countries. The data used are drawn from Milanovic's (2005) database and the World Income Distribution database (WID, 2008). The Milanovic's (2005) database merges three different databases: that of Deininger and Squire (1997), that of the United Nations (WIDER), and the World Income Distribution database (WID). In order to consider the differences concerning the calculation methodology from one database to another or from one year to another, we introduce into all our estimations three dummies capturing whether the Gini coefficient has been calculated from consumption or income. These dummies also capture whether the variables used are measured in real or nominal terms and whether the basic unit of analysis is the person or the household.[4]

The interest variable is oil rent as a percentage of GDP. Oil rent is the difference between the value of crude oil production at world prices and the total costs of production. The data are from the World Bank (2011a). The estimates are based on the sources and methods described in *The Changing Wealth of Nations: Measuring Sustainable Development in the New Millennium* (World Bank 2011).

Control variables: Except for corruption, all the control variables are from the World Bank (2011a). Corruption is captured by the variable "control of corruption" available in the *Worldwide Governance Indicators* of the World Bank. It captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests (Kaufman, Kraay, and Mastruzzi 2010). This variable ranges between -2.5 for a high level of corruption and 2.5 for a low level. However, the variable has been reversed and standardized to range between 0 and 1.[5] The same formula is applied to other variables of governance. Table 1 provides descriptive statistics of the variables used in the study.

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[3] A list of countries and available observations is presented in the appendix.

[4] See Ebeke and Le Goff (2009) for further discussions.

[5] The following formula has been applied : $\frac{-\text{corrupt}-\min(-\text{corrupt})}{\max(corrupt)-\min(corrupt)}$.

Table 1: Descriptive statistics

Variable	Observation	Mean	Std Dev.	Min.	Max.
Gini coefficient	176	44.65446	11.76924	17.52	73.5
Oil rent in % GDP	176	4.447441	9.372349	0	56.06991
GDP constant US$ 2000	176	2569.93	2083.853	125.4513	8699.01
Labor force	176	63.38144	4.406156	50.17978	70.4354
Inflation CPI	176	20.03244	84.08384	-5.069363	1058.374
Openness	176	77.28015	32.65912	21.32208	146.1924
Corruption	176	0.532323	0.137202	0.154890	.7683548
Initial level of Gini	176	4.364545	13.00297	0	57.78
Primary completion rate	176	94.15637	11.03338	16.21635	128.5463
Dummy consumption	176	0.681818	0.467099	0	1
Dummy income	176	0.670454	0.471389	0	1
Rule of law	176	0.507799	0.111481	0.245977	0.732023
Quality of regulation	176	0.377065	0 .133848	0.089381	0.761190
Governance effectiveness	176	0.443354	0.112313	0.135251	0.717611
Political stability	176	0.383188	0.137888	0.092125	0.715618
Voice and accountability	176	0.419152	0.165613	0.101075	0.855730

The estimates of the dynamic model presented above with the OLS estimator are inconsistent, since the lagged dependent variable is introduced alongside country fixed effects. This bias is of great concern because of the short temporal dimension of the data set used. The system GMM estimator must therefore be implemented. The equations in levels and the equations in first differences are combined in a system and estimated with an extended system GMM estimator, which allows for the use of lagged differences and lagged levels of the explanatory variables as instruments (Blundell and Bond 1998).[6] The GMM estimations control for the endogeneity of some explanatory variables.

4. Estimation results

The estimation of the dynamic panel data model provides two main results. The first one suggests that there is a non-linear relationship between oil rent and inequality in developing countries. The second result is that governance matters, but not all types of governance.

4.1. The non-linear relationship between oil rent and inequality

Table 2 shows the results of the GMM estimates of the dynamic model of the relationship between oil rent and inequality. The table also provides, along with the statistics of Arellano–Bond's test of first- and second-order autocorrelation, the Hansen test of over-identification. As regards the first- and second-order autocorrelation, the test fails to reject the null hypothesis of the absence of second-order autocorrelation. In the same vein, the Hansen test does not reject the null hypothesis of the validity of the instruments used in the regression.
Several specifications were adopted. The first column of the table presents the model without non-linearity. One may observe that the coefficient of oil rent is negative. Specifically, a 1%

[6] This paper uses the two-step system GMM estimator.

increase in oil rent as a share of the GDP induces a reduction in income inequality of 0.11 points. This negative impact can be attributable to both the spending and the labor mobility effect (Goderis and Malone 2009). In fact, in the early stages of oil exploitation, unskilled workers move from labor-intensive and low-wage sectors to the new oil sector, which exhibits a high average wage. At the same time, the government increase in social expenditures facilitates the access to basic needs. It is therefore worth mentioning that this negative effect is insufficiently highlighted in the literature. Most studies follow the dominant literature on the resource curse and only focus on the undermining effect of oil rent. This result is also found in this study. In fact, as the share of oil rent in the GDP increases, the short-run fall in inequality vanishes. Columns 2, 3, and 4 present the results of the model with non-linearity. In column 3 we augment the model with an interaction term between corruption and oil rent, while in column 4 an interaction term between oil rent and governance effectiveness is included. The main objective of these modifications is to test the hypothesis according to which the initial negative effect of oil rent on inequality is outweighed by bad governance.[7]

The first fact to notice is the increase in the coefficient of oil rent. This coefficient ranges between 0.24 and 0.94, far above 0.11 in the linear model. Second, the estimations support the hypothesis of a non-linear relationship between oil rent and inequality. Thus, the negative effect of oil rent lasts until a turning point after which one notices a rise in income inequality. According to the estimates, the turning point stands at 46.85% of the GDP and concerns 27% of the sample on a yearly basis.[8] This latter evidence supports the theory, notably Gylfason and Zoega (2003), Torvick (2002), and Goderis and Malone (2009). The most shared explanation of this result lies in the inappropriate management due to bad institutions, especially the widespread corruption. To this end, we control for governance (additively and multiplicatively) as shown in columns (3) and (4).

4.2. Governance matters: corruption and governance effectiveness at work

In order to test for the effect of governance on the oil rent–inequality nexus, we make use of all the measures provided by the *World Governance Indicators* (World Bank 2011b). Table 2 (column 3) shows that the fall in income inequality as a result of the increase in oil rent is fully absorbed by the increase in corruption.[9] This result is rather intuitive in that the high level of corruption in oil-rich countries is often put forward to explain the so-called resource curse. As suggested by Sala-i-Martin and Subramanian (2012), corruption from oil rather than the Dutch disease has been responsible for the poor long-run economic performance of most developing oil-rich countries. In fact, in the context in which rent seeking is pervasive, the elite use corruption in order to find political support, notably through an inefficiently large public sector, to stay in power.

[7] In Table 2, we present the results with all the other variables of governance.

[8] This estimate is that of column (2). In fact, the thresholds in columns (3) and (4) depend on the level of governance and have been computed at the mean, which is almost equal to the median of the distribution.

[9] Let us recall that the higher the value, the poorer the governance. Besides, the coefficient of the interaction variable is 1.040, while the coefficient of oil rent is -0.835.

Table 2: Oil rent and inequality, two-step GMM estimates

Dependent variable: Gini index	(1)	(2)	(3)	(4)
Gini index, t-1	**0.648***	**0.633***	**0.555***	**0.603***
	(0.0697)	**(0.0485)**	**(0.0606)**	**(0.0391)**
Oil rent in % of GDP	**-0.118***	**-0.241***	**-0.835***	**-0.940**
	(0.0301)	**(0.0504)**	**(0.192)**	**(0.433)**
Squared of oil rent		**0.00257***	**0.00227**	**0.00233**
		(0.000619)	**(0.000921)**	**(0.00156)**
Corruption	6.918	11.72***	5.420	
	(5.816)	(3.701)	(7.238)	
Corruption*oil rent			1.040***	
			(0.291)	
Governance effectiveness				3.272
				(4.418)
Governance effectiveness*oil				1.475**
				(0.644)
Initial level of Gini index	0.307	0.222	0.368	0.347
	(0.228)	(0.217)	(0.320)	(0.234)
GDP per capita constant US$ 2000	0.00159**	0.00187***	0.00222***	0.00196***
	(0.000640)	(0.000603)	(0.000631)	(0.000527)
Labor force	-1.026***	-1.154***	-1.406***	-1.294***
	(0.329)	(0.346)	(0.304)	(0.276)
Inflation (cpi)	0.000322	-0.000693	-0.000121	0.00193*
	(0.00153)	(0.000981)	(0.00146)	(0.00109)
Openness	-0.0331	-0.0224	-0.0206	-0.0333
	(0.0338)	(0.0269)	(0.0223)	(0.0262)
Primary completion rate	-0.141*	-0.281***	-0.231***	-0.160***
	(0.0740)	(0.0552)	(0.0399)	(0.0577)
Dummy consumption	-2.832***	-3.003***	-2.117***	-3.864***
	(1.010)	(0.678)	(0.646)	(0.944)
Dummy income	3.241***	3.799***	2.529***	3.407***
	(0.783)	(0.872)	(0.719)	(0.911)
Constant	86.43***	104.4***	120.4***	107.6***
	(21.32)	(21.50)	(18.83)	(13.51)
Arellano–Bond test for AR(1) in first differences	0.070	0.072	0.053	0.065
Arellano–Bond test for AR(2) in first differences	0.371	0.330	0.419	0.339
Hansen OID test	0.766	0.665	0.378	0.788
Oil rent threshold in % of GDP		**46.85**	61.85	48.69
Percentage of countries concerned		27	0	5
Observations	176	176	176	176
Number of countries	40	40	40	40

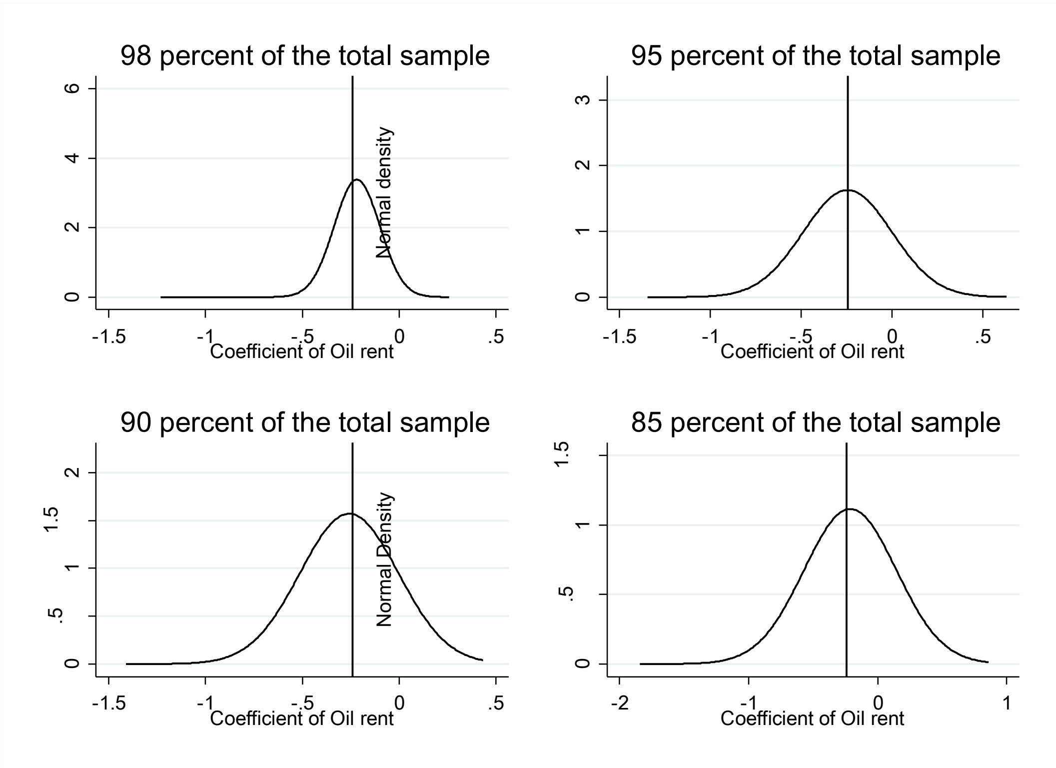
Notes: Standards errors are in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Table 2 also shows the results using governance effectiveness. The coefficient of the interaction term between oil rent and governance is positive and significant. In this case as well, the initial negative effect of oil rent is countervailed by the deterioration of governance effectiveness.[10] The same specification is used to test the effect of other measures of governance. However, the results are not significant[11].

4.3. Robustness check

In order to test the robustness of the results, we check the sensitivity of the coefficient of oil rent to the change in the composition of the sample.[12] We randomly select respectively 98%, 95%, 90%, and 85% of the observations (without replacement) and run the baseline regression (Table 2 column 1). This process, repeated 250 times, gives values of the coefficient on oil rent, for which the normal distribution is shown in Figure 5.

Figure 5: Robustness check



When the regression is run on 98% of the sample, the average coefficient of oil rent is -0.220 and remains close to the coefficient of the full sample (represented by the vertical line, which is equivalent to sampling 100% of the observations). However, the base of the distribution widens. In the same vein, when the regression is run on the other sample sizes (95%, 90%, and 85%), the coefficient of oil rent does not change very much while the base of the distribution widens slightly. One striking fact is that the significance of the coefficient is lower as the size of the sample decreases. Table 3 summarizes these facts.

[10] The coefficient of the interaction term stands at 1.44, while the coefficient of oil rent is -0.94.
[11] Results are available upon request.
[12] We follow in this way Kpodar and Andrianaivo (2012).

Table 3: Robustness tests

Variable	98%		95%		90%		85%	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Oil rent	-0.218	0.067	-0.2436	0.0882	-0.2584	0.1040	-0.2126	0.1122
Squared oil rent	0.0023	0.0010	0.0036	0.0016	0.0035	0.0021	0.0030	0.0022

5. Oil rent and inequality: exploring possible channels of causality

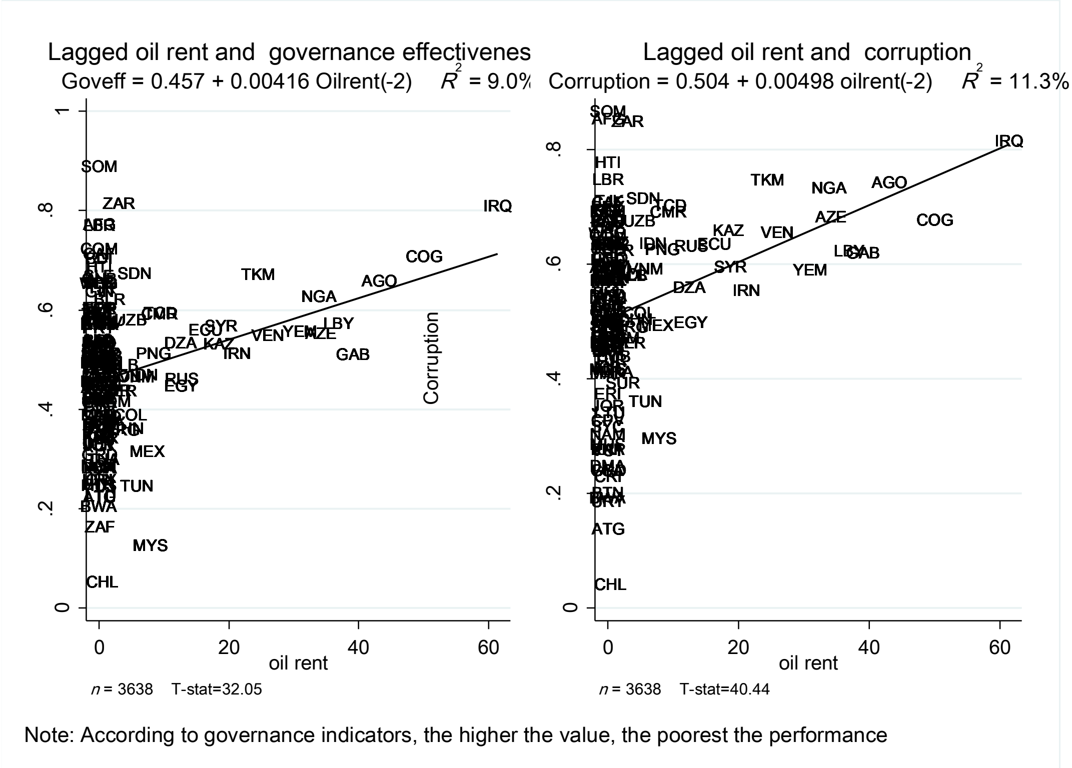
This section is rather exploratory and aims to investigate whether the data are consistent with some mechanisms highlighted in the literature as mediators of the relationship between oil rent and economic development.

One of the most important mechanisms pointed out in the literature is the deterioration of governance as a consequence of oil windfalls (Arezki and Brückner 2011; Ebeke and Omgba 2011; Sala-i-Martin and Subramanian 2012). Figure 6 portrays the relationship between governance and the lagged variable of oil rent.

The first chart (left-hand side) suggests a statistically positive association between the lagged variable of oil rent and the lack of effective governance. This association is significant as shown by the student statistic and comports with evidence provided by Bulte and Damania (2005). The second chart (right-hand side) shows the relationship between corruption and the lagged variable of oil rent.[13] The positive relationship shown by this chart is consistent with the prominent literature on the resource curse.

[13] We use the two-period lagged variable because we assume that it takes time for the increase in oil rent to fuel bad governance. It is worth mentioning that the first and the third lag have been also tested with the same result.

Figure 6: Assessing transmission channels: lagged oil rent and governance

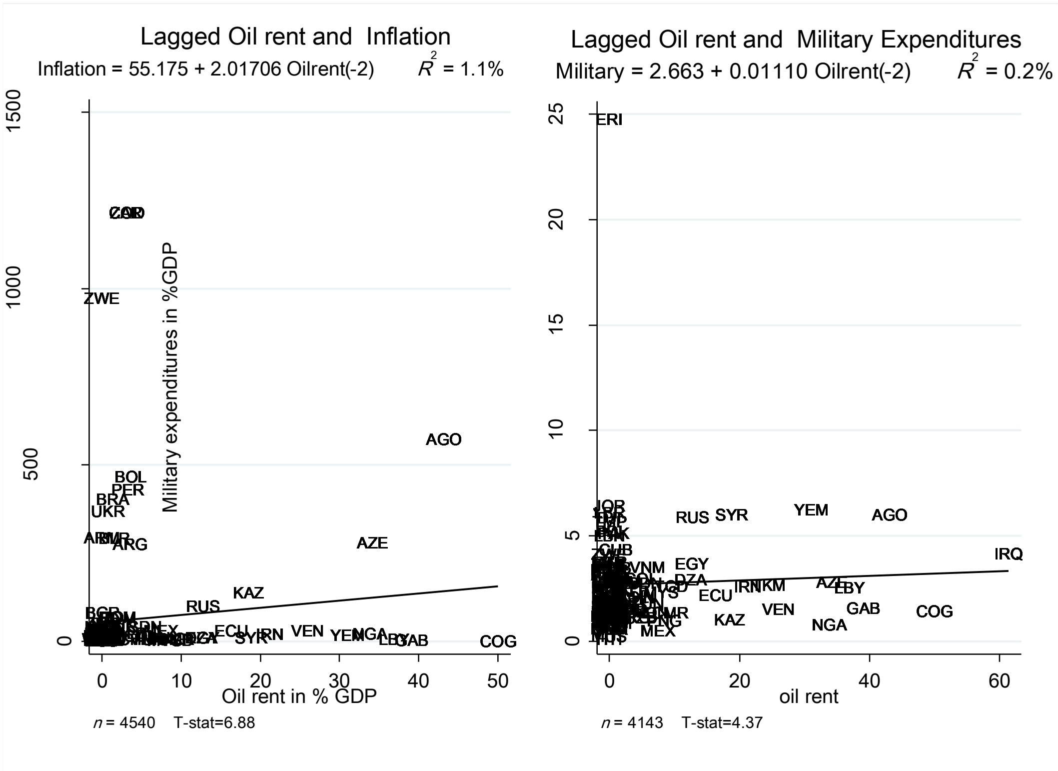


Source: Authors, based on the World Development Indicators, World Bank (2011)

Two other channels can be put forward to explain the relationship between oil rent and inequality in developing countries. The first is inflation. In fact, oil rent may lead to inflation through the boom of spending, notably in luxury goods, land, and housing. Furthermore, the Dutch disease effect generates inflation since people abandon other productive sectors to join the new oil sector. The first chart of Figure 7 presents the statistical association between oil rent and inflation. As expected, oil rent is positively and strongly correlated with inflation.

The second chart establishes the link between oil rent and military expenditure. Military expenditure is taken as a sign of the decrease in social spending. In fact, governments in oil-exporting countries may use oil rent in order to secure power, notably through an increase in military spending at the expense of social expenditure. This chart shows a positive relationship between oil rent and military expenditure.

Figure 7: Oil rent, inflation, and military expenditures in developing countries



Sources: Authors, based on the World Development Indicators, World Bank (2011)

Overall, this subsection suggests that governance, inflation, and military expenditure may be the mediators of the relationship between oil rent and inequality in developing countries.

6. Conclusion

Arguments abound for the relatively poor performance of oil-rich countries over the past four decades. This paper has empirically analyzed the path of income inequality induced by oil abundance. Using the system GMM estimator to address endogeneity issues, the evidence provided points to a non-linear relationship between oil rent and inequality in a set of developing countries. Specifically, oil rent lowers inequality in the short run. This effect then diminishes over time as the oil revenues increase. Our complementary finding is that the fall in income inequality as the result of the increase in oil rent is fully absorbed by the increase in corruption. This result is rather intuitive in that the high level of corruption in oil-rich countries is often put forward to explain the so-called resource curse.

Further, we examined the channels of causality underlying the relationship between oil rent and income inequality. The graphical analysis shows the consistency of the data with the hypothesis according to which corruption, military expenditure, and inflation mediate the effect of oil rent on income inequality.

Finally, this paper contributes to the existent literature by showing that, far from being a curse, oil resources, if they are well managed, are a blessing.

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Appendix

Table A1: List of countries

Country	Number of observations	Percentage of the sample
Argentina	11	6.25
Armenia	5	2.84
Azerbaijan	3	1.70
Belarus	8	4.55
Belize	1	0.57
Bolivia	4	2.27
Brazil	4	2.27
Bulgaria	8	4.55
Cape Verde	1	0.57
Chad	1	0.57
China	2	1.14
Colombia	4	2.27
Costa Rica	6	3.41
Dominican Republic	5	2.84
Ecuador	6	3.41
Egypt, Arab Rep.	1	0.57
El Salvador	9	5.11
Ethiopia	1	0.57
Georgia	9	5.11
Guatemala	2	1.14
Honduras	3	1.70
India	1	0.57
Indonesia	1	0.57
Kazakhstan	2	1.14
Kyrgyz Republic	3	1.70
Lithuania	5	2.84
Macedonia, FYR	8	4.55
Malawi	1	0.57
Mexico	2	1.14
Moldova	6	3.41
Nigeria	1	0.57
Panama	5	2.84
Paraguay	6	3.41
Peru	9	5.11
Romania	7	3.98
Russian Federation	3	1.70
Tajikistan	1	0.57
Ukraine	5	2.84
Uruguay	8	4.55
Venezuela, RB	8	4.55