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The impact of abundancy of resources and regime type on income inequality: The case of less-developed countries

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Abstract

This paper examined the effects of natural resource abundance on income inequality for lower-and higher-income earners in less-developed countries, as well as the effect of natural resources and the existence of democracy on the distribution of income. In light of previous studies, this study used panel data and a fixed-effects econometric model, which took into account the individuality of each less-developed country, to examine the effects of natural resource abundance on income inequality in lower- and higher-income brackets in less-developed countries. In the case of less-developed countries with natural resource abundance, we found that democratic countries experienced less income inequality than non-democratic countries. In addition, current economic standing and natural resource abundance had varying, yet significant, results; low-income less-developed countries generally had less income inequality if they lacked an abundance of natural resources. On the other hand, natural resource abundance resulted in less income inequality among high-income, less-developed countries. Regardless of current economic standing, our results showed an abundance of natural resources leads to a more rapid decline in income inequality over time—so long as that country continues on its path of economic growth.

Introduction

Kuznets (1955), in his benchmark study, demonstrated that the process of economic growth reduced income inequality by increasing per capita income. He showed an increase in income inequality at the beginning of a growth cycle was followed gradually by a reduction of income inequality. The study led to the famous Kuznets Curve, describing an inverted U-shaped, gradual increase in income inequality in the early stages of economic growth and a gradual decrease in income inequality in the later stages of the growth. In recent examinations of the impact of economic growth on income inequality (for example, Gelb, 1998; Leamer, Mual, Rodriguez, & Schott, 1999; Ross, 1999), the authors first replicated the Kuznets inverted U-shape curve with their available data; then, they used it as a benchmark to explain their findings. However, we think that these studies do not directly relate to the circumstances of a less-developed country for three important reasons:

First, in several studies the samples consisted of more high-income countries and few less-developed countries. Kuznets' own initial study examined data from Germany, the United Kingdom and the United States. This ignores elements of homogeneity that otherwise would prevail if the countries commonly known as less developed had been separated from high-income countries. The high-income

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countries have a long and sustained tradition of economic growth, as well as established and matured legal, political, and financial systems. Less-developed countries lack long and sustained economic growth and well-established social, financial, and political systems. Due to these shortcomings, one expects that the path of economic growth, and its impact on income inequality, will differ from those in high-income countries. Auty (2001) supports this expectation.

Second, many studies lump all less-developed countries together and treat that data as homogeneous. In many cases, the engine that drives economic growth in less-developed countries is natural resource exports. Revenue from these exports is used, in part, for domestic investment and subsequent economic growth (Leach & Gowen, 1987). The impact of less-developed countries' natural resource endowment on their economic growth and, by implication, on their income inequalities has been well studied (Deaton, 1999; Glaeser, La Porta, Lopez-de-Silanes, & Shleifer, 2004; Grossman & Helpman, 1996; Ross, 2003). However, not all less-developed countries have natural resource abundance and treating them as homogeneous can be misleading.

Third, few studies since Kuznets' 1955 benchmark have examined the existence of "democracy" or "lack of democracy" as one of the factors affecting income inequality in the event of economic growth for less-developed countries. Higher income countries are commonly governed by democratic systems where residents of the countries in the lower end of the income distribution can use the available instruments of checks and balances for bargaining to improve income levels and, by implication, reduce income inequality. These check and balance instruments are not available in most less-developed countries.

In light of previous studies as outlined above, this study used panel data and a fixed-effects econometric model, which takes into account the individuality of each less-developed country to:

1. Examine the effects of natural resource abundance on income inequality in the lower and higher-income less-developed countries. A panel data and fixed-effects econometric model takes into account the individuality of each less-developed country in our empirical study.
2. Examine the effect of natural resources and the existence of democracy on the distribution of income.

Further, an empirical examination of the impact of natural resource endowment on income distribution for less-developed countries should separate the low and high-income, less-developed countries to avoid the elements of heteroskedasticity. In this study, by separating the low-income, less-developed countries from the high-income, less-developing countries, we generated samples that avoided these econometric problems.

Literature Review

The impact of economic growth on income inequality has been extensively investigated in the economic literature dating back to 1955 and Kuznets' benchmark article. Only recently have economists started to consider the possession and abundance of natural resources as the engine of economic growth in many less-developed countries and, by implication, started to examine the impact of abundance of the resources on income inequality in those countries. In this context, the consensus of the studies is that countries with natural resource abundance suffer more income inequality than those that do not have abundance of natural resources. For example, Grossman and Helpman (1996) illustrated that an increase in natural resources will increase income inequality because it tends to promote corruption and greed among policy makers. Similarly, Deaton (1999) found that ownership of natural resources in the less-developed countries is often in the hands of a few elites and, therefore, when prices of these resources increase in international markets, more unequal income distribution results. Rodriguez and Sachs (1999) warned that an abundance of natural resources signals to the people a false sense of security and leads governments in the wrong direction regarding what is important for economic growth. Sachs and Warner (1999) showed that the lower the share of natural resources of less-developed countries as a percentage of their total exports, the faster their economic growth—and the lower their income inequalities. The literature reviewed asserts that a developing country possessing an abundance of natural resources will likely experience greater income inequality and slower economic growth in comparison to a developing country possessing less natural resources.

Government in less-developed countries is also affected by the presence of natural resources. Ross (1999, 2003) argued that revenue generated from natural resources undermines development through "rentier effects," generating corruption. He conjectured that a lack of democracy exacerbates corruption and income inequality. Acemoglu, Johnson, and Robinson (2001) concurred with Ross, arguing that political and economic transformation begins with a small group of elites monopolizing the resources. This monopolization of resources leads to more income inequality.

Leamer, Maul, Rodriguez, and Schott (1999) showed that the economies of the countries whose growth depends on natural resources tend to have a low trade balance. They asserted that more-developed countries use their developed industries and levels of education to reduce imports of natural resources from less-developed countries. To combat this situation, according to Leamer et al. (1999), the resource-rich, less-developed countries reduce prices to increase export revenues—to no avail. Despite the reduction in prices, income inequality increases.

When nations discover an increase in natural resources, they may begin to impede their own growth—economically and socially. Frankel and Romer (1999) showed that on many occasions, the discovery and exploitation of natural resources in less-developed countries leads to deindustrialization, or "Dutch Disease," where the discovery and exploitation of natural resources impedes the growth of manufacturing and service industries by shifting workers from these sectors to the extraction of natural resources. They concluded that lack of growth in the manufacturing and service industries leads to a more-unequal income

distribution. This shows that an increase in revenues from the sale of natural resources will create unstable social and political systems. Tornell and Lane (1999) illustrated the discovery of natural resources in some Latin American and Sub-Saharan African countries led to civil and social unrest. The unrest destroyed economic activity, inhibited economic growth, and further increased income inequality. Durham (1999) found that the type of government a country possesses is a crucial factor influencing income inequality. Bardhan (1997) argued that countries with natural resources ruled by elite politicians, in an effort to prevent loss of control over the population, tend to refuse industrialization. He concluded that the increased revenue from the sale of natural resources in these countries enlarges the already substantial gap between the rich and poor. This large spread in income eventually affects political stability.

Much of the literature derives a correlation between democracy and economic growth. Barro (1997) reported that "the positive relation between democracy and prior measures of prosperity is well established as an empirical regularity." Easterly (1999) defined growth and stability as related to political stability, concluding that democracy is more stable and better at fostering growth. Dollar and Kraay (2002) supported the freedom of movement of goods and people to improve growth, suggesting supportive government. Further, they observed that economic growth provides income gains to lower income people; and, these gains tend to endure for the poorer elements of society. This implies a reduction of income inequality.

The review of the literature revealed two interesting observations: First, the abundance of natural resources leads to more income inequality. Second, while none of the studies have examined explicitly whether the existence or lack of democracy is a determinant of income equality, we conclude from the available literature that a lack of democracy exacerbates income inequality in the less-developed countries.

Materials and Methods

Classification of Less Developed Countries by Income, Natural Resource Abundancy, and Level of Democracy

Classification by Income

The World Bank (2016b) classifies less-developed countries by their levels of per capita income. The classification leads to two categories: low-income, less-developed countries and high-income, less-developed countries. In our analysis, we also separated the low-income, less-developed countries from the high-income, less-developed countries. The low-income countries have many social, political, and economic and financial characteristics that are similar to each other and are different from those of high-income countries. This classification allowed us to create more homogenous samples for estimation of our econometric model. In particular, this classification reduced heteroskedasticity that otherwise might have influenced our estimates. Since we used panel data in our study, efforts were made to make ensure that a low-income, less-developed country did not switch to a high-income, less-developed country, and *vice versa*, over time.

Classification by Natural Resources Abundance

The United Nations (2016) classifies the less-developed countries by the number and amount of natural resources that each country possesses. In this classification, natural resources are broadly defined. For example, fossil fuels as a natural resource include crude oil, shale oil, oil sands, and natural gas liquids. Metal ores, as another natural resource, include lead, chromium, zinc, arsenic, gold, and silver. Wood production refers to all wood available in the rough, whether destined for industrial or fuelwood uses (FAOSTAT, 2016). If exports of natural resources constitute 10% or more of a country's net exports, then it is classified as having natural resource abundance (World Bank, 1997).

To generate more homogenous samples, we divided the less-developed countries into four categories:

1. low-income, less-developed countries with natural resource abundance
2. low-income, less-developed countries without natural resource abundance
3. high-income, less-developed countries with natural resource abundance
4. high-income, less-developed countries without natural resource abundance

In our classification, as suggested by Leamer et al. (1999), we considered only those countries possessing natural resources that made up at least 10% of their GDP; so no country could jump from one of our four categories to another over time. Four fixed-effects econometric models were applied, with one for each category.

Classification by Level of Democracy

Freedom House (2016) used a comprehensive list of criteria to measure the level of prevailing democracy in every country. Based upon the criteria, it constructed an index, known as the Freedom House Index, ranking the countries in terms of levels of democracy. The index can be used to compare the level of democracy prevailing in one country with that prevailing in other countries. The range of the index is from 1 to 7. Countries with an index value of 4 or less are labeled as democratic; countries with an index value above 5 being labeled as non-democratic.

Again, to create homogeneity in our samples, we divided the less-developed countries into:

1. democratic, less-developed countries with natural resource abundance
2. non-democratic, less-developed countries with natural resource abundance.

Essentially, we took the collection of less-developed countries that have the same degree of natural resource abundance and divided them into two categories according to their level of democracy. Controlling for natural resource abundance, this categorization allowed us to see how income inequalities within the less-developed countries are affected by the existence of a democracy.

Model and the Sources of Data

To explain the effects of natural resource abundance and the effects of the existence of democracy (or lack thereof) on income inequalities of less-developed countries, we used panel data to estimate a fixed-effects, one-way error component regression model. In this study, six fixed effects regression models were run for six different categories for a total of 150 less-developed countries that we created and compared. A typical model has the following structure (Chang & Ram, 2000; Edwards & McGuirk, 2004; Kuznets, 1955):

The original Kuznets Model

$$G_{it} = \alpha_i + \alpha_1 GDPP_{it} + \alpha_2 GDPP_{it}^2 + \varepsilon_{it} \quad (1)$$

Pooled effects regression

$$G_i = \beta_i + \beta_1 GDPP_{it} + \beta_2 GDPP_{it}^2 + \beta_2 low + \beta_4 lGDPP_{it} + \beta_5 lGDPP_{it}^2 + \beta_6 T + \beta_7 Ts + \varepsilon_{it} \quad (2)$$

Fixed effects regression

$$G_{it} = \alpha_i + \alpha_1 GDPP_{it} + \alpha_2 GDPP_{it}^2 + \varepsilon_{it} \quad (3)$$

$$\varepsilon_{it} = \upsilon_i + \mu_{it} \quad (4)$$

$$\alpha_i = \alpha_0 + \alpha_3 Z_i \quad (5)$$

where Z_i represents unobserved characteristics and α_0 and α_3 are coefficients. In this one-way error model, υ_i denotes the time-invariant and unobservable country-specific effects; μ_{it} denotes the remainder disturbance with a mean of zero and a variance-covariance of $\sigma_\nu^2 I_{nt}$ (Baltagi, 1995).

In this model, G_{it} measures income inequality for country i at time t and G_{it} is the Gini coefficient. $GDPP_{it}$ measures the natural logarithm of per capita income for country i at time t, and $GDPP_{it}^2$ measures the squared logarithm of per capita income of country i at time t. The model empirically examines the validity of the Kuznets inverted U-shaped curve; and, if the Kuznets inverted-U shaped curve is validated by the data, then the coefficient of $GDPP_{it}$ is used to infer the distribution of income within each country. Thus, we expect α_1 and β_1 to be positive, and α_2 and $\beta_2\beta_1$ to be negative. The World Bank (2016a) published data for the Gini coefficients that were drawn from the updated version of the Deininger and Squire (1996) dataset.

The data for per capita income were drawn from the World Bank's World Development Indicators, 2016 database (World Bank, 2016a). The panel data covers 46 years, from 1970 to 2015.

$LGDPP_{it}$ is the natural logarithm of income per capita for low-income country *i* at time *t*. $LGDPP_{it}^2$ is the squared term for income per capita for low-income country *i* at time *t*. From the Kuznets hypothesis, we infer that β_4 is positive and β_5 is negative. Low-income countries were used in our pooled regression Table 1 to determine if separate regressions for low- and high-income, less-developed countries were needed. Significance for the low-income, developed countries dummy, low, $LGDPP_{it}$, and $LGDPP_{it}^2$ would require separate regressions for the two different groups of countries (low- and high-income developed counties). The same treatment would be necessary if significance was found for regime type (democratic/non-democratic).

Results and Discussion

Statistical Evidence

In this section, we discuss the effects that natural resource abundance has on income inequality. To determine which regression results to use (fixed effects or OLS regression), we had to evaluate an F test to determine whether the income level dummy variables exerted a large enough collective effect to be included in the final model. The F test compared the overall fit of the model equation, including the dummies, to a revised equation that dropped

Table 1
Results for fixed effects and OLS regressions (Regression 1)

	Fixed effects regression		OLS Regression	
	Countries without natural resource abundance	Countries with natural resource abundance	Countries without natural resource abundance	Countries with natural resource abundance
$GDPP_t$	9.48[a] (8.62)	12.28[a] (7.21)	4.73[a] (9.15)	6.82[a] (3.77)
$GDPP_t^2$	−0.63[a] (−6.65)	−1.08[a] (−4.58)	−1.06[a] (−11.34)	−2.07[a] (−4.94)
$L\,GDPP_t$	18.68[a] (3.33)	23.33[a] (2.27)	6.61[a] (0.11)	16.82[a] (5.87)
$L\,GDPP_t^2$	−1.55[a] (−2.68)	−3.31[a] (−5.38)	−1.05[a] (−0.02)	−0.56[a] (−6.01)
Low	–	–	4.19[a] (6.19)	5.11[a] (7.10)
Trend	0.016[a] (2.15)	0.01[a] (1.27)	0.05[a] (0.39)	0.08[a] (0.67)
Trendsq	−0.00006[a] (−1.83)	−0.00004[a] (−1.03)	−0.02[a] (−0.47)	−0.03[a] (−0.56)
Constant	−0.36[a] (−0.44)	−0.22[a] (−0.24)	1.43[a] (0.24)	22.78[a] (3.12)
	Within $R^2 = 0.4651$	Within $R^2 = 0.4704$	$R^2 = 0.3695$	$R^2 = 0.4202$
	$n = 1316$	$n = 1627$	$n = 1408$	$n = 1316$
	No. Grp = 83	No. Grp = 93		
	Avg = 15.9 *n*/grp	Avg = 17.5 *n*/grp		

Dependent variable is the income inequality coefficient, GINI. Natural resources abundance and income per capita are independent variables. The regression type we chose is a fixed effect regression with auto correlation. The t values are in parentheses. Significance was determined using joint testing for all variables, offered by Green (1990)

[a] Statistically significance at 5% level

the dummies. This was accomplished by calculating the following equation:

$$F = \frac{\left(Rsq\left(\frac{F}{E}\right) - Rsq(OLS)\right)}{n - K - 1} q\left(1 - Rsq\left(\frac{F}{E}\right)\right) \quad (6)$$

We ran two F tests for all our regressions. The equation yields calculated F values of 2.82 for the natural resource abundance regression and 16.5 for the regression of countries without natural resource abundance. The critical F values significantly exceeded this at 2.47, assuming a 1% level of confidence and 120 degrees of freedom. Because the calculated F value did exceed the critical F value, the null hypothesis, which states that the regional dummies exert zero effect, is rejected. Therefore, we chose to use a fixed effects regression.

The results for regression 2 are presented below in Table 2. Columns (2), (3), (4), and (5) report results for each level of natural resources. For both natural resources abundance groups, *GDPP* and $GDPP_{it}^2$ coefficients are significant and with the proper signs, being a positive coefficient for *GDPP* and a negative one for $GDPP^2$. *GDPP* is highly significant and positively related to Gini. $GDPP^2$ is negatively related to the Gini and significant, showing an inverted U-relation between income per capita and income inequality. For the low-income country group, the significance of the coefficients on *Low*, *LGDPP*, and $LGDPP^2$ leads us to conclude that there are differences among countries with different income levels regarding income inequality and number of resources. Thus, a separate regression for each group for low and high-income would be necessary.

Those countries with natural resource abundance whose ratio of natural resource exports as a percentage of net exports are equal to or greater than 10% suffer from higher income inequality than countries without natural resources resource abundance. This is clear by looking at the coefficients for the *GDPP* between the two groups—*GDPP* for natural-resource-abundant countries is much higher than the *GDPP* coefficients in countries that are not abundant with natural resources. Therefore, resource-abundant countries have a higher initial income inequality level, but it declines faster. Table 3.

Ross (2003) found that the natural resources sector may produce greater inequality as it creates unusually high corruption rates, abnormally low rates of democratization, and increases the risk of civil war.

Since we estimated Kuznets' inverted U-shape curve to use as the benchmark to explain our findings, the interpretation of results was based upon the significance and magnitudes of the estimated coefficient of *GDPP* in the second column of Table 2.

From Figure 1, our results clearly show the Kuznets hypothesis in effect, which states that income inequality generally rises at low levels of per capita income. Countries without any natural resource abundance (solid line) have lower income inequality at lower levels of per capita GDP than countries that do possess natural resources. On the other hand, income inequality in resource-abundant countries (dotted line) declines at a faster rate. The results confirmed this, in agreement with the existing literature.

Looking at the *GDPP* coefficients, we could clearly see that they were different between the two groups of countries (countries with and without natural resource abundance). This information led us to conclude that in countries where there is abundance of natural resources, any increase in *GDPP* will further lead to an increase in its early stages to income inequality. This results in a higher

Table 2
Results for all fixed effects regressions: explained variable is income inequality

	Independent variable			
	$GDPP_t$	$GDPP_{it}^2$	Constant	
Democratic, less-developed countries with natural resources abundance	12.47[a] (10.11)	−2.49[a] (−12.38)	1.32[a] (2.72)	$R^2 = 0.3791$; $n = 865$ No. Grp = 60
Non-democratic, less-developed countries with natural resources abundance	18.09[a] (8.12)	−1.93[a] (−8.18)	−8.96[a] (−2.71)	$R^2 = 0.1319$; $n = 1232$ No. Grp = 90
High income, less-developed countries with natural resources abundance	29.65[a] (3.17)	−35.96[a] (−3.36)	93.35[a] (15.66)	$R^2 = 0.1951$; $n = 840$ No. Grp = 27
High income, less-developed countries without natural resources abundance	36.31[a] (3.26)	−27.42[a] (−3.06)	47.08[a] (65.96)	$R^2 = 0.1823$; $n = 938$ No. Grp = 39
Low income, less-developed countries with natural resources abundance	9.92[a] (13.35)	−5.43[a] (−10.87)	29.15[a] (77.82)	$R^2 = 0.4148$; $n = 716$ No. Grp = 38
Low income, less-developed countries without natural resources abundance	6.45[a] (11.23)	−2.82[a] (−10.08)	34.18[a] (85.71)	$R^2 = 0.3906$; $n = 1241$ No. Grp = 46

The t-values are in parentheses
[a] Statistically significant at 1% level or more

Table 3
Summary statistics of each variable

Variable	Mean	SD
Gni	40.95584	8.260993
Gdpperc	6424.352	7819.84
Fuel	9.776084	17.58674
Metal	7.83096	13.9851
Gold	13.91042	21.44072
Wood	34596.94	75240.73
Oil	827.5296	937.3894

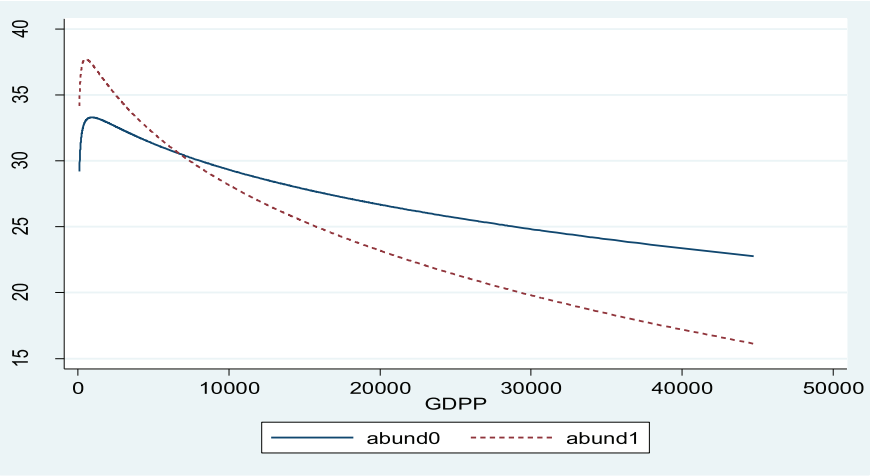

Figure 1 (Pooled regression) Kuznets inverted U curves for countries with natural resource abundance and countries without natural resource abundance, (Gini on the Y-axis) abund0 = countries without natural resource abundance; abund1 = countries with natural resource abundance

placement of the Kuznets Curve, but income inequality decreases faster.

There is evidence which shows that countries that are dependent on natural resources suffer a higher level of income inequality. This behavior, according to the literature review, would result from a cluster of problems. Countries with natural resource abundance:

1. tend to grow slowly (Doppelhofer, Miller, & Sala-i-Martin, 2000; Manzano & Rigobon, 2001)
2. may produce greater inequality, as they have unusually high corruption rates and suffer from abnormally low rates of democratization
3. face an exceptionally high risk of civil war (Collier & Hoffler, 2004).

Interpretations of Results

In the first two categories, we compared democratic and non-democratic countries with the same degree of natural resource abundance. Since the magnitude of the coefficient associated with *GDPP* is smaller for the democratic countries than that for non-democratic countries (comparing 12.47 with 18.09), we concluded that given the same degree of natural resources abundance, income inequality will be lower in those counties that enjoy more democracy. This confirmed a prior hypothesis that the existence of democracy and its system of checks and balances can contribute to the establishment of a more-equal income distribution within those countries that have abundant natural resources.

The second set of countries that we compared with each other were the high-income, less-developed countries with natural resource abundance and the high-income, less-developed countries without natural resource abundance. The comparison revealed that the high-income, less-developed countries with natural resource abundance suffer more inequality but this declines faster without natural resource abundance (Figure 1). Our result differed from the findings of Manzano and Rigobon (2001) and Doppelhofer et al. (2000), who concluded that countries without natural resource abundance suffer more income inequality. We believe that their conclusions differ because they used samples of non-homogeneous countries.

The comparison of low-income, less-developed countries with natural resource abundance and low-income, less-developed countries without natural resources abundance showed that income inequality is more prevalent in the low-income, less-developed countries with natural resources abundance. Surprisingly, when we compared all the categories of the countries, we found that the low-income, less-developed countries without natural resource abundance enjoyed less income inequality than the other categories of countries analyzed. We attributed this to the fact that in a great majority of these countries, poverty is so prevalent that there is little variation in the incomes of their citizens. Unfortunately, they share poverty equally.

Fully understanding the Dutch Disease, the natural resource curse presents a challenge best identified by Sachs and Warner (2001): "Just as we lack a universally accepted theory of economic growth in general, we lack a universally accepted theory of the curse of natural resources." Industrializing economies, a fair and balanced distribution of wealth generated by natural resources (higher employment levels), and building proper institutions (which leads to less conflicts and more manufacturing) could be some obvious answers to escape the curse.

Conflicts of Interest

None.

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