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# Does resource abundance impede growth in services? An empirical study from global panel data

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## Abstract

Most empirical studies on the relationship between natural resource abundance and sectoral output focused on manufacturing and agriculture. Given the growing importance of services both in developed and developing economies for several decades, this article aims to analyze the effects of natural resource abundance on services with special focus on sub-Saharan Africa. Applying the Generalized Quantile Regression (GQR) estimator on panel data from 100 countries over the period 1990-2020, the results reveal that natural resource abundance negatively affects services. Especially, we find robust evidence that natural resource rents have a negative and significant impact on services both for the full sample and in sub-Saharan Africa, suggesting that natural resource abundance impedes the growth in services. Our results are robust to the use of oil and gas rents as an alternative proxy for natural resource abundance, especially for the full sample.

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# 1. Introduction

For several decades, most countries have been experiencing the shift towards services. The service sector is increasingly becoming the main sector in many economies. For example, according to data from the World Bank, in 2019, services accounted for about 70% of GDP and 72% of employment in OECD countries, 68% of GDP and 66% of employment in Latin America and Caribbean, and at least 50% of GDP in sub-Saharan Africa (SSA) and in several other regions in the world. In the literature, several economists (e.g., Engel, 1857; Bell, 1973) support that the shift towards services is, to some extent, due to the shifting of the demand structure towards tertiary needs (services). This increase in demand for services is mainly attributed to an increase in household incomes beyond the necessary level to meet primary and secondary needs. This situation may occur during a resource boom which leads to an increase in demand for services (Corden, 1984). However, until now, very few studies empirically tested the effects of a resource boom on services. Most empirical studies focused on the effects of natural resource abundance on manufacturing and, to a lesser extent, on agriculture. To fill this gap, this article aims to empirically investigate the relationship between natural resource abundance and services.

The relationship between natural resource abundance and services is part of the broader issue of the relationship between natural resource abundance and economic growth. This issue has received considerable attention among scholars and policymakers. However, the results remain controversial and inconclusive. According to some studies (e.g., Fan et al., 2012; Ji et al., 2014; Arin and Braunfels, 2018; Elwasila, 2020), natural resource abundance promotes economic growth, while other studies (e.g., Sachs and Warner, 1997; Arezki and Ploeg, 2010; Kakanov et al., 2018; Shabbaz et al., 2019; Bergougui and Murshed, 2021) suggested that natural resource abundance turns into a curse. The term “resource curse” (also known as the paradox of plenty) was used for the first time by Auty (Auty, 1993; 1998; and 2001). It refers to a situation in which the economic performance of a resource-rich country is poorer than that of a resource-poor country. The resource curse is most common in developing countries, especially in SSA. This situation is mainly attributed to poor institution, the Dutch disease, the lack of the diversification of the economy, and the volatility of commodity prices. Among these factors, the Dutch disease is the most related to the sectoral effects of natural resource abundance. The term “Dutch disease” refers to a situation in which a resource boom negatively affects the other sectors of the economy. This phenomenon is best known following the discovery in the Netherlands of large natural gas deposits in the North Sea in the 1960s. In the literature, the core model of the Dutch disease (Corden and Neary, 1982; Corden, 1984) showed that resource abundance may affect services through two effects, namely the spending effect, and the resource movement effect. The spending effect occurs when a resource boom increases domestic income. This increase in income leads to a rise in demand (and spending) for non-tradables (including services), which increases prices and output in the services sector. As for the resource movement effect, it negatively affects services through an increase in demand for labor and capital in the booming sector. This leads to the transfer of labor and capital from the other sectors (including services) to the booming sector. Thus, in a situation of full employment, the resource movement effect reduces output in the services sector.

In addition to the Dutch disease, the relationship between natural resource abundance and services can be related to the enclave economy theory (especially in the case of developing countries). According to this theory, the effects of natural resource abundance on the rest of the economy are negligible due to a weak link between the resources sector and the other sectors (Bairoch, 1967; Sachs and Warner, 1995; Kelley, 2012). Indeed, in developing countries, most oil, gas and mining companies are majority-owned by foreigners. These foreigner companies

often do not meet local content requirements (such as local employment and subcontracting with local companies). Additionally, in many resource-rich countries, mining infrastructure (especially railways and ports for exports) are exclusively used for mining activities. Hence, these infrastructures do not benefit local populations. Thus, foreign direct investment in the resources sector may create an enclave sector in the host economy (i.e. a sector with few links with the rest of the economy). Furthermore, in SSA, most inputs used in the natural resources sector are imported from abroad (Brahmbhatt et al., 2010). Therefore, according to the enclave economy theory, the potential positive effect of natural resource abundance on services should be limited, particularly in SSA. In the literature, the few studies (e.g. Koitsiwe and Adachi, 2015; Reisinezhad, 2020; Alssadek and Benhin, 2021; Asiamah et al., 2022) related to our issue concluded to a negative impact of natural resource abundance on services.

Based on both Dutch disease and enclave economy theories, we hypothesize that natural resource abundance does not promote services. Indeed, the Dutch disease model showed that a boom in the natural resources sector tends to increase prices in the non-tradables sector (including services), which will decrease demand for services. However, this negative impact on services may vary depending on subsector. For example, a resource boom may particularly affect some traditional services (especially hotel, tourism, restaurant, and transport) due to an increase in prices. In contrast, services with high growth potential like finance and insurance, or IT might not be negatively affected, especially in low-income countries. Because these service subsectors can offer new services to absorb excess demand. Additionally, the negative effect of natural resource abundance on services may be less significant in low-income countries (especially SSA) because of both the limited development of services and the weak link between the booming sector and the rest of the economy.

Concerning the methodology, we employ Generalized Quantile Regression (GQR), which is a robust econometric technique on annual panel data from 100 countries over the period 1990-2020. This econometric method allows for, among others, non-normality, cross-sectional dependence, and non-stationarity of data (Powell, 2020; Byaro et al., 2023a). Additionally, unlike econometric techniques which are based on mean estimation, quantile regression estimates the impact of natural resource rents on services at different quantiles. We pay special attention to the case of SSA, which is an interesting study case because of both the abundance of natural resources and poor economic performance in this region. Additionally, empirical studies focused on the sectoral effects of natural resource abundance in SSA are relatively rare (Asiamah et al., 2022).

This article contributes to the literature providing empirical evidence of the nexus between natural resource abundance and services. Thus, unlike the core model of the Dutch disease which only showed the potential sectoral effects of a resource boom, an empirical study allows to know both the nature and magnitude of the effects of natural resource abundance on services. The findings of this study may help policymakers to understand how resource abundance affects the economy through the services sector. Hence, this may help them to design appropriate strategies to prevent or limit potential negative effects of a resource boom on services.

The remainder of this article is organized as follows: Section 2 provides a brief literature review related to our issue. Section 3 presents data and methodology. Section 4 reports and discusses the results. Section 5 concludes the research with policy implications.

# 2. Related empirical literature

Unlike manufacturing and agriculture, there are very few empirical studies on the effects of natural resource abundance on services. These studies used various natural resources as proxies for natural resource abundance. Overall, the results showed a negative impact of natural resource abundance on services. For instance, Looney (1990) examined the relationship between oil revenues and sectoral output in Saudi Arabia over the period 1965-1985. Using Cochrane- Orcutt two stage iteration estimator, the results showed evidence of the existence of Dutch disease in several economic activities (including some service activities). Koitsiwe and Adachi (2015) employed VAR method to analyze the effects of mining boom on several sectors (including services) in Australia over the period 1975-2013. They found that mining GDP contributes to the variation in the services sector. Pham et al. (2015) analyzed the effects of mining boom on tourism in Australia over the period 2004-2011 using the MMF-TOUR model which consists of several simulations. The results revealed that a mining boom has a negative impact on tourism. Reisinezhad (2020) empirically tested the Dutch disease hypothesis using SGMM method on panel data from 132 countries over the period 1970-2014. The results indicated that natural resource boom harms both manufacturing and services, especially in resource-rich countries. Alssadek and Benhin (2021) investigated the relationship between oil boom and sectoral output using data from 36 oil-rich developed and developing countries over the period 1970-2016. The results from panel data fixed effect with Driscoll-Kraay standard errors estimation approach suggested that an oil boom negatively affects sectoral output (including services) for several regions such as MENA, SSA, European, North America, and Asian and Pacific. Assiamah et al. (2022) empirically tested the Dutch disease in the case of various resources (natural gas, coal, oil, mineral, and total natural resources) using data from SSA over the period 2005-2019. The results from SGMM method showed a negative impact of all these resources, except oil, on services, manufacturing, and agricultural sectors. Unlike these studies, Maranon and Kumral (2021) suggested that resource boom is positively associated with services in Chile for the period 1990-2018. More precisely, using Granger causality and cointegration, their results revealed that the copper boom is positively associated with, among others, non-tradable sectors (including services).

Overall, the results tend to indicate a negative relationship between natural resource abundance and services. However, given a relatively small number of empirical studies focused on services, more studies are necessary to conclude about this issue.

# 3. Data and methodology

## 3.1. Data

This article uses annual panel data from 100 countries (Table AI in Appendices) over the period 1990-2020. All data are obtained from the World Development Indicators (WDI) database of the World Bank. This data includes Services added value, Natural resource rents, GDP per capita, Trade openness, Foreign direct investment, Urban population, Mobile cellular subscriptions, Individuals using the internet, and Access to electricity. Table I gives the definition and source of each variable.

**Table I. Description of variables**

| Name of variable | Symbol | Unit | Source |
|---|---|---|---|
| Services added value | Services | % of GDP | WDI |
| Natural resource rents | Resources | % of GDP | WDI |
| GDP per capita | GDP | Constant 2005 US$ per capita | WDI |
| Trade | Trade | % of GDP | WDI |
| Foreign Direct Investment | FDI | % of GDP | WDI |
| Urban population | Urban | % of total population | WDI |
| Mobile cellular subscriptions | Mobile | Per 100 people | WDI |
| Individuals using the internet | Internet | % of population | WDI |
| Access to electricity | Electricity | % of population | WDI |

Table II provides summary statistics of the variables used in this study. For example, on average, services account for 51.91% of GDP with a standard deviation of 11.03%. The wide gap between the minimum (10.86%) and the maximum (87.42%) shows a wide variation in services among countries. Regarding resources, the mean is 6.50% of GDP with a standard deviation of 9.5%. The wide gap between the minimum (0%) and the maximum (66.65%) proves the wide variation in natural resource rents among countries.

Regarding the normality test, the Jarque-Bera test results indicate that the p-value is lower than 1% for all variables, suggesting that our data are not normally distributed.

**Table II. Summary statistics**

| Variable | Obs. | Mean | Std. Dev. | Min. | Max. | J-B. Chi (2) value |
|---|---|---|---|---|---|---|
| **Services** | 3057 | 51.913 | 11.034 | 10.859 | 87.421 | 13.63** |
| **Resources** | 3094 | 6.437 | 9.504 | 0 | 66.653 | 1.2e+04*** |
| **GDP** | 3100 | 10556.12 | 15785 | 190.234 | 87123.66 | 5150*** |
| **Trade** | 2928 | 74.771 | 44.632 | 0.021 | 437.326 | 3.5e+04*** |
| **FDI** | 3073 | 3.638 | 11.156 | -104.059 | 279.347 | 1.2e+07*** |
| **Urban** | 3100 | 54.694 | 22.250 | 5.416 | 100 | 141*** |
| **Mobile** | 3100 | 51.774 | 51.936 | 0 | 185.559 | 311.6*** |
| **Internet** | 3046 | 22.081 | 28.425 | 0 | 98.046 | 692.5*** |
| **Electricity** | 2719 | 76.896 | 30.882 | 0.534 | 100 | 531.8*** |

Note: ***p value < 0.01, **p value < 0.05 and *p value < 0.10.

To check the multicollinearity among the independent variables, we use correlation matrix and variance inflation factors (VIF) tests.

The correlation matrix is given in Table III. The results show a strong correlation among several variables. For example, according to the results, there is a strong positive correlation between internet and mobile (0.924), between urbanization and GDP per capita (0.757), between urbanization and electricity (0.696), and between electricity and GDP per capita (0.666). This may indicate a potential multicollinearity problem among the independent variables. Hence, we test the multicollinearity among the independent variables using the VIF tests. Table IV displays the VIF values for all variables. The results indicate that the VIF value is lower than 10 for all variables. This implies that there is not a major problem of multicollinearity among the independent variables. Therefore, the regression results of this study are free from multicollinearity problems.

To eliminate the difference in scale between data, we transform all our variables into logarithm with the exception of FDI which includes many negative values. This also makes data more closely to normal data by reducing their skewness. Additionally, log transformation makes the interpretation of the coefficients of variables in the regression easier to interpret (like elasticities).

**Table III. Correlation matrix of variables**

| | ln(Resources) | ln(GDP) | ln(Trade) | FDI | ln(Urban) | ln(Mobile) | ln(Internet) | ln(Electricity) |
|---|---|---|---|---|---|---|---|---|
| **ln(Resources)** | 1.0000 | | | | | | | |
| **ln(GDP)** | -0.477 | 1.0000 | | | | | | |
| **ln(Trade)** | -0.299 | 0.264 | 1.0000 | | | | | |
| **FDI** | -0.151 | 0.096 | 0.204 | 1.0000 | | | | |
| **ln(Urban)** | -0.287 | 0.757 | 0.216 | 0.083 | 1.0000 | | | |
| **ln(Mobile)** | -0.096 | 0.354 | 0.236 | 0.106 | 0.328 | 1.0000 | | |
| **ln(Internet)** | -0.178 | 0.476 | 0.254 | 0.108 | 0.414 | 0.924 | 1.0000 | |
| **ln(Electricity)** | -0.339 | 0.666 | 0.253 | 0.058 | 0.696 | 0.376 | 0.483 | 1.0000 |

Note: The variables are converted into a natural logarithmic format except FDI which includes many negative values.

**Table IV: Variance Inflation Factors (VIF)**

| Variable | VIF | 1/VIF |
|---|---|---|
| **ln(Resources)** | 1.43 | 0.698 |
| **ln(GDP)** | 3.29 | 0.304 |
| **ln(Trade)** | 1.20 | 0.836 |
| **FDI** | 1.06 | 0.943 |
| **ln(Urban)** | 2.87 | 0.348 |
| **ln(Mobile)** | 7.58 | 0.132 |
| **ln(Internet)** | 8.73 | 0.114 |
| **ln(Electricity)** | 2.32 | 0.432 |

## 3.2. Methodology

Using the Jarque-Bera test for testing the normality of our data, the results show that data are not normally distributed (Table 2) even after transforming them into natural logarithm (Table AII in appendices). Based on these results, we employ a quantile regression approach. Unlike standard regression techniques (especially OLS), quantile regression allows non-normality of data. It is also robust to outliers and heavy distributions (Chen and Lei, 2018). Proposed by Koenker and Bassett (1978), quantile regression is based on median estimates. It is employed to estimate the relationship between the dependent variable and the independent variables at different quantiles. Additionally, quantile regression considers distributional heterogeneity and the unobserved individual (Khan et al., 2020; Bilgili et al., 2022).

Specifically, we use Generalized Quantile Regression (GQR), which is a robust version of standard quantile regression. Developed by Powel (2020), this estimator is calculated using adaptive Markov Chain Monte Carlo (MCMC) sampling and distribution (Powell, 2020; Byaro et al., 2023b). Unlike other versions of quantile regression, Generalized Quantile Regression (GQR) allows for cross-sectional dependence and non-stationarity (Powell, 2020; Byaro et al., 2023b). Hence, the use of Generalized Quantile Regression does not require cross-sectional dependence and unit root tests. Thus, using Generalized Quantile Regression, we want to empirically examine the relationship between natural resource abundance and services.

The complete model is presented as follows:

$$\ln(\text{Services}_{it}) = \beta_0 + \beta_1 \ln(\text{Resources}_{it}) + \beta_2 \ln(\text{GDP}_{it}) + \beta_3 \ln(\text{Trade}_{it}) + \beta_4 \ln(\text{Urban}_{it}) + \beta_5 \text{FDI}_{it} + \beta_6 \ln(\text{Mobile}_{it}) + \beta_7 \ln(\text{Internet}_{it}) + \beta_8 \ln(\text{Electricity}_{it}) + \varepsilon_{it} \quad (1)$$

Where $i$ denotes the country index, $t$ denotes the time index, and $\varepsilon_{it}$ the error term.

# 4. Results and discussion

## 4.1. Main results

Tables V to VIII present the Generalized Quantile Regression estimates on the effects of natural resources abundance on services. The results are presented at $10^{th}$, $25^{th}$, $50^{th}$, $75^{th}$, and $90^{th}$ quantiles for each Table. These quantiles are the most common in studies. Two samples are used in this study, namely the full sample which includes 100 countries, and a sub-sample which includes 30 SSA countries. To avoid outlier observations in the SSA sample, we exclude South Africa. Indeed, given the wide gap between South Africa and the other SSA countries in terms of the development level (such as infrastructure, access to electricity, internet, and the telephone penetration), data on South Africa may occur as outlier observations among that on SSA countries. This would potentially skew the results.

Table V gives regression results for the full sample. As expected, the results show that natural resource abundance lowers services. We find that natural resource rents have a negative and significant impact (at the 1 % significance level) on services at all quantiles. However, the magnitude of this impact varies across different quantiles (from -0.061 at $10^{th}$ quantile to -0.035 at $75^{th}$ quantile). According to the results, a 1% increase in GDP per capita decreases services by 0.061 % at $10^{th}$ quantile, while it causes a fall in services by 0.035 % at $75^{th}$ quantile. These findings tend to be consistent with the core model of the Dutch disease that suggested that a resource boom decreases the non-tradable sector (including services) through spending and resource movement effects. These results can be explained, on the one hand, by the fact that, a strong increase in demand for services (especially tourism, restauration, and transports) in a situation of resource boom tends to impede the growth in services through a rise in prices, and on the other hand, by the transfer of labor and capital from services to the natural resources sector. These results are also consistent with several studies such as Pham et al. (2015), Reisinezhad (2020), and Assiamah et al. (2022) that revealed a negative relationship between natural resource abundance and services.

Concerning the control variables, the results indicate that GDP per capita, FDI, and internet tend to promote services, while trade openness, urbanization, and electricity are negatively associated with services. These effects are statistically significant (at the 1% significance level) at all quantiles for all variables with the exception of mobile. The positive effect of GDP per capita on services is higher (0.069) at the lowest quantile ($10^{th}$ quantile), while it is lower (0.024) at the highest quantile ($90^{th}$ quantile). The findings for GDP per capita are in line with some studies (e.g., Salam et al., 2018; Alssadek and Benhin, 2021) that revealed a positive effect of GDP per capita on services. Furthermore, some economic theories (such as the "three-sector model" constituted by Clark, Fisher, and Fourastié) claims that the demand for services tends to rise as the income increases. For FDI, the results are consistent with Salam et al., (2018) that found a positive relationship between FDI and services for both developing and developed countries. As for internet, the results support the idea that IT fosters services such as e-commerce, finance and insurance. For trade openness, the findings are similar to these obtained in Salam et al. (2018) and Ndubuisi et al. (2023) that suggested that higher trade openness hinders the growth in services. This can be explained by the fact that trade openness tends to foster trade in goods to the detriment of services due to the preponderance of trade in goods between countries. For electricity and urbanization, the negative effects on services seem counterintuitive. Furthermore, for electricity, these results are not confirmed in all regressions, especially in the case of SSA (Tables VI and VIII). Regarding urbanization, these findings are partly consistent with Mendez et al. (2022) that revealed that urbanization decreases productivity in services in developing countries, while it boosts productivity in services in

developed countries. Finally, for mobile, we find mixed results. Additionally, this impact is not statistically significant at lowest quantiles ($10^{th}$ and $25^{th}$).

**Table 5: Effects of natural resources rents on services (Full sample)**

| Explanatory variables | Q10 | Q25 | Q50 | Q75 | Q90 |
|---|---|---|---|---|---|
| **Constant** | 4.451*** (0.081) | 4.499*** (0.057) | 4.461*** (0.036) | 3.998*** (0.013) | 4.082*** (0.067) |
| **ln(Resources)** | -0.058*** (0.002) | -0.061*** (0.001) | -0.043*** (0.001) | -0.035*** (0.001) | -0.051*** (0.001) |
| **ln(GDP)** | 0.069*** (0.002) | 0.048*** (0.002) | 0.034*** (0.002) | 0.030*** (0.001) | 0.024*** (0.001) |
| **ln(Trade)** | -0.157*** (0.010) | -0.205*** (0.009) | -0.137*** (0.004) | -0.063*** (0.001) | -0.063*** (0.006) |
| **ln(Urban)** | -0.128*** (0.012) | -0.030*** (0.009) | -0.023*** (0.008) | -0.009** (0.004) | 0.088*** (0.005) |
| **FDI** | 0.001*** (0.001) | 0.001*** (0.001) | 0.001*** (0.001) | 0.001*** (0.001) | 0.001*** (0.001) |
| **ln(Mobile)** | -0.002 (0.004) | -0.004 (0.004) | -0.021*** (0.003) | -0.009*** (0.001) | 0.025*** (0.001) |
| **ln(Internet)** | 0.034*** (0.004) | 0.028*** (0.003) | 0.046*** (0.003) | 0.019*** (0.001) | -0.014*** (0.002) |
| **ln(Electricity)** | -0.036*** (0.002) | -0.020*** (0.004) | -0.028*** (0.007) | 0.024*** (0.002) | -0.068*** (0.006) |
| **Obs.** | 2370 | 2370 | 2370 | 2370 | 2370 |

Note: Estimation results generated by Stata 19. ***p value < 0.01, **p value < 0.05 and *p value < 0.10 standard error in parentheses.

Table VI provides the results of the regressions addressing the effects of natural resource abundance on services in SSA. Like for the full sample (Table V), the results suggest that natural resource rents are negatively associated with services in SSA. This impact is statistically significant at the 1% significance level at all quantiles. We also find that the magnitude of the coefficients varies across different quantiles. For example, an increase in natural resource rents leads to a decrease in services by 0.02 % at $75^{th}$ quantile, while it causes a 0.069 % services fall. Like for the full sample (Table V), these results are in line with both the core model of the Dutch disease and several studies (e.g., Pham et al., 2015, Reisinezhad, 2020, and Assiamah et al., 2022).

Regarding the control variables, the results are similar to those obtained for the full sample for several control variables. Indeed, the sign of the coefficients is the same for Urban, FDI, Mobile, and Internet. For example, for urbanization, like for the full sample, our results suggest a negative and significant impact on services at the 1% significance level at all quantiles with the exception of $90^{th}$ quantile. As we highlighted earlier, this finding is consistent with Mendez et al. (2022) that found a negative relationship between urbanization and services in developing countries. However, for the other control variables (GDP, trade openness, and electricity), the results are not similar to those obtained for the full sample. For GDP per capita, the results suggest that it, overall, negatively and significantly affects services in SSA. This finding tends to be in line with Ndubuisi et al. (2023) that revealed that real GDP per capita hinders the growth in services in Africa. This can be explained by the spending effect, which means that an increase in income leads to a higher demand for services. This will increase prices, and as a result a fall in demand and output in the services sector. This phenomenon may particularly affect developing countries (especially SSA) due to the limited development of services. For trade openness, we find mixed results. Indeed, the results show that trade openness has a positive and significant effect at $10^{th}$ and $90^{th}$ quantiles at the 1% significance level, a negative and significant effect at $25^{th}$ and $50^{th}$ quantile, and an insignificant effect at $75^{th}$ quantile on services. Finally, in contrast with the results for the full sample, the results reveal that there is a positive relationship between electricity and services at all quantiles, with the exception of $10^{th}$ quantile in SSA. These results can be explained by the fact that electricity is a key input to the production of many services.

**Table VI: Effects of natural resources rents on services (SSA)**

| Explanatory variables | Q10 | Q25 | Q50 | Q75 | Q90 |
|---|---|---|---|---|---|
| **Constant** | 3.956*** (0.005) | 5.023*** (0.209) | 4.823*** (0.064) | 4.288*** (0.115) | 3.874*** (0.071) |
| **ln(Resources)** | -0.066*** (0.001) | -0.069*** (0.008) | -0.052*** (0.002) | -0.020*** (0.007) | -0.022*** (0.002) |
| **ln(GDP)** | 0.031*** (0.001) | -0.088** (0.044) | -0.111*** (0.008) | -0.034** (0.017) | -0.027*** (0.005) |
| **ln(Trade)** | 0.022*** (0.001) | -0.047*** (0.014) | -0.014** (0.006) | 0.016 (0.011) | 0.016*** (0.004) |
| **ln(Urban)** | -0.116*** (0.001) | -0.189*** (0.029) | -0.107*** (0.011) | -0.138*** (0.028) | 0.011 (0.012) |
| **FDI** | 0.001*** (0.001) | 0.006*** (0.001) | 0.003** (0.001) | 0.006*** (0.001) | 0.005*** (0.001) |
| **ln(Mobile)** | -0.007*** (0.001) | -0.023*** (0.008) | -0.044*** (0.004) | -0.046*** (.013) | -0.020*** (0.002) |
| **ln(Internet)** | 0.029*** (0.001) | 0.054*** (0.012) | 0.071*** (0.005) | 0.068*** (0.016) | 0.019*** (0.002) |
| **ln(Electricity)** | -0.047*** (0.001) | 0.086** (0.036) | 0.105*** (0.007) | 0.116*** (0.008) | 0.084*** (0.011) |
| **Obs.** | 636 | 636 | 636 | 636 | 636 |

Note: Estimation results generated by Stata 19. ***p value < 0.01, **p value < 0.05 and *p value < 0.10 standard error in parentheses.

## 4.2. Robustness tests

To check the robustness of our empirical findings on the relationship between natural resource abundance and services, we employ an alternative proxy of resource abundance as a variable of interest. We use oil and gas rents (of % GDP) which are obtained from the World Development Indicators (WDI) database of the World Bank.

Table VII depicts the regression results for the full sample. According to these results, oil and gas rents have adverse effects on services at all quantiles. We also find that these effects are statistically significant at the 1% significance level. These findings are consistent with those obtained in Table V that indicate a significant and negative impact of natural resource rents on services at the 1% significance level.

**Table VII: Effects of oil&gas rents on services (Full sample)**

| Explanatory variables | Q10 | Q25 | Q50 | Q75 | Q90 |
|---|---|---|---|---|---|
| **Constant** | 4.885*** (0.067) | 5.239*** (0.236) | 5.129*** (0.034) | 4.371*** (0.049) | 4.449*** (0.089) |
| **ln(Oil&Gas)** | -0.006*** (0.001) | -0.003*** (0.001) | -0.003*** (0.001) | -0.002*** (0.001) | -0.003*** (0.001) |
| **ln(GDP)** | 0.105*** (0.001) | 0.126*** (0.007) | 0.107*** (0.001) | 0.096*** (0.003) | 0.087*** (0.001) |
| **ln(Trade)** | -0.038*** (0.001) | -0.214*** (0.013) | -0.202*** (0.003) | -0.098*** (0.002) | -0.067*** (0.004) |
| **ln(Urban)** | -0.359*** (0.015) | -0.356*** (0.041) | -0.261*** (0.006) | -0.143*** (0.013) | -0.124*** (0.003) |
| **FDI** | -0.002*** (0.001) | -0.001 (0.001) | 0.007*** (0.001) | 0.003** (0.001) | 0.001*** (0.001) |
| **ln(Mobile)** | -0.023*** (0.001) | -0.014*** (0.002) | -0.048*** (0.002) | 0.014*** (0.001) | -0.015*** (0.004) |
| **ln(Internet)** | 0.055*** (0.001) | 0.027*** (0.002) | 0.054*** (0.001) | 0.002 (0.002) | 0.019*** (0.004) |
| **ln(Electricity)** | -0.114*** (0.006) | -0.039** (0.017) | -0.045*** (0.002) | -0.054*** (0.016) | -0.073*** (0.015) |
| **Obs.** | 1260 | 1260 | 1260 | 1260 | 1260 |

Note: Estimation results generated by Stata 19. ***p value < 0.01, **p value < 0.05 and *p value < 0.10 standard error in parentheses.

The results on the effects of oil and gas rents on services in SSA are displayed in Table VIII. These results show that, overall, oil and gas rents have a negative impact on services in SSA. However, this impact is statistically insignificant at 25$^{th}$, 50$^{th}$, and 75$^{th}$ quantiles. This can be explained by the limited development of the services sector in SSA and the weak link between the booming sector and the rest of the economy. Furthermore, these findings are supported by some economic theories (in particular, the "three-sector model" constituted by Clark, Fisher, and Fourastié) that stipulate that the share of services in an economy is lowest in the first stage of the development process of a country. Additionally, these findings may be partially explained by the negligence of some service activities (especially tourism) in many

resource-rich countries in developing countries. For example, although some resource-rich countries hold tremendous tourism potential, the tourism sector is less developed in these countries than in resource-poor countries due to their heavy dependence on the resources sector. This is the case of some resource-rich countries such as Guinea, Angola, and Algeria where the tourism sector is relatively less developed.

**Table VIII: Effects of oil & gas rents on services (SSA)**

| Explanatory variables | Q10 | Q25 | Q50 | Q75 | Q90 |
|---|---|---|---|---|---|
| **Constant** | 2.612*** (0.065) | 6.878*** (1.217) | 7.093*** (0.364) | 6.123*** (0.368) | 4.990*** (0.008) |
| **ln(Oil&Gas)** | -0.005*** (0.001) | 0.018 (0.138) | 0.004 (0.004) | -0.001 (0.003) | -0.001*** (0.001) |
| **ln(GDP)** | -0.568*** (0.011) | -0.724*** (0.138) | -0.325*** (0.078) | -0.143*** (0.023) | -0.123*** (0.002) |
| **ln(Trade)** | -0.070*** (0.005) | -0.107*** (0.021) | 0.019 (0.043) | 0.025 (0.045) | -0.090*** (0.001) |
| **ln(Urban)** | 0.494*** (0.031) | -0.246 (0.189) | -0.805*** (0.145) | -0.534*** (0.119) | -0.029*** (0.004) |
| **FDI** | 0.020*** (0.002) | -0.004 (0.005) | 0.001 (0.002) | -0.002 (0.003) | -0.001*** (0.001) |
| **ln(Mobile)** | 0.020*** (0.002) | 0.031** (0.015) | 0.035* (0.019) | -0.029** (0.014) | -0.046*** (0.001) |
| **ln(Internet)** | -0.091*** (0.002) | -0.007 (0.018) | 0.008 (0.022) | 0.076*** (0.014) | 0.081*** (0.001) |
| **ln(Electricity)** | 0.922*** (0.009) | 0.835*** (0.029) | 0.519*** (0.076) | 0.210*** (0.027) | 0.088*** (0.002) |
| **Obs.** | 124 | 124 | 124 | 124 | 124 |

Note: Estimation results generated by Stata 19. ***p value < 0.01, **p value < 0.05 and *p value < 0.10 standard error in parentheses.

Based on these results (Tables VII and VIII), we demonstrate that the empirical findings on the effects of natural resource abundance on services are robust to differences in proxies of natural resource abundance. Furthermore, regarding the control variables, despite some differences in the magnitude of the coefficients, our results remain, overall, consistent with those obtained in Tables V and VI.

# 5. Conclusions and policy implications

Despite many studies on the Dutch disease, only few studies empirically tested the effects of natural resource abundance on services. Yet, for several decades, services have been increasingly a key sector in both developed and developing economies. To fill this gap, this article investigated the relationship between natural resource abundance and the service sector. We showed that natural resource abundance has adverse effects on services, which is the main result of this article.

We employed the Generalized Quantile Regression (GQR) estimator to empirically analyze the effects of natural resource abundance on services. Using data from 100 countries over the period 1990-2020, the results revealed that natural resource abundance is negatively associated with services. According to the results, natural resource rents have negative and significant effects on services added value (% of GDP). These findings are consistent with the Dutch disease theory that claims that a resource boom tends to negatively affect the other sectors of the economy. However, the results revealed that the impact of oil and gas rents on services is less significant in SSA than for the full sample. We explained this finding by the limited development of services and the weak link between the booming sector and the rest of the economy in SSA. Furthermore, some economic theories stipulate that the demand for services is traditionally low in the first stage of the development process of a country (i.e. in low-income countries).

Regarding the control variables, the results suggested that GDP per capita and electricity access do not affect services in the same way for the full sample and SSA. Indeed, according to the results, an increase in GDP per capita boosts services for the full sample, while it lowers services in SSA. We explained the negative impact of GDP per capita on services in SSA by the spending effect, which suggests that an increase in income lowers services output through a rise in demand and prices in the service sector. For electricity, we found that it is negatively associated with services for the full sample, while its impact on services is positive in SSA. The positive relationship between electricity access and services in SSA can be explained by the key role of electricity to the production of many services. For the other control variables, the results indicated that trade openness, and urbanization tend to negatively affect services, while FDI, and internet are positively associated with services for both the full sample and SSA. The negative effect of trade openness on services can be attributed to the fact that trade openness tends to foster trade in goods to the detriment of services due to the preponderance of trade in goods in international trade. Finally, for mobile, overall, the results are mixed. Because its effects on services are positive at some quantiles and negative at other quantiles.

In this study, we found strong evidence that natural resource abundance hampers the growth in services in line with the core model of the Dutch disease. However, like many studies related to natural resource abundance or services, this study might suffer from some limitations. The first limitation is the aggregation bias by treating services without distinction between subsectors of services which may obscure the heterogeneity between different service subsectors. Hence, this does not enable to make appropriate recommendations by subsector for policymakers. The second limitation is related to the use of natural resource rents (or oil and gas rents) as a proxy of resource abundance. Rents may be influenced by other factors than endowments, such as extraction costs, market prices, and governance structures. Thus, natural resource rents might appear low even when resources are abundant, especially in developing countries.

The findings of this study support the idea that an abundance of resources may negatively affect the non-resources sector in resource-rich countries. To overcome this challenge, the improvement of governance and institution, and the diversification of the economy could be decisive, especially in SSA. For example, policymakers could increase resource wealth through local content requirements and in reducing corruption. Additionally, an effective use of resource rents could develop the services sector through investment in training and infrastructure in this sector, especially in SSA. This will limit potential adverse effects of the Dutch disease on services.

Given the wide diversity of both services and natural resources, the relationship between natural resource abundance and services may vary depending on service subsector and/or the type of natural resource. Thus, to further investigate this relationship, future research may focus on the effects of diverse types of resources (such as oil, gas, and mineral) on different service subsectors (such as tourism, transport, wholesale, finance, and retail trade).

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# Appendices

**Table AI: List of countries**

| | | |
|---|---|---|
| Argentina | Ethiopia* | Nicaragua |
| Armenia | Finland | Netherlands |
| Australia | Fiji | Norway |
| Austria | France | Nepal |
| Benin* | Gabon* | New Zealand |
| Burkina Faso* | United Kingdom | Pakistan |
| Bangladesh | Guinea* | Panama |
| Bulgaria | Gambia, The* | Philippines |
| Bahamas, The | Guatemala | Paraguay |
| Belize | Honduras | Russian Federation |
| Bolivia | Haiti | Rwanda* |
| Brazil | Indonesia | Saudi Arabia |
| Barbados | India | Sudan* |
| Brunei Darussalam | Iran, Islamic Rep. | Senegal* |
| Bhutan | Iraq | Singapore |
| Botswana* | Italy | El Salvador |
| Switzerland | Jordan | Suriname |
| Chile | Kazakhstan | Sweden |
| China | Kyrgyz Republic | Eswatini* |
| Cameroon* | Korea, Rep. | Seychelles* |
| Congo, Dem. Rep.* | Lebanon | Togo* |
| Congo, Rep.* | Sri Lanka | Tajikistan |
| Colombia | Lesotho | Trinidad and Tobago |
| Comoros* | Morocco | Turkiye |
| Cabo Verde* | Mexico | Tanzania* |
| Costa Rica | North Macedonia | Uganda* |
| Cyprus | Mali* | Ukraine |
| Germany | Mauritania* | Uruguay |
| Dominica | Mauritius* | Uzbekistan |
| Denmark | Malawi* | Vietnam |
| Dominican Republic | Malaysia | South Africa |
| Ecuador | Namibia* | Zambia* |
| Egypt, Arab Rep. | Niger* | Zimbabwe* |
| | | Nigeria* |

Note: *sub-Saharan Africa countries excluding South Africa

**Table AII: Normality test after log transformation of variables**

| Variables | J-B. Chi (2) value |
|---|---|
| **ln(Services)** | 1523*** |
| **ln(Resources)** | 991.1*** |
| **ln(GDP)** | 119*** |
| **ln(Trade)** | 1.2e+05*** |
| **FDI** | 1.2e+07*** |
| **ln(Urban)** | 482.8*** |
| **ln(Mobile)** | 2952*** |
| **ln(Internet)** | 2108*** |
| **ln(Electricity)** | 4678*** |

Note: ***p value < 0.01, **p value < 0.05 and *p value < 0.10.