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Extending the concept of the resource curse:
Natural resources and public spending on health

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Abstract

This paper extends the concept of the resource curse by studying whether and through which transmission channels natural resource wealth affects social spending. Even though the availability of vast natural capital reserves has commonly been linked to the neglect of human development, most of the literature has continued to focus on economic performance. This paper is the first to empirically explore the link between natural resource wealth and public health expenditures in light of the hypothesis that the availability of resource wealth as a source of unearned state income enhances state autonomy, which leads to policies that fail to prioritize human development. Using a large panel dataset of world countries covering the period from 1991 to 2010, we find a robust, significant inverse relationship between natural resource dependence, and even abundance, and public health spending over time. The effect remains significant after controlling for state autonomy, volatility, and other factors. These findings have implications for national authorities as well as the extractive industry. Governments should be made accountable for natural resource wealth and correct taxation could provide additional resources, earmarked for health. The extractive industry could increase their investments in sustainable Social Corporate Responsibility operations, specifically in the health sector.

1. Introduction

The paradox of mineral wealth has inspired innumerous studies and continues to fascinate researchers across disciplinary boundaries. While most of the literature has been focusing on the implications of the abundance of or dependence on natural resources on economic growth or other measures of economic performance, it has become apparent that the resource curse extends beyond its economical dimension and entails adverse implications for human development. In its 2013 Africa Health Forum Report, the World Bank states that African countries that are experiencing strong economic growth from mineral revenues do not appear to have translated this wealth into improved health. Moreover, the 2013 African Progress Report notes that child malnutrition is endemic amongst African resource-rich countries and the levels of maternal mortality are well above average. Karl (2007) also mentions that despite significant rises in per capita income, the living standards in oil-dependent countries have degraded over the past decades. In order to tackle the perceived misalignment of natural resource wealth and human development, it is important to investigate the actual effects of resource endowments on public spending in the health sector.

The objective of our paper is to contribute to the literature on the resource curse. This paper focuses on inputs rather than outcomes, as to grasp to what extent governments in resource-rich countries fail to prioritize policies geared towards the poor and human development in general. To our knowledge, our paper is the first to empirically explore the impact of natural resource wealth on public health expenditures over time, using a large panel dataset of world countries covering the period from 1991 to 2010, that the authors constructed for the aim of this research. We find that both resource abundance and resource dependence are associated with lower public health spending, as a percentage of GDP over time. Our findings have implications for national authorities as well as for the extractive industry.

The paper is organized as follows. The concept of the resource curse is depicted in section 2. The third section describes the empirical specifications and the determinants of public health spending, including the transmission channels through which natural resource wealth could affect expenditures on health. The results and robustness tests are discussed in section 4 and 5 respectively. Section 6 concludes the paper.

2. The Concept of the Resource Curse

It has been observed for some decades now that the possession of natural resources does not necessarily generate economic prosperity. On the contrary, it has almost become a conventional wisdom that resource wealth represents a curse rather than a blessing. Resource-rich African countries have often underperformed, while their resource-poor East-Asian counterparts are on the rise. The phrase "natural resource curse" was therefore coined by Auty (1994) to describe this phenomenon otherwise referred to as the "paradox of plenty".

Pioneering empirical research from Sachs and Warner (1995) shows a significant inverse association between the ratio of natural resource exports to GDP and economic growth. Their results have been replicated by Davis (2013) and refined by numerous other authors, such as Gylfason, Herbertsson and Zoega (1999), who already emphasized the likelihood of reduced investment in human capital in resource-rich countries. Auty (2001) finds that the per capita incomes of resource-poor countries grew between two to three times faster compared to their resource-rich counterparts. Neumayer (2004) concludes that the resource curse holds for "genuine income"[1] as well. Collier and Goderis (2007) demonstrate that commodity booms have positive short-term effects on output, but adverse long-term effects for high-rent, non-agricultural commodities. Papyrakis and Gerlagh (2004) find that the negative indirect effects of resources on growth outweigh the direct positive effects. Van der Ploeg and Poelhekke (2011) provide evidence that the main effect of resource abundance is to increase growth volatility, which in turn reduces the long-term rate of growth. Other scholars focus on the role of rent-seeking (Torvik, 2002; Gylfason and Zoega, 2006) and corruption (Bhattacharyya and Hodler, 2010). The availability of natural resources has also been argued to make states more vulnerable to conflict (Collier and Hoeffler, 2003). The latter however, is not unchallenged. Cotet and Tsui (2013) argue that simply controlling for country fixed effects removes this statistical association.

A general picture of course masks some variation. A minority of resource-rich countries seem to have fared extremely well, indicating that natural resources are no barrier to economic success. A great deal of literature attempts to explain this variation. Isham et al. (2005) find that only countries dependent on point-source resources are predisposed to heightened economic and social divisions and weakened institutional capacity. Van der Ploeg and Poelhekke (2008) note that the detrimental volatility associated with the resource curse mainly stems from point-source resources. Mehlum et al. (2002; 2006) argue that the effect of resource wealth on growth depends on the quality of institutions. Hodler (2006) finds that the effect of natural resources on income is positive in ethnically homogeneous countries, but becomes increasingly negative as ethnic fractionalization increases.

The evidence of the existence of a resource curse effect on economic performance has been subject of debate. Criticism is mostly directed at the trade-based proxies for natural resource abundance, popularized by Sachs and Warner (1995, 2001). Brunnschweiler and Bulte (2008) argue that the ratio of natural resource exports to GDP is a measure of resource dependence rather than abundance. While this is a valid criticism, we argue that it doesn't necessarily imply that the resource curse doesn't hold. Rather it necessitates a clear distinction between natural resource dependence and abundance. Abundance indicates the amount of natural capital that a country has as its disposal, while dependence measures the extent to which a country relies on natural resources for its livelihood.

[1] The authors take into account natural capital depreciation as he uses real net domestic product where depreciation of produced capital has been subtracted from GDP as a measure for income.

Typical examples of countries with abundant natural resources and good economic performance, such as Canada and Norway, are often not dependent on them. Ding and Field (2005) show that while resource dependence has a significantly negative effect on growth rates, abundance appears to have a positive impact. Daniele (2011) finds that human development indicators, measured by the human development index, are negatively influenced by dependence, but positively by abundance. We therefore allow for the possibility that the effects of resource dependence and abundance may be markedly different.

Most of the literature has continued to focus on economic performance and empirical research on other effects of vast natural resource endowments is still scant. Bulte et al. (2005) find that the resource curse appears to spill over from economic growth to a broader set of development indicators. Carmignani and Avom (2010) find that resource dependence is negative for social development and the transmission appears to operate via income inequality and volatility. The link between natural resources and inequality has been established by Gylfason and Zoega (2002), Fum and Hodler (2010) and Goderis and Malone (2011). Carmignani (2013) confirms the results with regards to lower human development and higher income inequality for natural resource abundance. Finally, Gylfason (1999, 2001) notes that school enrolment tends to be inversely related to resource abundance, suggesting that natural capital crowds out human capital. He also mentions that on average public expenditure on education and health care provision in 2004 in mineral-rich countries seemed to be considerably lower than their level of income might suggest. The author does however not investigate the latter issue in-depth.

3. Empirical Specification and Variables

3.1. Data

We constructed a panel dataset for the period of 1991 to 2010 based on several internationally and scientifically recognized data sources. In line with Brunschweiler and Bulte (2009), Bhattacharayya and Hodler (2010), Bjørnskov (2010) and others, we have subdivided the data into five year periods; from 1991 to 1995, from 1996 to 2000, from 2001 to 2005 and finally from 2006 to 2010. We will hence use five year averages.

3.2. Public health spending

We use the World Bank data on public health expenditures as a percentage of GDP, which is derived from data from the World Health Organization (see table I). It includes recurrent and capital spending from the government budgets, external borrowings and grants and social health insurance funds (World Bank, 2013b).

Table I : Descriptive statistics on public health expenditures as a % of GDP

	Obs.	Countries	Mean	Std. Dev.	Minimum	Maximum
World	750	190	3.60	2.25	0.03	16.77
Africa	210	54	2.34	1.12	0.10	6.19
Asia	180	46	2.37	1.42	0.03	8.25
Eastern Europe	84	21	4.73	1.09	1.28	6.52
Western Europe	84	21	6.40	1.49	2.70	9.37
Latin America + Caribbean	132	33	3.41	1.26	1.15	9.64
North America	8	2	6.68	0.66	5.89	7.79
Oceania	52	13	6.61	3.88	1.94	16.77

Source: World Bank

3.3. The determinants of public health spending

3.3.1. Natural resources

The main rationale behind the hypothesis that natural resource dependence or abundance will negatively affect public expenditure on health lies within the notion of unearned state income (Moore, 2001). Through natural resource production, governments are able to increase their autonomy. This disconnect could decrease the need for the government to gain citizens' support, which consequently might diminish incentives to provide public goods such as health care. Moreover, as the government of a resource-rich country is most likely less dependent on tax revenues, politicians may not feel the need to engage in public expenditures that justify the taxes.

In line with the criticism from Brunschweiler and Bulte (2008) and Lederman and Maloney (2008), we have chosen not to use any exports-based proxies. Rather, we use the estimates from the World Bank database on the Changing Wealth of Nations, which presents a set of "comprehensive wealth accounts" for over 150 countries for 1995, 2000 and 2005 and contains elaborate estimations of natural capital that are reported in 2005 US dollars.

Similar to assumptions made by Brunschweiler and Bulte (2008) and Gylfason (2001), we assume that the cumulative resource extraction since 2005 has not significantly altered countries' natural capital stocks in the next five year period, therefore we use the 2005 estimations as a proxy for natural capital in the period from 2006 to 2010. Descriptive statistics of the explanatory variables are reported in table II.

3.3.1.1. *Natural resource dependence*

In order to take into account a country's dependence on natural resources, we use the same measure as Gylfason (2001); the share of natural capital in total national wealth[2].

3.3.1.2. *Natural resource abundance*

We use the logarithm of the estimated natural capital per capita as a proxy for natural resource abundance (see Brunschweiller and Bulte, 2009).

3.3.2. Income

There exists a large body of literature that shows income to be one of the most important factors explaining health expenditure variation. Moreover, it has been widely hypothesized that health care in general represents a luxury good (Getzen, 2000). GDP therefore arguably represents an important determinant of public health expenditure (Costa-Font et al., 2011; Clemente et al., 2004). While most studies mainly focus on OECD countries, Okunade (2005) and Murthy and Okunade (2009) confirm the importance of GDP for health expenditures in Africa as well.

We include a measure on the initial level of income by adding World Bank data on GDP per capita, reported in current US dollars, at the beginning of every five year period (see Brunnschweiler and Bulte, 2009). We use the logarithm of initial GDP as well as its square to take into account a potential non-linear effect.

3.3.3. Aid

As it is argued that income is a crucial determinant of public health expenditure, supplements to income, such as aid, are expected to relax macroeconomic budget constraints and increase resources for health care (Okunade, 2005). Moreover, often a substantial proportion of development assistance is directly targeted at the health sector. Murthy and Okunade (2009) demonstrate that real per capita foreign aid is an important determinant of health care expenditure.

To measure the impact of aid, we include World Bank data on one year-lagged net Official Development Assistance (ODA) received as a percentage of Gross National Income (GNI). According to the Organization for Economic Cooperation and Development definitions, ODA consists of disbursements of loans made on concessional terms[3] and grants by official agencies of the Development Assistance Committee-members, by multilateral institutions and by non-DAC countries to promote economic development and welfare (World Bank, 2013c). Repayments of the principal of loans are deducted to arrive at net ODA (DAC, 2008). As observations for developed countries are reported missing in the World Bank database, we assume zero-values for the developed EU countries, as well as Liechtenstein, the United States, Canada, Japan, Australia and New Zealand.

In sum, the empirical model is of the following form:

[2] Total wealth is present value of future consumption that is sustainable, discounted at a rate of time preference of 1.5 % over 25 years.

[3] ODA includes loans with a grant element of at least 25 % (calculated at a discount rate of 10 %).

$$Public\,Health\,Expenditure_{it} = \beta_0 + \beta_1 Natural\,Resource\,Dependence_{it} + \beta_2 \log(Initial\,GDP\,per\,capita)_{it} + \beta_3 log^2(Initial\,GDP\,per\,capita)_{it} + \beta_4 Aid_{it} + \varepsilon_{it}$$

where i represents a country, t time, and ε the error term.

3.3.4. Transmission channels

Besides the previously mentioned variables that can be argued to directly affect public health expenditures, the following transmission channels could play an important role and will therefore be added to the empirical model.

3.3.4.1. *Civil liberties*

We will capture the transmission channel of the resource curse of increased state autonomy by a civil liberties indicator. Gylfason and Zoega (2006) demonstrate an additional indirect effect of natural resources on growth through civil liberties. This variable could also play a role in explaining variation in public health spending. Delavallade (2006) finds that civil liberties are an important determinant of public sector expenditures, in particular on health. A lack of civil liberties is related to the unaccountability of political leaders, which may give rise to opportunities for public agents to favor rent generating sectors at the expense of the social sectors. It can be expected that lower citizen involvement would lead to lower prioritization of social expenditures. Finally, civil liberties has also been used as a proxy for the quality of institutions (Gylfason and Zoega, 2006), which has been argued to be an important determinant of the effect of natural resources (Mehlum et al., 2006).

We opted to include the Freedom House civil liberties index. This measure contains numerical ratings between one and seven, one being the highest score. The ratings are based on an evaluation of four subcategories: freedom of expression and belief, associational and organizational rights, rule of law, and personal autonomy and individual rights (Freedom House, 2013).

3.3.4.2. *Volatility*

Another commonly mentioned transmission channel of the resource curse that we consider as important with regards to the effect on public health spending is the volatile nature of resource revenues. There are a number of difficulties that arise with a volatile income source that could lead to uncertainty over future financing and complicate longer term planning, which will ultimately affect public spending. Political scientists have argued that the volatility of resource revenues may induce a certain degree of myopic behaviour (Van der Ploeg and Poelhekke, 2009), which could potentially give rise to a disregard for building human capital.

Similar to Van der Ploeg and Poelhekke (2009), we have based our measure of volatility on the standard deviation of growth in GDP per capita. In a dynamic setting however, this becomes more complex. Our measure of volatility captures the standard deviation of GDP per capita growth from the country average for the entire 20-year period applied to every five year period, similar to

$$Volatility_{i\tau} = \sqrt{\frac{\sum(GDP\,pc\,growth_{it} - \overline{GDP\,pc\,growth_{i.}})^2}{N_\tau}}$$

where τ represents a five year period and N the number of observations.

Table II : Descriptive statistics

	Obs.	Countries	Mean	Std. Dev.	Minimum	Maximum
C.1.a Log natural capital per capita	574	152	8.66	1.47	0.69	12.27
C.1.b Natural capital share of total wealth	574	152	28.52	32.21	0.00	243.96
C.2.a Log initial GDP per capita	788	204	7.85	1.64	4.28	11.79
C.2.b Log² initial GDP per capita	788	204	64.32	26.42	18.33	139.06
C.3 ODA as a % of GNI	711	192	7.04	11.05	-0.12	93.14
C.4.a Civil liberties	747	189	3.44	1.82	1	7
C.4.b Volatility	766	198	4.29	4.17	0.18	43.62

Sources : World Bank, Freedom House

In sum, the empirical model which takes into account the transmission channels looks as follows:

$$
\begin{aligned}
Public\,Health\,Expenditure_{it} &= \beta_0 + \beta_1 Natural\,Resource\,Dependence_{it} + \beta_2 \log(Initial\,GDP\,per\,capita)_{it} \\
&+ \beta_3 log^2(Initial\,GDP\,per\,capita)_{it} + \beta_4 Aid_{it} + \beta_5 Civil\,Liberties_{it} \\
&+ \beta_6 Volatility_{it} + \varepsilon_{it}
\end{aligned}
$$

3.4. Statistical controls

To check for collinearity, we applied the diagnostic tools developed by Belsley, Kuh and Welsch (1980) and find that the conditioning numbers are well below the suggested cut-off value of 30, indicating that there are no problems with collinearity.

As this paper is based on panel data, it is important to differentiate between the fixed effects and the random effects model. We use the Hausman test, in which the random effects model is preferred under the null hypothesis, to determine which model is more appropriate. Due to space constraints we limit ourselves to discussing the regressions that are deemed most suitable according to this test.[4] To address any remaining within-country correlation, we use cluster-robust standard deviations.

Finally, to identify outliers, we use the multivariate outlier detection method of Hadi (1992, 1994) for which we set the significance level for outlier cutoffs at 5 percent. The tables below will display the results of the regression applied to the entire sample as well as to the restricted sample.

[4] Additional information can be obtained from the corresponding author upon request.

4. Results

4.1. The impact of natural resource dependence on public health spending

Graph 1 illustrates the negative relationship between public health expenditures as a percentage of GDP and the share of natural capital in total national wealth which is confirmed by our regression results.

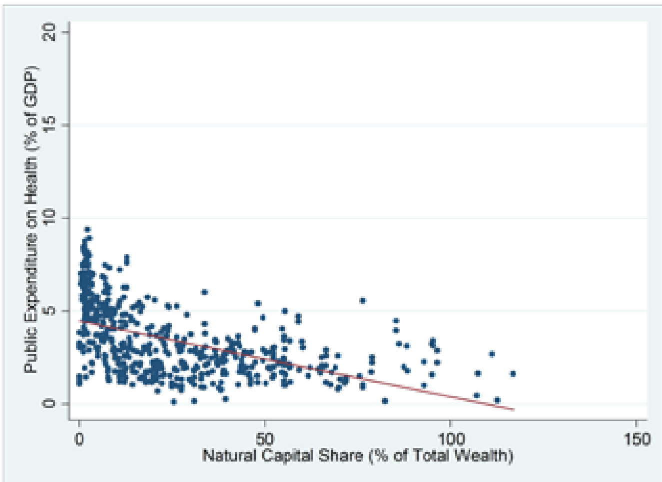

Table III: Results fixed effects GLS regressions on Public Health Expenditures as a % of GDP (with cluster-robust standard errors)

		excl. outl.		*excl. outl.*		*excl. outl.*
Constant	3.7661*** (0.000)	3.8617*** (0.000)	5.2550*** (0.004)	5.2709*** (0.005)	5.2298*** (0.002)	6.4482*** (0.000)
Nat. resource dependence	-0.0125*** (0.001)	-0.0173*** (0.000)	-0.0126*** (0.000)	-0.0139** (0.014)	-0.0130*** (0.001)	-0.0155*** (0.005)
Log initial GDP pc			-0.8674* (0.081)	-0.8768* (0.083)	-0.9634** (0.034)	-1.2078** (0.012)
Log initial GDP pc squared			0.0835** (0.013)	0.0844** (0.013)	0.0951*** (0.002)	0.1080*** (0.001)
Aid					0.0171** (0.017)	-0.0051 (0.774)
Number of obs.	569	555	569	557	541	521
Number of countries	151	149	151	149	148	146
Within R²	0.0505	0.0533	0.1515	0.1389	0.1783	0.1653
Between R²	0.1923	0.2770	0.5062	0.5367	0.5669	0.5728
Overall R²	0.1777	0.2623	0.4855	0.5198	0.5733	0.5871
Hausman test	7.06*** (0.0079)	13.62*** (0.0000)	9.27** (0.0260)	8.31** (0.0399)	20.59 (0.0004)	22.37*** (0.0002)

Note: The Hausman test results are based on the GLS regressions without cluster-robust standard errors.

Table III shows that natural resource dependence is significant with a negative sign at the one percent level in all basic regression specifications. These results confirm that resource dependence leads to lower public health expenditures relative to GDP. According to these estimations, keeping all other factors constant, a ten per cent increase in the share of natural capital in total national wealth corresponds to an average decrease of public health expenditures by 0.12% of GDP. Bearing in mind that the world average expenditure on health for this period was only 3.7% of national GDP (World Bank, 2013b), this represents a considerable difference.

When introducing the initial level of income, we find a significantly negative coefficient for the logarithm of initial GDP per capita and a significantly positive effect of its squared term. This appears to be in line with Murthy and Okunade (2009) who find a significantly positive effect of initial income on health expenditure. However, looking into the dynamics of income and health expenditure, goes beyond the scope of this paper. In sum, controlling for the initial level of income does not alter our findings for resource dependence.

The coefficient for ODA as a percentage of GNI is positive and significant at the five per cent level. This result offers support for the hypothesis that a higher share of aid in a country's GNI is associated with higher public spending on health relative to GDP. Our findings are conform with the results of Murthy and Okunade (2009) who find a significantly positive effect of foreign aid on health expenditures in developing countries.

To test the robustness of our findings, we repeat the regressions excluding outliers. Except for aid, all the variables remain significant and maintain the expected sign.

Now that we have established the direct effect of natural resource dependence on public health expenditures, we will add variables that capture potential transmission channels of the resource curse. The results are illustrated in table IV.

Table IV : Results fixed effects GLS regressions on Public Health Expenditures as a % of GDP (with cluster-robust standard errors)

		excl. outl.		*excl. outl.*		*excl. outl.*
Constant	6.4733*** (0.000)	7.4934*** (0.000)	6.1876*** (0.000)	5.9505*** (0.003)	7.1119*** (0.000)	6.9285*** (0.000)
Nat. resource dependence	-0.0118*** (0.000)	-0.0144*** (0.008)	-0.0121*** (0.001)	-0.0153*** (0.004)	-0.0112*** (0.000)	-0.0143*** (0.006)
Log initial GDP pc	-1.0687** (0.016)	-1.2873*** (0.006)	-1.2350 (0.009)	-1.1752** (0.024)	-1.2914*** (0.006)	-1.2603** (0.014)
Log initial GDP pc squared	0.0971*** (0.002)	0.1089*** (0.001)	0.1158*** (0.000)	0.1132*** (0.001)	0.1151*** (0.000)	0.1143*** (0.001)
Aid	0.0163** (0.013)	-0.0046 (0.792)	0.0134** (0.021)	0.0072 (0.614)	0.0131** (0.023)	0.0065 (0.647)
Civil liberties	-0.1750** (0.011)	-0.1555** (0.016)			-0.1461** (0.026)	-0.1290** (0.040)
Volatility			-0.0418*** (0.003)	-0.0409 (0.012)	-0.0373*** (0.007)	-0.0352** (0.034)
Number of obs.	538	518	537	511	534	508
Number of countries	147	145	148	145	147	144
Within R²	0.1931	0.1763	0.2006	0.1878	0.2099	0.1939
Between R²	0.6125	0.6118	0.5710	0.5855	0.6115	0.6161
Overall R²	0.6128	0.6213	0.5829	0.6054	0.6164	0.6309
Hausman test	18.80*** (0.0021)	20.12*** (0.0012)	18.63*** (0.0022)	13.81** (0.0168)	18.05*** (0.0061)	15.22** (0.0186)

Note: The Hausman test results are based on the GLS regressions without cluster-robust standard errors.

The civil liberties indicator, which is related to state unaccountability, is significant at the five per cent level in both regression specifications. The negative coefficient indicates that a higher score, which corresponds to poorer performance with regards to civil liberties, is associated with a decrease of public expenditure on health. These results are conform with the findings of Delavallade (2006) and could imply that natural resource dependence might affect public health expenditures through civil liberties. However, adding an interaction term to the analysis[4] illustrates that the coefficients of the two level variables remain approximately the same while the coefficient of the interaction effect is very small and insignificant. This result implies that the impact of natural resource dependence on public health expenditures does not alter depending on the degree of civil liberties in a country.

The coefficient for volatility is negative and significant at the one per cent level. In line with the findings of Van der Ploeg and Poelhekke (2009) , we find that volatility exerts a negative influence on public expenditure on health relative GDP. This makes intuitive sense as volatility is bound to complicate planning and might induce a certain degree of shortsightedness. As the magnitude of the impact of resource dependence on health expenditures might differ depending on the degree of volatility, we included an interaction term in our analysis[4]. Yet, our basic results remain the same while there does not seem to be a significant interaction effect.

Overall, it is important to note that the coefficient for natural resource dependence has only decreased slightly and it remains highly significant in all the regression specifications. This indicates that the effect of resource dependence on public expenditure on health can only partly be attributed to changes in civil liberties and the volatility of growth per capita.

Again, we repeat the regressions excluding outliers and find that, except for aid, all results are robust.

4.2. The impact of natural resource abundance on public health spending

As aforementioned, it is important to differentiate between resource dependence and resource abundance. We therefore repeat the regressions using the logarithm of total natural capital per capita as a measure for abundance. Natural resource abundance is significant with a negative sign at the one percent level in all three of the basic regression specifications. Keeping all other factors constant, a ten per cent increase in natural capital per capita corresponds to an average decrease of public expenditure on health by over 0.05% of GDP. Table V shows that the remaining results are the same.

Table V : Results fixed effects GLS regressions on Public Health Expenditures as a % of GDP (with cluster-robust standard errors)

		excl. outl.		*excl. outl.*		*excl. outl.*
Constant	8.0616*** (0.000)	8.5573*** (0.000)	8.3224*** (0.001)	9.5453*** (0.000)	8.7190*** (0.000)	9.7376*** (0.000)
Nat. resource abundance	-0.5346*** (0.004)	-0.5831*** (0.002)	-0.5013*** (0.007)	-0.5333*** (0.006)	-0.5413*** (0.005)	-.5770*** (0.004)
Log initial GDP pc			-.6216 (0.211)	-0.8852* (0.071)	-0.7425 (0.103)	-.8720* (0.067)
Log initial GDP pc squared			0.0681** (0.044)	0.0869*** (0.009)	0.08127*** (0.009)	.0880*** (0.006)
Aid					0.0160*** (0.026)	.0030 (0.860)
Number of obs.	569	561	569	558	541	529
Number of countries	151	149	151	149	148	146
Within R^2	0.0445	0.0507	0.1395	0.1540	0.1712	0.1723
Between R^2	0.0644	0.0689	0.2080	0.4358	0.2315	0.4220
Overall R^2	0.0554	0.0573	0.2037	0.4175	0.2952	0.4285
Hausman test	18.80*** (0.0021)	33.52*** (0.0000)	30.35*** (0.0000)	31.30*** (0.0000)	49.51*** (0.000)	58.15*** (0.0000)

Note: The Hausman test results are based on the GLS regressions without cluster-robust standard errors.

5. Robustness Tests

In order to test the robustness of our results, we will now add variables to the regression that have been found to play an important role in explaining the resource curse.

5.1. Natural resource dependence

Instead of civil liberties, we add the level of democratization as an additional explanatory variable. Keefer and Khemani (2005) state that the level of democratization matters especially for public service delivery to the poor, including health. To investigate this effect we add the Polity 2 score to the regression analysis. This score captures the regime authority spectrum on a 21-point scale ranging from minus ten, which corresponds to hereditary monarchy, to plus ten, consolidated democracy (CSP, 2013). Table VI shows the results of the fixed effect regressions on public expenditure on health relative to GDP including the Polity 2 score.

As expected, the level of democratization has a significantly positive effect on public health expenditures. These estimations show that on average countries with a higher Polity 2 score spent more on public health. It is important to note however, that adding this variable does not affect our main results.

Delavallade (2006) demonstrates a significant effect of freedom, an index that represents the mean of country scores for civil liberties and political rights, on the proportion of public spending destined for health care. We therefore repeat the analysis including this measure and find that our previous results are confirmed while a higher score on the freedom index, which corresponds to poorer performance, is associated with lower public health expenditures (see table A.1 in Appendix).

Another factor that has been commonly mentioned in the resource curse literature (Collier and Hoeffler, 2003; Ross, 2003; Cotet and Tsui, 2013) and can influence public spending on health is the occurrence of conflict. It can be assumed that government priorities are altered when conflict arises and social sectors, such as health, receive relatively fewer funds. Based on the UCDP/PRIO armed conflict dataset, we derived a dummy variable that equals one in years where conflict is reported in the database, and zero otherwise. The fixed effects regression results are summarized in table VI.

We find some support for the idea that conflict is a negative determinant of public expenditure on health relative to GDP. The coefficient is significant at the ten per cent level for the entire sample, but loses significance when excluding outliers. According to these estimates, keeping all other factors constant the occurrence of conflict corresponds to an average decrease of public health expenditures by 0.17% of GDP. The rest of our results remains robust.

Table VI : Results fixed effects GLS regressions on Public Health Expenditures as a % of GDP (with cluster-robust standard errors)

		excl. outl.		*excl. outl.*
Constant	6.9680*** (0.000)	7.6203*** (0.000)	5.5319*** (0.000)	6.2320*** (0.001)
Nat. resource dependence	-0.0120*** (0.001)	-0.0196*** (0.000)	-0.0134*** (0.000)	-0.0169*** (0.002)
Log initial GDP pc	-1.4868*** (0.002)	-1.5782*** (0.002)	-1.0113** (0.023)	-1.1470** (0.017)
Log initial GDP pc squared	0.1299*** (0.000)	0.1353*** (0.000)	0.0969*** (0.001)	0.1043*** (0.001)
Aid	0.01234 (0.153)	-0.0074 (0.676)	0.0168* (0.010)	0.0030 (0.840)
Polity 2	0.03538** (0.021)	0.0247* (0.057)		
Conflict			-0.1726* (0.099)	-0.1446 (0.171)
Number of obs.	483	464	535	514
Number of countries	132	130	148	146
Within R²	0.2128	0.2237	0.1865	0.1770
Between R²	0.6088	0.6029	0.5667	0.5790
Overall R²	0.6151	0.6219	0.5698	0.5923
Hausman test	20.57 (0.0010)	20.33 (0.0011)	20.94*** (0.0008)	19.49*** (0.0016)

Note: The Hausman test results are based on the GLS regressions without cluster-robust standard errors.

According to Hodler (2006) and Fum and Hodler (2009) it is important to take into account the role of ethnic divisions. Fractionalized countries are argued to have lower levels of trust, more corruption, less transfers, subsidies and political rights (Alesina et al., 2003), which could ultimately affect public social spending. We control for this effect by adding a variable on ethnic fractionalization developed by Desmet et al. (2012). Fractionalization (ELF1[5]) measures the probability that two randomly chosen individuals will belong to different ethnic groups. As the index displays little variation over time, we apply a random effects regression, of which the results are summarized in table VII. Ethnic fractionalization has a significantly negative effect on public health expenditures. According to these estimates, a ten per cent increase in the aforementioned probability is on average associated with a decrease of public health expenditures by 0.14 % of GDP.

Based on the literature (Gylfason et al., 1999; Sala-i-Martin and Subramanian, 2003; Boschini et al., 2007), we test the robustness of our results by controlling for regional effects. We introduce dummy variables for Africa and Asia. As the latter are time invariant, we again use a random effects regression model. The findings in table VII indicate that countries in Africa and in Asia spend on average up to 1% and 1.4% of GDP less on public health compared to the rest of

[5] The authors report the index for different levels of linguistic aggregation, based on language trees from the Ethnologue data. We work with the index at level one, which is the highest level of aggregation and thus represents the deepest linguistic cleavages.

the world. The impact of natural resource dependence on public health spending does not alter by region[4].

Table VII : Results random effects GLS regressions on Public Health Expenditures as a % of GDP (with cluster-robust standard errors)

		excl. outl.		*excl.outl.*
Constant	5.6593*** (0.000)	6.5291*** (0.000)	7.1963*** (0.000)	7.9593*** (0.000)
Nat. resource dependence	-0.0105*** (0.000)	-0.0166*** (0.000)	-0.0101*** (0.000)	-0.0140*** (0.000)
Log initial GDP pc	-1.2144*** (0.001)	-1.3611*** (0.000)	-1.4226*** (0.000)	-1.5751*** (0.000)
Log initial GDP pc squared	0.1209*** (0.000)	0.1274 (0.000)	0.1287*** (0.000)	0.1366*** (0.000)
Aid	0.0213*** (0.000)	0.0114 (0.413)	0.0217*** (0.000)	0.0143 (0.305)
ELF1	-0.0141** (0.011)	-0.0119** (0.041)		
Africa			-0.9886*** (0.000)	-0.9034*** (0.000)
Asia			-1.4356*** (0.000)	-1.3851*** (0.000)
Number of obs.	541	520	541	521
Number of countries	148	146	148	146
Within R^2	0.1721	0.1695	0.1711	0.1567
Between R^2	0.6026	0.6053	0.6736	0.6751
Overall R^2	0.6001	0.6113	0.6519	0.6641

5.2. Natural resource abundance

We repeat the robustness tests with resource abundance as an explanatory variable. Results are depicted in table VIII. Our main findings remain robust when we include the level of democratization into the regression. We don't find support for the role of conflict.

Table VIII : Results fixed effects GLS regressions on Public Health Expenditures as a % of GDP (with cluster-robust standard errors)

		Excl. Outliers		*Excl. Outliers*
Constant	11.7716*** (0.000)	12.1993*** (0.000)	8.8915*** (0.000)	9.9098*** (0.000)
Nat. resource abundance	-0.6893*** (0.000)	-0.7069*** (0.000)	-0.5442*** (0.006)	-0.5829*** (0.004)
Log initial GDP pc	-1.2795** (0.010)	-1.3333*** (0.008)	-0.7667* (0.088)	-0.8935* (0.060)
Log initial GDP pc squared	0.1178*** (0.000)	0.1214*** (0.000)	0.0821*** (0.008)	0.0887*** (0.006)
Aid	0.0136 (0.137)	0.0046 (0.771)	0.0157** (0.022)	0.0037 (0.829)
Polity 2	0.0345** (0.012)	0.0340** (0.018)		
Conflict			-0.1127 (0.291)	-0.0957 (0.379)
Number of obs.	483	476	535	523
Number of countries	132	131	148	146
Within R^2	0.2352	0.2433	0.1763	0.1762
Between R^2	0.2589	0.4426	0.2332	0.4221
Overall R^2	0.3426	0.4633	0.2986	0.4319
Hausman test	59.24*** (0.0000)	50.21**** (0.0000)	48.88*** (0.0000)	56.05*** (0.000)

Note: The Hausman test results are based on the GLS regressions without cluster-robust standard errors.

Next, we look at the effect of ethnic fractionalization and find a significantly negative effect (see table IX). Excluding the outliers, the results of the regression analysis of the restricted sample confirm the hypothesized negative effect of resource abundance on public spending on health.

Finally, we introduce the dummy variables for Africa and Asia in the random effects regressions and find that, on average, public health expenditures are significantly lower in Africa and in Asia compared to the rest of the world. Contrary to earlier findings for resource dependence, results not reported in this paper[4] also indicate that the negative effect of natural resource abundance on public health expenditures is significantly stronger in Africa and in Asia.

Table IX : Results random effects GLS regressions on Public Expenditure on Health as a % of GDP (with cluster-robust standard errors)

		excl. outl.		*excl. outl.*
Constant	5.2521*** (0.000)	6.4297*** (0.000)	7.5166*** (0.000)	9.0858*** (0.000)
Nat. resource abundance	-0.0717 (0.563)	-0.2503** (0.032)	-0.1476 (0.252)	-0.3688*** (0.001)
Log initial GDP pc	-1.0677*** (0.004)	-1.0457*** (0.009)	-1.2835*** (0.000)	-1.2450*** (0.001)
Log initial GDP pc squared	0.1160*** (0.000)	0.1190*** (0.000)	0.1242*** (0.000)	0.1263*** (0.000)
Aid	0.0172*** (0.004)	0.1190 (0.314)	0.0182*** (0.002)	0.0169 (0.171)
ELF1	-0.0190*** (0.001)	-0.0138*** (0.003)		
Africa			-1.2138*** (0.000)	-1.3104*** (0.000)
Asia			-1.5871*** (0.000)	-1.5061*** (0.000)
Number of obs.	541	529	541	529
Number of countries	148	146	148	146
Within R^2	0.1342	0.1457	0.1431	0.1561
Between R^2	0.6068	0.6434	0.6651	0.7079
Overall R^2	0.6017	0.6256	0.6455	0.6761

As certain countries have succeeded in transforming their natural resource wealth into health spending and development, a final test consists in applying our regression model to these specific cases. The 2013 Africa Health Forum Report enlists Chile, Botswana, Malaysia and Norway as success stories. We therefore conduct an ordinary least squares regression of our basic model with resource abundance, focusing on these four specific countries (see table A.2 in Appendix), and find no evidence of a negative effect of natural resource abundance on public expenditures on health relative to GDP. Experiences from these countries could offer valuable insights in how to overcome the problems identified in this paper.

6. Conclusions

This paper contributes to the scientific literature on the resource curse by empirically investigating how natural resource wealth affects public health spending. Little attention has been paid to this matter so far, while research indicates that health care is crucial to building human capital and securing sustainable economic growth. This is especially important for developing countries as improving the health status of their citizens could substantially ameliorate their economic performance. Moreover, it has been shown that public spending on health care matters more for the poor in general (Gupta et al., 2003). Finally, this paper is innovative as it examines the effects of natural resources on inputs rather than human development outcomes as the latter most likely will also reflect factors beyond policymakers' control.

We study the effects of natural resources on public expenditure on health relative to GDP in light of the hypothesis that the availability of natural resource wealth as a source of unearned state income enhances state autonomy, which will lead to policies that fail to prioritize human development. We find a robust, significant inverse relationship between natural resource dependence and public spending on health relative to GDP. This effect remains significant even after controlling for potential transmission channels as civil liberties and volatility, and other variables such as the level of democratization, conflict, ethnic fractionalization and regional effects. Moreover, our regression results show that the mere availability of natural resources (or natural resource abundance) has a significantly negative effect on public health expenditures relative to GDP. While this effect appears to be slightly less robust than the relationship between natural resource dependence and public health expenditure, it remains significant in most of our robustness checks.

The establishment of the existence of a resource curse effect on public health expenditures underlines the importance of government accountability and transparency with regards to natural resource wealth. Today, the best instrument for ensuring greater transparency is the Extractive Industries Transparency Initiative (EITI). EITI partner countries are obliged to publicize the tax revenues they receive from companies in the oil, gas and mining industries, thereby contributing to greater transparency between the extractive industry and the authorities. Currently, there are 25 compliant countries and 16 candidate countries (EITI, 2013). Governments should be made accountable for natural resource wealth, not only through transparent declaration, but also correct taxation and redistribution of natural resource capital. Following our findings, a substantial part of the tax revenues could for example be earmarked for the health sector. Our results also urge the extractive industry to invest in sustainable Social Corporate Responsibility operations, especially in the health sector and/or increase health funding through other innovative channels of development finance.

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Appendix

Table A.1: Results fixed effects GLS regressions on Public Expenditure on Health as a % of GDP incl. Freedom (with cluster-robust standard errors)

		excl. outl.		*excl. outl.*
Constant	5.9800*** (0.000)	6.9413*** (0.000)	9.1207*** (0.000)	10.0367*** (0.000)
Nat. resource dependence	-0.0124*** (0.001)	-0.0148*** (0.008)		
Nat. resource abundance			-0.5027** (0.012)	-0.5415*** (0.009)
Log initial GDP pc	-1.0413** (0.021)	-1.2524*** (0.009)	-0.8256* (0.069)	-0.9355** (0.049)
Log initial GDP pc squared	0.0980*** (0.002)	0.1093*** (0.001)	0.0847*** (0.006)	0.0904*** (0.005)
Aid	0.0163** (0.016)	-0.0052 (0.771)	0.0153** (0.027)	0.0022 (0.896)
Freedom	-0.1020* (0.084)	-0.0753 (0.171)	-0.0912* (0.091)	-0.0802 (0.152)
Number of obs.	538	518	538	526
Number of countries	147	145	147	145
Within R^2	0.1836	0.1671	0.1742	0.1739
Between R^2	0.6030	0.5998	0.3199	0.4956
Overall R^2	0.6031	0.6099	0.3783	0.4961
Hausman test	23.24*** (0.0003)	24.58*** (0.0002)	40.92*** (0.0000)	43.43*** (0.0000)

Note: The Hausman test results are based on the GLS regressions without cluster-robust standard errors.

Table A.2: Results OLS regressions on Public Health Expenditures as a % of GDP excl. (Chile, Botswana, Malaysia, Norway) (with cluster-robust standard errors)

Constant	-12.8918* (0.097)	7.1106 (0.874)	-0.8271 (0.988)
Nat. resource abundance	1.7311** (0.045)	-0.3678 (0.737)	-0.0615 (0.975)
Log initial GDP pc		-1.9741 (0.828)	-0.7547 (0.939)
Log initial GDP pc squared		0.2236 (0.660)	0.1485 (0.794)
Aid			0.2591 (0.749)
Number of obs.	16	16	16
Number of countries	4	4	4
Overall R^2	0.6900	0.8291	0.8345

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