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¿QUÉ HACEN LOS PAÍSES RICOS EN RECURSOS NATURALES NO RENOVABLES CON SUS RENTAS?
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RESUMEN

Este documento de trabajo examina tres preguntas relacionadas al uso de las rentas provenientes de recursos naturales no renovables: (1) ¿Hasta qué punto los países ricos en recursos naturales no renovables utilizan sus rentas para aumentar el consumo presente, la inversión o los activos netos extranjeros (o reducir los pasivos extranjeros netos)? (2) ¿Hasta qué punto los países establecen impuestos sobre los recursos naturales y cómo utilizan estos ingresos fiscales: aumentan el gasto público (en particular la inversión pública en infraestructura y formación de capital humano), reducen la carga impositiva sobre otras actividades (y se vuelven fiscalmente dependientes en los recursos naturales) o aumentan la deuda pública? (3) ¿Hasta qué punto estos países tienen un gasto público menos eficiente, más volátil y pro-cíclico? Adicionalmente, examinamos si los efectos sobre el desempeño macroeconómico y fiscal dependen del nivel de desarrollo y la calidad de las instituciones de cada país.

Palabras clave: recursos naturales, rentas, instituciones, desarrollo

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ABSTRACT

This paper examines three sets of questions related to the use of non-renewable natural resource rents: (1) To what extent countries rich in non-renewable natural resources use such rents to increase present consumption or investment or save them through net increases in foreign assets (or reduction of net foreign liabilities)? (2) To what extent countries tax them and how do they use such fiscal revenues: whether to increase public expenditures (and in particular public investment in infrastructure and human capital formation), reduce taxes on other activities (and become fiscally dependent on their natural resource wealth) or net public debt? (3) To what extent countries rich in non-renewable natural resources have less efficient and more volatile and pro cyclical public expenditures? Additionally, we examine if these effects on macro and fiscal performance depend on the countries level of development and quality of institutions, as theory suggests.

Keywords: natural resources, institutions, development

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WHAT DO NON-RENEWABLE NATURAL RESOURCE RICH COUNTRIES DO WITH THEIR RENTS?

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1. **Introduction and Summary**.

This paper examines three sets of questions related to the use of non-renewable natural resource rents: (1) To what extent countries rich in non-renewable natural resources use such rents to increase present consumption or investment or save them through net increases in foreign assets (or reduction of net foreign liabilities)? (2) To what extent countries tax them and how do they use such fiscal revenues: whether to increase public expenditures (and in particular public investment in infrastructure and human capital formation), reduce taxes on other activities (and become fiscally dependent on their natural resource wealth) or net public debt? (3) To what extent countries rich in non-renewable natural resources have less efficient and more volatile and pro cyclical public expenditures? Additionally, we examine if these effects on macro and fiscal performance depend on the countries level of development and quality of institutions, as theory suggests (see Section 2).

Section 2 presents our conceptual framework derived from several previous papers on these and related subjects (in particular, on the so called "resource curse") and show that what countries rich in non-renewable natural resources do with their rents largely determine if their natural resource wealth ends up being a blessing or a curse. There are three reasons why we concentrate our analysis on non-renewable resource rich countries: first, rents and fiscal revenues from oil, gas and minerals tend to be much higher than those accruing to land and other renewable natural resources; second, as the use of non-renewable resources depletes natural capital, rents should be fully or mostly saved and invested in other forms of capital, an issue of much lesser importance with respect to the use of renewable resources [1]; third, most resource curse arguments and examples are referred to oil and mineral rich countries.

To examine the three sets of questions posed above, we built a data base of macro, fiscal and institutional variables, described in Section 3, for the longest available periods for a large sample of 184 countries, of which 34 (8 from Latin America) are classified as rich in non-renewable natural resources according to IMF criteria (See Section 2). We collected data on natural-resource based fiscal revenues for this restricted sample from different IMF sources[2]. In order to motivate the rest of the paper, Section 3 also includes a brief analysis of what Latin American countries rich in non-renewable natural resources actually have done with their increase in rents during the most recent commodity price boom. We find that there were common elements but also significant variations in their macro or fiscal effects. While some countries increased significantly either their domestic investment or their current account surplus

[1] Where the issue is rather to avoid the deterioration of the resource base

[2] Data on hydrocarbon rich countries were provided by Villafuerte and Lopez-Murphy (2010), while data on mineral rich countries were collected from IMF Article IV Reports of these countries.

ratios to GDP, or both, others did not. Though in all cases their commodity-related fiscal revenues on them increased sharply and net public debt was significantly reduced, most of them also increased their public expenditure ratios and/or reduced taxes on other activities incurring in pro cyclical fiscal policies and increasing their dependence on such revenues.

Sections 4, 5 and 6 present the econometric tests performed on both the large and the restricted sample in order to explore, respectively, the three set of questions enunciated above. Our empirical results confirm in general the theoretical expected effects of natural resource abundance on fiscal and macro performance discussed in Section 2 below. In particular, natural resource abundant countries tend to accumulate more total assets (fixed plus financial), tax less other activities, have more volatile and less efficient public expenditures and lower quality of fiscal institutions, controlling for income levels.

Also as expected from theory, many effects of resource abundance on macro and fiscal performance differ according to country income levels and the quality of its institutions. Thus, lower income non-renewable resource abundant countries invest more, but higher income resource abundant countries invest less and save more abroad, as compared with countries with similar income levels. Investment levels are higher in resource rich countries with better institutions, controlling by income levels. Similarly, countries with better institutions obtain higher fiscal revenues from their non-renewable natural wealth but are less fiscally dependent on such revenues, controlling by resource abundance and income levels. Low income commodity fiscally dependent countries have larger public expenditures than other countries with similar income levels. On the contrary, higher income commodity fiscally dependent countries tend to have smaller governments, though larger public investment, than other countries with similar income levels. Total public expenditures are lower in resource rich countries with better institutions, controlling by income levels. As another example, the higher inefficiency of public expenditures in commodity fiscally dependent countries is in some cases mitigated by the presence of better quality of institutions, controlling by income levels.

An interesting result is that, although public expenditures are more volatile in commodity fiscally dependent countries, they do not appear to be more pro cyclical in general. This apparent puzzle is explained by the fact that the contemporaneous co-movement of commodity fiscal revenues and GDP is not strong on average (though it is higher for oil dependent countries or with a year lag). Such a co movement varies significantly across commodity fiscally dependent countries.

Section 7 summarizes our empirical conclusions and present policy recommendations for non-renewable resource rich countries with different income and resource abundance levels.

2. "Resource curse" theories and the use of resource rents

Is natural wealth a curse or a blessing? What does it depend on?

There is a wide technical literature on the so called "resource curse": the alleged fact that normally, or at least frequently, countries endowed with natural resource wealth grow less rapidly than the rest[3]. Such a stylized fact, if true, would be at first sight counter intuitive as natural resource wealth should be a blessing for economic growth. First, it is an almost free factor of production (as compared to machines and equipment that are more costly to produce) which give a strong absolute advantage in certain types of goods and services such as oil, gas, fuels and petrochemicals for oil rich countries, and food, land based raw materials, wood, agro industry, cellulose, wood products and bio-fuels for land rich countries. In addition, it benefits other domestic activities through backward and forward linkages. And, further, it provides an easy handle to get **fiscal revenues** (from oil, mining and land rents) which should have lower dead-weight costs than most taxes on domestic activities or trade.

Of course, the materialization of such potential benefits will depend on the quality of domestic institutions and policies. In particular, the quality of fiscal institutions and policies will determine if natural resource rents and derived fiscal revenues are well used in increasing the profitability of productive investments, either through improved supply of public goods and public infrastructure, or through lower marginal taxation of private investments or through enhanced human capital accumulation, or a sound combination of the above. Or else, in contrast, poor fiscal institutions and policies may lead mostly to increased consumption and to inefficient public investments or worst, to waste and private appropriation of rents through corruption and capture by specific groups or interests.

Given that the "natural resource curse", if true, would be an economic puzzle, most of the earlier papers on the subject focused either on establishing or denying any statistical regularity related with its alleged existence and/or the potential economic and political channels that could explain such an outcome[4]. The literature is not conclusive on statistical regularities: there are no robust results to suggest the predominance of a curse or a blessing associated with natural resource wealth[5]. But, still, there are enough individual cases of natural resource curse, especially among oil and mineral rich countries, to merit attention. On the other hand, according to this literature, potential channels for the existence of a resource curse could be either of an economic or political nature, which we briefly summarize in what follows, emphasizing their potential links with fiscal institutions and policies.

To begin with, a significant part of the technical literature on the "natural resource curse" is devoted to discussing possible political channels, mostly related to potentially adverse effects of poorly regulated political competition over natural resource rents. In an extreme case, there are adverse effects of civil strife and war over appropriation of oil and mineral rents observed during certain periods in some

[3] See, for example, Sachs and Warner (2001) and Collier and Goderis (2007). For a recent review of the literature see Frankel (2010).

[4] See, for example, Gylfason, Herbertson and Zoega (1999), Sachs and Warner (2001), Collier (2007)

[5] See, for example, Maloney and Lederman (2003, 2007 and 2008) who find no evidence of resource curse and Frankel (2010)

countries, mostly in Africa. More often, this literature focus on the potential adverse effects of corruption and capture by particular interests or groups, that may lead not only to misuse or inefficient use of those rents, but to weakened institutions and poor policies and a generalized culture of rent-seeking that may affect overall growth negatively in the long run [6].

Regarding economic channels, the most popular explanation has been related to the so called "Dutch Disease": the exploitation of natural resources can have an adverse effect on other tradable goods and services (mostly through increased relative prices of non tradable with inelastic supply functions, the corresponding currency appreciation and pull out of factors of production), whose production is presumed to have higher positive externalities and/or productivity growth than activities directly related to natural resource exploitation and non- tradable activities. Though advocates of this theory rarely attempt to provide evidence on such "superiority" of other tradable activities, this remains a widely popular view in policy circles.

Variants of the Dutch Disease theory can be constructed from alleged evidence that countries that concentrate in natural resource exports have less capacity to "jump" towards developing exports of presumably more productive goods[7], or that export concentration in general, itself a potential consequence of natural resource wealth, tends to lead to lower growth[8]. The latter view is related to the fact that export concentration, especially in natural resource exports, may lead to higher macro volatility and that the latter can be detrimental to long term growth performance[9].

In contrast, some of the recent literature focus on the determinants of either a blessing or a curse related to natural resource wealth. This literature stresses the role of institutions and policies, which are assumed to be at least partially exogenous to natural resource wealth, in determining if potential benefits on growth dominate, or not, over potentially adverse effects of such wealth in particular country settings. In particular, this literature emphasizes the role of fiscal institutions and policies in determining what countries actually do with fiscal revenues derived from natural resource wealth[10].

According to this view, Dutch Disease type effects can be partially avoided through fiscal institutions and policies that save a considerable amount of natural resource rents –thus limiting overspending on non tradable goods and services that would lead to adverse relative price effects on other tradable activities-, as in the case of the Norwegian or Alaskan wealth funds. Alternatively, the potential effects of currency appreciation on other tradable activities can be partially mitigated or compensated through sound public investments that increase the productivity of other tradable (and non tradable) activities or through lower marginal tax rates on investment in tradable activities that increase their after-tax private profitability.

Similarly, natural resource abundance effects on macroeconomic volatility can be avoided or mitigated through fiscal institutions and policies that permit counter cyclical fiscal policies, or at least avoid pro

[6] See, for example, Auty (2001), Ross (1999), Easterly and Levine (2002), Haber and Menaldo (2011).
[7] See Hausmann, Hwang and Rodrik (2007) and Hidalgo, Klinger, Barabási and Hausmann (2007).
[8] See Lederman and Maloney (2003) and World Bank (2010)
[9] See, for example, Servén (1998), Kraay and Ventura 2001), World Bank (2010)
[10] See for example Van der Ploeg (2011), Arezki and Van der Ploeg (2007) and Perry and Olivera (2010)

cyclical fiscal policies by smoothing public expenditure growth over time. In addition to wealth funds like the Norwegian or Alaskan, commodity related stabilization funds, fiscal rules a la Chile or just stronger fiscal institutions and sound fiscal policies like in Australia or South Africa, seem to go a long way in avoiding or reducing potential macroeconomic volatility associated with natural resource wealth[11].

In summary, if natural wealth ends up being a blessing or a curse on growth, depends largely on what countries do with such wealth and in particular with the rents and fiscal revenues derived from its use. This is especially true for countries abundant in minerals and hydrocarbons, which tend to derive higher rents and fiscal revenues from their exploitation. For these reasons, this paper focuses on examining empirically what is it that countries rich in minerals and hydrocarbons do in practice with the rents and fiscal revenues related to their exploitation and to what extent differences in behavior are associated with differences in their level of income and the quality of their institutions.

Macro and fiscal effects of the use of resource rents

Specifically, we will focus on three sets of questions. First, to what extent countries rich in non-renewable natural resources use such rents to increase present consumption or investment or save them through net increases in foreign assets (or reduction of net foreign liabilities)? It is often stated in policy circles that non renewable resource rich countries should invest all derived rents in domestic fixed assets (to avoid a reduction of net productive capacity) or to save them for future generations through a wealth fund (investing these savings in foreign assets) and use only at present the income obtained from the fund, as Norway or Alaska does. Collier, Spence, Van der Ploeg and Venables (2009), as well as previous papers by some of these authors, analyze formally what countries should do with their natural resource wealth and find that the optimal combination of increased present consumption, domestic investment and foreign savings depends on the relative magnitudes of the social rate of discount between future and present consumption and the rate of return of domestic investments and foreign savings. Optimality requires equating all these marginal rates.

Usually, the poorer the country, the higher the social rate of discount between future and present consumption and the larger the fraction of natural resource rents that should be devoted to increase present consumption, other things being equal. Also, the poorer the country, there should be more highly profitable domestic investment opportunities, although these may be limited by weaker absorptive capacities. Thus, both poor and middle income non-renewable resource rich countries should probably invest domestically a large fraction of these rents (e.g., until the marginal rate of return of these investments equals the rate of return of foreign asset investments). In contrast, rich countries, with lower social rates of discount between future and present consumption and of their marginal domestic investments, should probably save most of their rents for future generations, as Norway and Alaska do. These simple theoretical models show that the often heard prescription that poor or middle income countries should do as the latter, is clearly mistaken. The optimal solution depends on specific country circumstances and there is no “one size fits all” correct prescription.

[11] See, for example, Collier et al (2009) , Perry and Olivera (2010), Frankel (2010), Sachs (2010)

Incidentally, the model of Collier et al can be easily augmented to show that if the marginal rate of return of foreign assets falls below the expected real increase of the price of the non renewable commodity, then the latter should be kept in the ground. Further, taking into account the relative uncertainty of all these parameters would greatly complicate the theoretical models, but would reinforce the conclusion that the optimal solution is heavily dependent on specific country circumstances.

The second set of questions we will examine relates to the extent countries tax non-renewable resource extraction and how do they use such fiscal revenues: whether to increase public expenditures (and in particular public investment in infrastructure and human capital formation), reduce taxes on other activities (and become fiscally dependent on their natural resource wealth) or net public debt? Analogous to the previous discussion, the optimal combination of these courses of action would depend on specific country circumstances: the relative values of the social marginal rate of return of public expenditures, of lower public debt or of higher public financial assets (which may be larger than the corresponding financial rates of return[12]) or of lower taxes on other activities. Optimization would equalize all these social marginal rates of return. The actual combination will depend on political economy factors: the perceived marginal political return to policy makers and politicians of these different courses of action. Given short political horizons and lack of transparency and certainty on long run effects, it is likely that the outcome of the political process often leads to lower public savings (and higher than optimal public debts), higher public expenditures (tilted towards current expenditures) and lower taxes on other activities, as compared to an optimal solution.

The third set of questions to be examined are: to what extent countries rich in non-renewable natural resources have less efficient, more volatile and pro cyclical public expenditures? Several studies have found that developing countries tend to have pro cyclical fiscal policies[13]. Reasons for such behavior have been variously traced to the propensity to spend out most of extraordinary fiscal revenues during booms (due to short horizons of policy makers and politicians and imperfect information of voters) which, together with pro cyclicality of capital flows and domestic credit, require counter cyclical fiscal adjustments during busts [14]. Combined with the effect of fiscal multipliers, such policies tend to increase macroeconomic volatility[15] and, as mentioned above, high macroeconomic volatility has been shown, in turn, to have negative effects on long term growth, according to several recent studies. In many non-renewable resource rich countries business cycles are associated with commodity price cycles. In such circumstances, it is likely that the political economy forces and financial sector pro cyclical behavior that lie behind observed pro cyclicality of fiscal policies in developing countries, may lead to especially strong pro cyclicality in fiscal policies of non-renewable resource rich countries, especially when they are fiscally dependent on such revenues. However, natural resource abundance may lead to higher volatility

[12] As they may reduce vulnerabilities (eg, reduce the likelihood of fiscal crises or help mitigate their effects) and lower the marginal cost of foreign and domestic credit for both the Government and the private secto.r See Levy-Yeyati and Sturzenegger (2007).

[13] See, for example, Gavin and Perotti (1997), Talvi and Vegh (2005), Manasse (2005), and Kaminski, Reinhart, and Vegh (2004)

[14] See discussion in Perry et al (2009)

[15] Izletsky and Vegh (2008)

but not necessarily to higher pro cyclicality of public expenditures in countries where business cycles and commodity price cycles are not strongly correlated. This is an empirical issue.

On the other hand, public choice theory assumes that taxation create incentives for taxpayers to demand that public expenditures financed with their taxes respond to their needs and preferences and are carried out in an efficient and transparent way. Conversely, whenever the link between public expenditures and taxation is weakened, as when a country finances a large part of them with natural resource revenues or foreign aid (or a local government with transfers from the national government), such incentives are supposed to diminish and therefore there are reasons to expect lower efficiency and transparency of public expenditures and allocations that are less responsive to citizens needs and preferences[16]. As mentioned above, "resource curse" theories further suggest that under those conditions fiscal institutions and institutions in general are expected to be weaker and less transparent

Empirical answers to these set of questions will help to clarify the channels through which natural resource wealth can become a blessing or a curse. They can also help in designing adequate fiscal institutions and policies to take advantage of the opportunities associated with high natural resource related rents and fiscal revenues and to avoid or mitigate potential adverse effects that may also be associated with such natural wealth and derived rents.

3. The data set, definition of variables and stylized facts

Table 1 below summarizes the data used. We constructed two samples. The larger one includes data from 184 countries, resource rich and poor alike, with some variables spanning from 1960 to 2010 and others for a shorter period, whose main sources are IMF IFS Statistics, the World Bank WDI, trade data from COMTRADE and indexes of quality of institutions from the World Bank, International Country Risk Guide (ICRG) and the OECD/Open Budget Initiative (OBI). The second one is restricted to countries considered rich in hydrocarbons and/or mineral resources by the IMF on the basis of the following criteria: (i) an average share of hydrocarbon and/or mineral fiscal revenues in total fiscal revenue of at least 25 percent during the period 2000-2003 or (ii) an average share of hydrocarbon and/or mineral export proceeds in total export proceeds of at least 25 percent during the period 2000-2003. Forty one countries fulfill these criteria: see the list and the average values of their ratios of commodity-related fiscal revenues to GDP and to total fiscal revenues for the period 1991-2008 in Table A2 in the Appendix.

For this restricted sample we obtained information about fiscal revenues derived from hydrocarbons from the database constructed by Mauricio Villafuerte and Pablo Lopez-Murphy (2010)[17] since 1991 and we augmented it with data on fiscal revenues derived from mining activities for countries that fulfilled the previous criteria, collected from IMF Article IV published consultations for natural resource rich countries for the same period. Unfortunately we do not have data on fiscal revenues derived from non-renewable natural resources for most of those countries in which these revenues were positive but their share in total fiscal revenues was below the IMF criteria for 2000-2003. We have arbitrarily set them at

[16] Typical examples are from the experiences of countries in authoritarian regimes as first discussed by Mahdavy (1970) and more recently made popular by Ross (2001).
[17] See Villafuerte and Lopez-Murphy (2010)

0.01% of GDP for all countries that do not fall into the IMF category of hydrocarbon or mineral rich countries, which may affect the significance and value of the results of regressions with the large sample when using this variable. Also, whenever we could not find data on commodity-related fiscal revenues for a hydrocarbon or mineral rich countries in a given year we treated that observation as missing.

Along this paper we follow Leamer and Lederman and Maloney in measuring resource abundance through an index of revealed comparative advantage: net non-renewable natural resource exports per capita[18]. It would be preferable to use a measure of the value or magnitude of resource endowments, which would be a more, though not fully, exogenous measure of abundance, but data availability and valuation problems preclude us to follow that route. The advantages of using net non-renewable natural resource exports per capita in relation to other common measures of resource abundance in the literature (such as the ratio of natural resource exports to GDP or to total exports) are discussed in Lederman and Maloney (2007).

What countries do with their non renewable natural resource rents depends significantly on how much fiscal revenues they derive from their exploitation. This, in turn, depends on modes of exploitation (public enterprises, joint ventures, concession contracts) and their characteristics, as well as on royalties and taxes paid to the central and sub national governments and on the net profits of public enterprises and to what extent they are transferred to the budget or spent in non mining and oil activities. Ownership, contractual, royalties, tax and public enterprises management regimes vary widely across these countries and they jointly determine present non-renewable resource based fiscal revenues and investment levels in natural resources exploration and development, and hence future potential rents and fiscal revenues derived from them. There is a rich literature on both the theoretical, empirical and political economy aspects of these important issues[19].

This paper use an aggregate measure of fiscal revenues derived from non-renewable resources to GDP and explore to what extent non renewable natural resource abundance is transformed into fiscal revenues and into fiscal dependence (measured by the share of non-renewable resource related fiscal revenues over total fiscal revenues). The later is a highly endogenous variable, which depends not just on the fiscal revenues derived from resource extraction but also on to what extent natural resource rich countries fail to achieve diversification of production, and on to what extent they tax other economic activities.

[18] Leamer (1984). See discussion in Lederman and Maloney (2007) about the merits and limitations of this and other measures of natural resource abundance

[19] Sunley and Baunsgaard (2001), Baunsgaard (2001), Ahmad and Mottu (2002).

Table1: Data characteristics

Description / Source	Obs	Mean	stdev	Min	Max
Real GDP per capita PPP	3547	10,561	12,987	1.33	149,899
Net natural resource exports per capita.	2498	-3.72	11.05	-17.38	18.12
Natural resource fiscal revenue to GDP.	4879	1.86	6.72	0.00	60.22
Resource rich countries (dummy)	4415	0.19	0.39	0.00	1.00
Public Investment to GDP	2305	6.14	4.21	0.00	34.99
Government expenditures to GDP	2638	31.68	13.78	0.19	204.17
Government revenue to GDP	2715	30.55	18.60	3.29	556.31
Government Effectiveness Index	1967	-0.01	1.01	-2.50	2.27
Political Stability Index	1992	-0.04	1.00	-3.28	1.58
Rule of Law Index	2010	-0.02	1.00	-2.69	1.96
ICRG Indicator of Quality of Government	2531	0.56	0.22	0.04	1.00
Agriculture's share of economy (% of GDP)	3128	17.32	15.17	0.00	93.98
Net asset accumulation to GDP	2243	14.63	19.71	-490.99	81.92
Central Government Debt (% of GDP)	905	54.50	36.32	0.21	277.53
Gross fixed k formation (% of GDP)	3253	21.95	8.26	-23.76	113.58
Natural resource fiscal revenue to gov revenue	519	0.45	0.27	0.00	1.05
Countries Not Fiscally Dependent on Natural Resource Revenues					
Real GDP per capita PPP	2722	10,365	11,806	1	89,833
Net natural resource exports per capita.	1912	-8.20	7.77	-17.38	15.18
Natural resource fiscal revenue to GDP.	3563	0.01	0.30	0.00	0.60
Resource rich countries (dummy)	3563	0.00	0.00	0.00	0.00
Public Investment to GDP	1681	5.89	3.94	0.00	34.77
Government expenditures to GDP	1980	31.97	14.10	0.19	168.44
Government revenue to GDP	2041	30.21	20.15	3.29	556.31
Government Effectiveness Index	1448	0.10	1.04	-2.50	2.27
Political Stability Index	1470	0.06	0.97	-3.28	1.58
Rule of Law Index	1475	0.08	1.00	-2.69	1.96
ICRG Indicator of Quality of Government	1766	0.59	0.24	0.04	1.00
Agriculture's share of economy (% of GDP)	2400	17.95	15.70	0.00	93.98
Net asset accumulation to GDP	1762	13.69	20.53	-490.99	77.33
Central Government Debt (% of GDP)	735	54.61	32.95	3.60	243.60
Gross fixed k formation (% of GDP)	2535	22.04	7.96	-23.76	92.44
Countries Fiscally Dependent on Natural Resource Revenues					
Real GDP per capita PPP	825	11,208	16,279	509	149,900
Net natural resource exports per capita.	586	10.90	6.68	-12.91	18.12
Natural resource fiscal revenue to GDP.	852	10.61	12.86	0.00	60.22
Resource rich countries (dummy)	852	1.00	0.00	1.00	1.00
Public Investment to GDP	624	6.82	4.79	0.00	34.99
Government expenditures to GDP	658	30.81	12.75	6.47	204.17

Government revenue to GDP	674	31.55	12.75	5.83	107.32
Government Effectiveness Index	443	-0.41	0.78	-2.13	2.08
Political Stability Index	445	-0.49	0.98	-3.08	1.45
Rule of Law Index	444	-0.51	0.83	-2.05	1.95
ICRG Indicator of Quality of Government	749	0.49	0.16	0.11	1.00
Agriculture's share of economy (% of GDP)	728	15.23	13.04	0.26	61.97
Net asset accumulation to GDP	481	18.10	15.93	-147.37	81.92
Central Government Debt (% of GDP)	170	54.03	48.41	0.21	277.53
Gross fixed k formation (% of GDP)	718	21.65	9.24	3.48	113.58
Natural resource fiscal revenue to gov revenue	519	0.46	0.27	0.00	1.05

Table 1 shows that the countries in the restricted sample of hydrocarbon and mineral rich countries according to IMF criteria, have fiscal revenues derived from non-renewable natural resources of 10.61% of GDP on average over the period (equivalent to 46 % of total fiscal revenues), varying from a minimum of 12.86% to a maximum of 60.2% (from 27% to 100%). They have a slightly larger income per capita on average than the rest, but with a much higher dispersion. They also tend to have slightly larger overall fiscal revenues but slightly smaller central government expenditures and higher public investment to GDP ratios and similar levels of public debt on average. They tend to have a slightly lower domestic investment ratio but a much higher net asset accumulation (adding up net asset accumulation domestically and abroad) to GDP ratio. Finally, they tend to have lower institutional quality, on average, as compared to the rest.

The figures presented in Annex 1 show the behavior of some of these variables for the 8 Latin American countries included in the non-renewable resource rich sample during the recent commodity price boom. Their results show some commonalities but also some important differences, as summarized in Table 2 below. Fiscal performance was more similar across countries. Commodity-related fiscal revenues increased sharply and gross public debt levels were reduced sharply, as ratios of GDP, in all 8 countries. There were, however, some differences on the evolution of public expenditures and non-commodity related fiscal revenues. Total public expenditures increased as a share of GDP in all countries, indicating a pro cyclicality response, except in Peru and Mexico where public expenditure smoothing has been remarkable. The degree of pro cyclicality was stronger in Colombia, Ecuador and Venezuela. Public Investment behavior was also pro cyclical in all countries except in Colombia (where the significant increase in public expenditures was restricted to current expenditures) and Mexico, being weaker in Peru and stronger in Ecuador and Trinidad and Tobago. It is interesting to note that the fiscal rule in Chile did not avoid some pro-cyclicality of public expenditures, probably due to the changes that took place in the structural balance goal (which was reduced from 1 to 0.5% of GDP) and the increase in the estimated long-term price of copper. On the other hand, non-commodity-related fiscal revenues dropped as a share of GDP in Bolivia, Chile, Mexico (though recovering somewhat after an initial fall), Trinidad and Tobago and, especially, in Venezuela, but it did not change in Peru (it decreased initially but then recovered) and increased in Ecuador and Colombia.

The macroeconomic effects were even more dissimilar across countries. GDP growth showed a high correlation with commodity prices in most countries (especially in Bolivia, Colombia and Peru), but it was weak in Ecuador and not significant in Chile. The Chilean result suggests a powerful macro stabilization effect of its fiscal rule, in spite of some pro cyclicality that was allowed in public expenditures. The result in Ecuador is quite surprising given the dollarization of its economy. Domestic investment to GDP increased in most countries: more sharply in Colombia (probably reinforced by the improvements in security), modestly in Bolivia, Chile and Peru and weakly in Ecuador. However, it did not increase in Venezuela (probably given the sharp deterioration in investment climate that led private investment to fall while public investment was increasing sharply) and Mexico and it decreased in Trinidad and Tobago. Half of the countries saved part of the boom through increased current account to GDP ratios: net foreign asset accumulation was particularly strong in Bolivia and Trinidad and Tobago, significant in Peru and modest in Ecuador. It was not significant in Chile, nor in Mexico, and was negative In Colombia and Venezuela, probably due to the deterioration of the trade balance as a consequence of strong currency appreciation in some of these countries (and the effects of US slowdown in the case of Mexico), which compensated or overcompensated the effects in the reduction of net public external debt.

Table 2

Macro and fiscal performance in Latin American non-renewable resource rich countries during the recent price boom. Correlations with commodity prices

	Growth	Domestic Investment /GDP	Current Account /GDP	Commodity-related fiscal revenues/GDP	Non commodity-related fiscal revenues/GDP	Public expenditures /GDP	Public Investment /GDP	Public Debt/GDP
BOL	+++	++	+++	+++	--	+	+	---
CHL	No	++	No	+++	--	+	+	---
COL	+++	+++	--	+++	++	++	No	---
ECU	+	+	+	+++	+	++	++	---
PERU	+++	++	++	+++	No	-	+	---
MEX	++	No	No	+++	-	No	No	--
TTO	++	--	+++	+++	--	+	++	---
VEN	++	No	--		---	++	n.a.	---

Source: Figures in Annex 1

4. Macro effects of the use of non-renewable resource rents: *Do non-renewable natural resource rich countries invest or save more?*

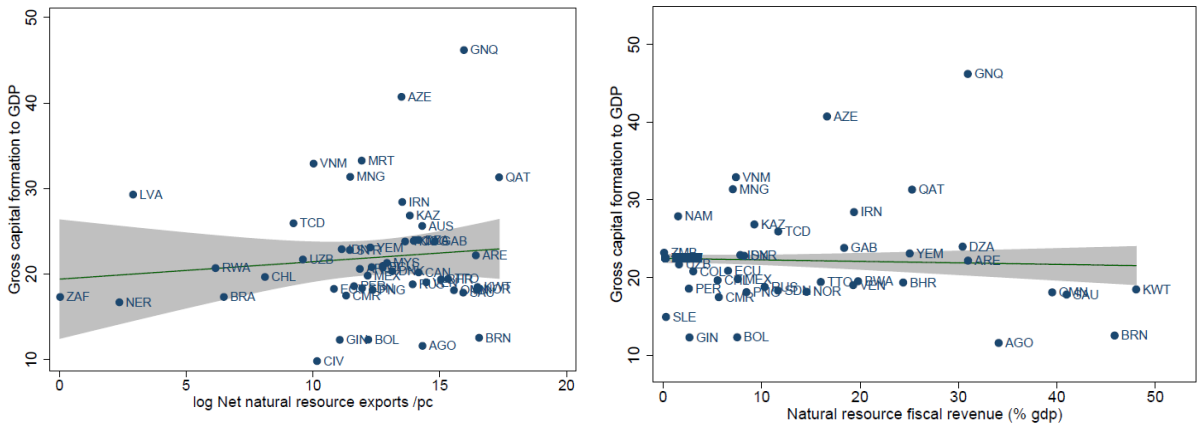
In this section we test some of the macro hypothesis derived from the theoretical discussion in Section 2. Specifically, do low and middle income non-renewable resource rich countries indeed consume and invest domestically more of their natural resource rents, while high income non-renewable NR rich countries save more, in comparison with countries with similar income levels?.

Figure 1 shows that, in general, non-renewable resource rich countries do not tend to invest more domestically than the rest. There is a positive but not significant slope of the correlation line in the left-hand side panel (gross capital formation/GDP vis-a-vis log of net non-renewable natural resource

exports per capita) and none in the right-hand side panel (gross capital formation/GDP vs. non-renewable fiscal revenues/GDP). The variance is quite large: some countries (like Equatorial Guinea and Azerbaijan invest considerably more than similar natural resource rich countries) and others, such as Bolivia, Brunei, Angola and Guinea, invest considerably less.

Figure 1

Non-renewable Natural Resource Wealth and Domestic Investment



To explore this issue further we estimated OLS regressions with gross capital formation/GDP as dependent variable and different measures of non-renewable resource abundance and dependence as independent variables, as well as several controls. Table 3 shows the more significant results. The coefficient on net non-renewable resource exports per capita is positive and significant [20] and the coefficient on the interaction of this term with GDP per capita is negative and significant. Thus, as expected from the theoretical discussion in Section 2, low income non-renewable resource rich countries tend to invest more than others with similar income levels, but this effect is mitigated and potentially reversed in high income non-renewable resource rich countries. For the whole sample, investment ratios are in addition positively related to total government revenue and to an index of Government Effectiveness and the coefficient of the interaction between Government Effectiveness and net non-renewable resource exports per capita is positive and significant. These results suggest that the quality of institutions matter, and were robust to the choice of World Bank indicators of quality of institutions; Rule of Law and the Control of Corruption. However, they were not significant when we used the OECD budget transparency index.

[20] Though this result was not robust in all the specifications we estimated

Table 3
Domestic Investment and NR Abundance

Dep Var: log of investment to GDP	(1)	(2)
log GDP/pc PPP	0.472	-0.029
	(0.462)	(0.157)
Log NNRE/pc	0.308*	0.050*
	(0.162)	(0.026)
log GDP/pc PPP x Log NNRE/pc	-0.041*	-0.006**
	(0.022)	(0.003)
Log gov. revenue	0.104	0.242***
	(0.144)	(0.077)
log NRFR/GDP	0.031	-0.051
	(0.056)	(0.036)
govt_eff_index	-0.098	0.150***
	(0.313)	(0.051)
govt_eff x Log NNRE/pc	0.028	0.008**
	(0.023)	(0.003)
cons.	-0.689	2.336*
	(3.491)	(1.388)
Country fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
R-squared	0.783	0.785
N	338	1537

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

A clearer picture emerges when we look at total asset accumulation (adding domestic investment and foreign asset accumulation –see technical details in the Appendix). Figure 2 shows that higher non-renewable resource abundance and dependence are positively and strongly related to total asset accumulation. More interestingly, Figure 3 shows that higher income rich non-renewable resource countries accumulate more assets than the rest, as expected from the theoretical discussion in section 2.

Figure 2

Total Net Asset Accumulation and non-renewable NR Abundance and Dependence

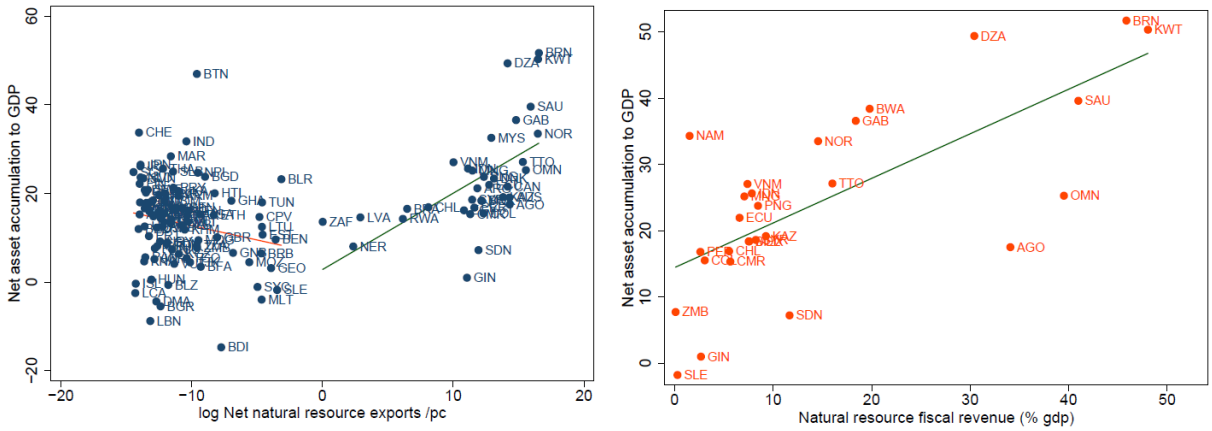
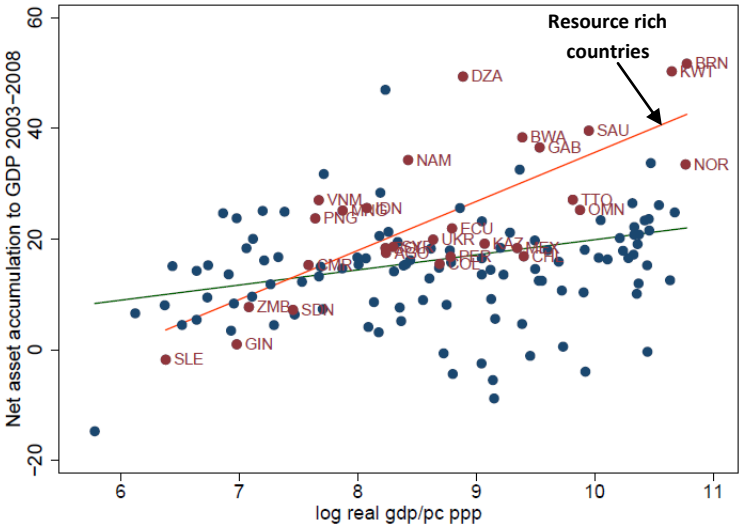


Figure 3

Total Net Asset Accumulation and GDP pc



Using OLS econometric estimations we are able to corroborate these findings. Table 4 presents the main results using Total Net Asset Accumulation as the dependent variable, measures of resource abundance and resource revenues as independent variables and different control variables. We corroborate that Net Asset Accumulation is positively and significantly related to most measures of non-renewable resource abundance and fiscal revenues, especially for higher income countries (a positive and significant coefficient on the interaction of some resource related variables with GDP per capita).

Table 4
Total Net Asset Accumulation and non-renewable NR Abundance

Dep. Variable: Total net asset accumulation	(1)	(2)	(3)	(4)	(5)	(6)
log GDP/pc PPP	0.177***	0.191***	0.206***	0.177***	-0.05	0.195***
	(0.032)	(0.029)	(0.05)	(0.032)	(0.119)	(0.033)
RRICH	-1.027			-0.824	-2.690**	
	(0.739)			(0.681)	(1.277)	
log GDP/pc PPP x RRICH	0.143*			0.092	0.321**	
	(0.082)			(0.074)	(0.147)	
log NRFR/GDP		0.028***	0.011	0.029**	0.234**	
		(0.007)	(0.053)	(0.014)	(0.108)	
log GDP/pc PPP x log NRFR/GDP			0.002		-0.025**	
			(0.006)		(0.012)	
Log NNRE/pc						0.009***
						(0.003)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.131	0.135	0.135	0.139	0.144	0.127
N	2054	2054	2054	2054	2054	1440

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

5. Fiscal effects of non-renewable resource rents

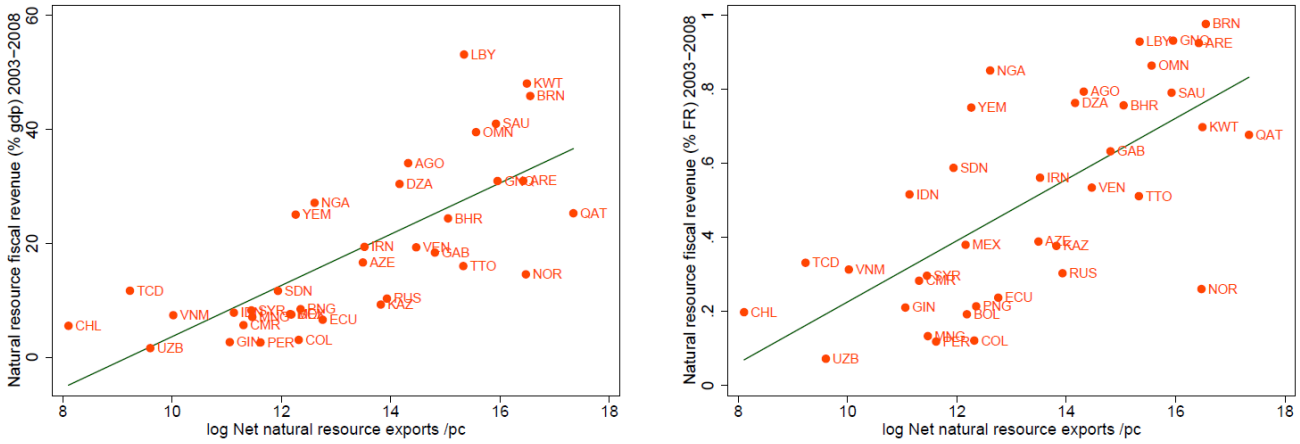
- ***From Natural Resource Abundance to Fiscal Dependence***

As mentioned in Section 2, what countries do with their non renewable natural resource rents is likely to depend significantly on how much fiscal revenue they derive from their exploitation and to what extent they become fiscally dependent on them.

Figure 4 below shows the bilateral relationship between nonrenewable natural resource abundance, the importance of non-renewable resource fiscal revenues (as a fraction of GDP) and fiscal dependence on these revenues (the share of non-renewable resource fiscal revenues in total fiscal revenues) for our restricted sample. As expected, these correlations are positive and significant, but the variance is large, especially with respect to our fiscal dependence variable. Several countries, notably Norway, and to a lesser extent Russia and some Latin American countries (Colombia, Peru, Ecuador, Bolivia and Trinidad and Tobago), have lower fiscal dependence than expected (through a simple regression of our fiscal dependence index on our resource abundance index) given their natural resource abundance. Others, notably Nigeria and Yemen, and to a lesser extent other African and Asian countries and, surprisingly, Chile, show higher fiscal dependence than expected given their natural resource abundance measures. Mexico and Venezuela appear close to the regression lines.

Figure 4

From Natural Resource Abundance to Fiscal Dependence. Restricted sample



Given this variance, we proceeded to explore the determinants of dependence on natural resource fiscal revenues by regressing our two measures of fiscal dependence on our measure of resource abundance, using as control variables GDP per capita and different indexes of quality of institutions. We also interacted our non-renewable resource related variables with these controls. Table 5 and 6 below show the more significant OLS econometric results that were obtained for the restricted and full sample, respectively. As can be seen, the coefficients on net non-renewable resource exports per capita and GDP per capita were always positive and the latter always significant. More interestingly, a given level of resource abundance translates into higher fiscal revenues as a share of GDP for higher values of the index of quality of institutions as measured by the World Bank Government effectiveness index in the case of the restricted sample and even into higher fiscal dependence on these revenues (Table 5). The latter result is quite surprising: it implies that not only the capacity to effectively tax non-renewable resource extraction is directly linked to the quality of institutions; even controlling by the level of GDP per capita, but that it overrides whatever effect better institutions have on increased taxation of other economic activities. However, the corresponding results for the large sample differ in this respect: the coefficients on the interaction of our resource abundance index with the indexes of institutional quality have now negative signs, though they are only significant when we use the ICR Quality of Governance index (see Table 6).

Table 5

From Resource Abundance to natural-resource revenues and fiscal dependence. Restricted sample

	Log NRFR/GDP			Log NRFR/FR		
Dep. variable: Log NRFR/GDP	(1)	(2)	(3)	(4)	(5)	(6)
Log GDP/pc PPP	0.620***	0.568**	0.726***	0.464**	0.365	0.580***
	(0.155)	(0.252)	(0.171)	(0.175)	(0.275)	(0.181)
Log NNRE/pc	0.073*	0.074*	0.246***	0.30	0.031	0.264***
	(0.042	(0.042)	(0.052)	(0.054)	(0.055)	(0.058)
Govt. effect. index		-0.203	-2.616***		-0.175	-3.244***
		(0.157	(0.686)		(0.152)	(0.663)
Govt. effect. Index x Log NNRE/pc			0.190***			0.239***
			(0.052)			(0.049)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.901	0.903	0.917	0.881	0.883	0.909
N	424	399	399	382	365	365

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6

From Resource Abundance to commodity-related fiscal revenues and fiscal dependence. Full sample

	log NRFR/GDP		Log NRFR/FR	
	1	2	3	4
log GDP/pc PPP	0.386***	0.307*	0.924	0.867
	(0.132)	(0.177)	(0.601)	(0.735)
Log NNRE/pc	0.007***	0.024***	0.035**	0.124***
	(0.002)	(0.007)	(0.015)	(0.044)
govt_eff_index	-0.109***		-0.171	
	(0.037		(0.224)	
govt_eff_index x Log NNRE/pc	-0.002		-0.011	
	(0.002)		(0.012)	
ICG -Quality of Government		-0.182		0.406
		(0.211)		(0.923)
ICG – QOG x Log NNRE/pc		-0.026***		-0.155***
		(0.009)		(0.057)
cons.	-8.238***	-7.059***	-13.99***	-13.774**
	(1.112)	(1.512)	(5.057)	(6.374)
Country Fixed Effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
R2	0.997	0.997	0.875	0.873
N	1865	1497	1938	1563

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

- ***Do NR rich countries have larger States and produce more public goods?***

What do non-renewable NR rich countries do in practice with fiscal revenues derived from their exploitation? Do they have larger States than similar non non-renewable NR rich countries (e.g., countries with the same level of income per capita)? If so, do they have larger public current expenditures (and on what) and/or public investment ratios to GDP? Or else, do they tax less other activities? Or do they accumulate more public financial assets and/or hold lower public debts? We examine these empirical questions in this and the following sections.

Figure 5 show that higher income rich non-renewable NR countries tend to have smaller central Governments (lower central public expenditures) than countries with similar GDP per capita. This is not true, though, at low levels of GDP per capita. However, the variance is large, so some non-renewable resource rich countries, especially Ukraine, Yemen and Angola, and to a lower extent Norway and a few more, tend to have larger central Governments (expenditures) than other countries with similar income per capita; while other non renewable resource rich countries, such as Equatorial Guinea, United Arab Emirates, Cameroon, Chad and some Latin American (Peru, Chile and Mexico) have much smaller central Governments (expenditures) than other countries with similar GDP per capita, whether or not rich in non renewable resources.

Figure 5
Do non-renewable NR rich countries have larger States?

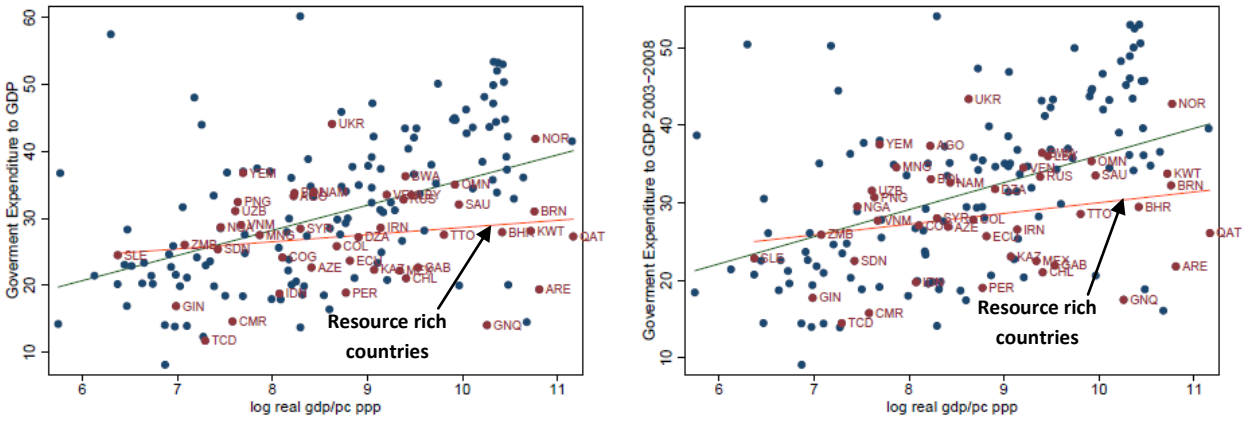


Table 7 shows the main results of OLS estimations of equations in which government size (as measured by central public expenditures/GDP) is regressed on GDP per capita and indexes of non-renewable resource abundance. These results tend to confirm what is apparent in Figure 5. Column 2 show that higher fiscal revenues derived from nonrenewable resources tend to lead to larger central Governments in low income countries, but that this effect is smaller or is reversed in countries with higher income per capita. Column 3 suggest no significant effects of quality of institutions, though, for the restricted sample, we obtained that among countries rich in non-renewable natural resources those with high indexes of Government effectiveness tend to have smaller States for a given level of commodity-related fiscal revenues (not shown).

Table 7

Do non-renewable NR rich countries have larger Governments?

Dep. Variable: Log of Gov. expenditure to GDP	(1)	(2)	(3)
log GDP/pc PPP	0.02	-0.118	-0.02
	(0.202)	(0.107)	(0.152)
log NRFR/GDP	-0.042	0.487**	0.420*
	(0.054)	(0.193)	(0.225)
log NRFR/GDP x log GDP/pc PPP		-0.056**	-0.046*
		(0.023)	(0.026)
govt_eff_index			-0.039
			(0.053)
govt_eff_index log NRFR/GDP			0.001
			(0.011)
cons.	2.975*	4.49***	3.61***
	(1.773)	(0.949)	(1.323)
Country Fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
r2	0.775	0.783	0.842
N	2185	2185	1714

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure 6

Do countries with fiscal dependence on non-renewable NR have higher public investment?

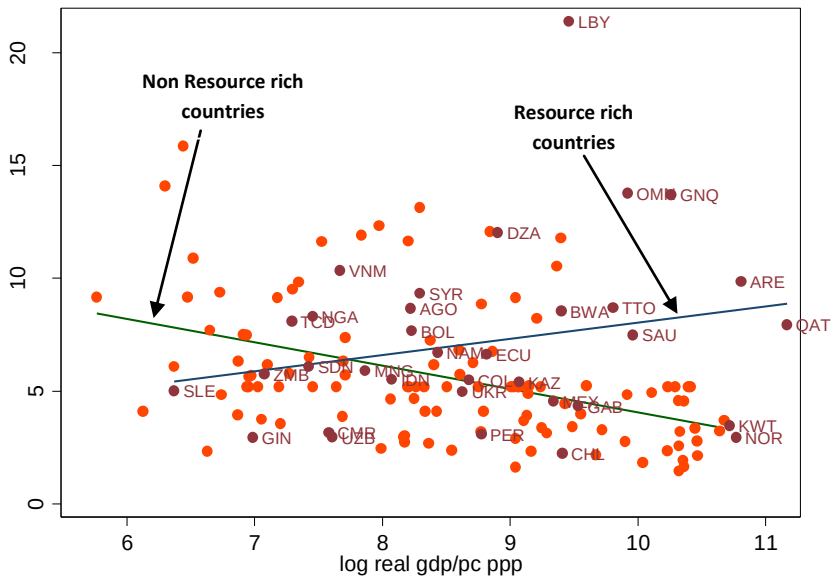


Figure 6 suggests that high income countries with large fiscal revenues derived from non-renewable resources tend to have significantly higher public investment levels that other countries with similar income levels (the slope of the two regression lines have even different signs). Table 8 presents the main results of OLS estimates of public investment ratios to GDP (of the central Government) as the dependent variable. Column 1 shows that high income countries with high fiscal revenues derived from non—renewable resources tend to have larger public investment ratios than other countries with similar income per capita, while the contrary maybe true for low income countries, dependent on non-renewable fiscal revenues. It also indicates that countries with high indexes of government effectiveness tend to have higher public investment ratios, but that this effect is mitigated in countries with high fiscal revenues derived from non-renewable resources. Columns 3 and 4 suggest a strong non linearity in the effect of fiscal revenues derived from non-renewable resources on public investment ratios.

Table 8

Public Investment and non-renewable NR wealth

Dep. Var. Log of Public investment to GDP	(1)	(2)	(3)	(4)
log GDP/pc PPP	-0.394	0.189	-0.154***	-0.109
	(0.396)	(0.155)	(0.033)	(0.072)
RRICH x log GDP/pc PPP			0.169***	0.131***
			(0.033)	(0.046)
log NRFR/GDP	-1.321	0.041		
	(0.857)	(0.128)		
log NRFR/GDP x log GDP/pc PPP	0.176*			
	(0.098)			
govt_eff_index	0.749***	0.485**		
	(0.184)	(0.191)		
govt_eff x log NRFR/GDP	-0.280***	-0.146**		
	(0.05)	(0.066)		
log NRFR/GDP squared		0.071	0.030***	0.017*
		(0.045)	(0.007)	(0.01)
OECD efficiency				-0.003
				(0.004)
OECD efficiency x log NRFR/GDP				0.00
				(0.001)
cons.	4.78	-0.288	2.649***	2.369***
	(3.387)	(1.367)	(0.302)	(0.538)
Country Fixed Effects	Yes	Yes	Yes	No
Year fixed effects	Yes	Yes	Yes	No
r2	0.803	0.81	0.161	0.308
N	323	323	1897	44

Table 9 presents results of similar exercises with expenditures in education and health (as a fraction of GDP) as dependent variables. Results suggest that countries with high fiscal revenues derived from non renewable resources do not tend to spend more on education and may invest less on health than other countries with similar income levels

Table 9

Do non-renewable NR rich countries spend more in public education and health?

Dep. Variable:	Log gov. expending in education	Log gov. expending in education	Log gov. expending in health	Log gov. expending in health
	(1)	(2)	(3)	(4)
log GDP/pc PPP	0.306	0.255	-0.459	-0.363
	(0.348)	(0.238)	(0.282)	(0.281)
log NRFR/GDP	-0.251	-0.084	0.126	0.018
	(0.377)	(0.076)	(0.221)	(0.026)
log NRFR/GDP x log GDP/pc PPP	0.016		-0.018	
	(0.039)		(0.025)	
govt_eff_index	-0.016	-0.006	0.139*	0.105
	(0.162)	(0.171)	(0.081)	(0.078)
govt_eff_index_log NRFR/GDP	0.003	0.006	0.014	0.009
	(0.023)	(0.025)	(0.011)	(0.01)
log NRFR/GDP squared		-0.005		-0.037*
		(0.022)		(0.019)
cons.	-0.672	0.136	6.302**	7.107***
	(3.246)	(2.6)	(2.514)	(2.492)
r2	0.861	0.861	0.944	0.945
N	573	573	835	835

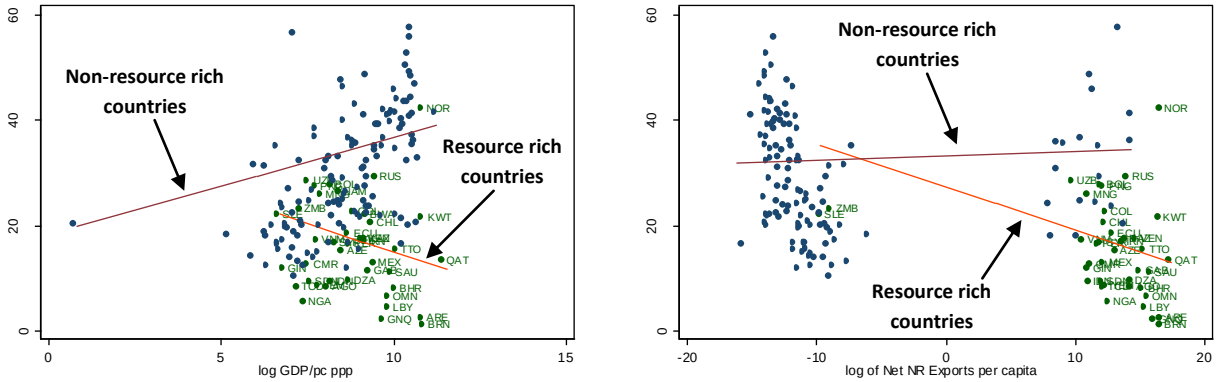
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

- ***Do non-renewable NR rich countries tax less other activities or carry lower public debts?***

Figure 7 shows that non-renewable resource rich countries tax less other activities. It indicates that non commodity-related taxes to GDP ratios fall steeply with the size of non-renewable exports per capita (left-hand side panel) and that the difference in such tax ratios between non-renewable resource rich countries and the rest increases steeply with the level of GDP per capita. These stylized facts are consistent with the previous finding that high income countries with large fiscal revenues from derived from non-renewable resources tend to have lower public expenditure to GDP ratios.

Figure 7

Do countries with high fiscal revenues from non-renewable NR tax less other activities?



Econometric estimates presented in Table 10 confirm that countries with high fiscal revenues from non-renewable resources tax less other activities.

Table 10

Do countries with high fiscal revenues from non-renewable resources tax less other activities?

	Resource Rich countries			All countries	
	(1)	(2)	(3)	(4)	(5)
Dep var: Non-NRFR/GDP					
NRFR/GDP	-0.24***	-0.24***	-0.20***	-0.22***	-0.21
	(0.068)	(0.054)	(0.046)	(0.049)	(0.137)
log real GDP/pc PPP		-0.32	-0.76	2.70**	-0.4
		(1.703)	(1.755)	(1.337)	(1.833)
Agriculture (% of GDP)		-0.11	-0.16	-0.15**	-0.11
		(0.113)	(0.107)	(0.07)	(0.112)
Corruption index		-1.2	-1.43	-0.45	-1.2
		(1.814)	(1.5)	(0.769)	(1.813)
Lag non-NRFR/GDP			0.23*	0.47***	
			(0.138)	(0.1)	
NRFR/GDP squared					0.00
					(0.002)
Constant	19.96***	24.33	24.11	-5.46	24.89
	(1.07)	(15.32)	(17.07)	(12.36)	(16.11)
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	519	278	262	1,209	278
R-squared	0.862	0.884	0.899	0.935	0.884

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Finally, as discussed above, non-renewable resource rich countries may opt to use part of their fiscal revenues associated with their exploitation to accumulate public financial assets (or fixed assets abroad) or equivalently to carry on lower levels of public debt. Results obtained so far are reported in Table 11. Column 1 shows that low income countries with high fiscal revenues from non-renewable resources carry on higher levels of public debt than countries with similar income levels, but that this effect is reduced or disappears in high income countries. Column 2 indicates that these effects depend strongly on the values of the index of Government effectiveness. Columns 3 and 4 indicate, as expected, that countries with higher overall fiscal revenues carry higher levels of public debt, but that this effect is lower in countries that derive significant revenues from non-renewable natural resources.

Table 11

Do non-renewable resource rich countries carry lower levels of public debt?

Dep Var: Log of Public Debt to GDP	(1)	(2)
log GDP/pc PPP	2.035	-0.944**
	(1.183)	(0.447)
log NRFR/GDP	6.525***	
	(1.98)	
log NRFR/GDP x log GDP/pc PPP	-0.781***	
	(0.25)	
log NRFR/FR		5.062**
		(2.313)
log NRFR/FR x log GDP/pc PPP		-0.627**
		(0.299)
govt_eff_index	-2.397*	-1.833
	(1.292)	(1.288)
govt_eff x log NRFR/GDP	0.644*	0.413
	(0.317)	(0.299)
cons.	-13.147	11.48***
	(9.645)	(3.863)
Country fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
R2	0.752	0.737
N	154	154

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

6. Effects on non-renewable resource abundance on the volatility, pro-cyclicality and efficiency of public expenditures.

- ***Do non-renewable resource rich countries have more volatile and procyclical fiscal policies?***

In this section we explore if non-renewable resource rich countries or those deriving high fiscal revenues from non-renewable resources tend to have more volatile and procyclical fiscal policies than others. Higher volatility of expenditures is expected due to the higher volatility of non-renewable resource related fiscal revenues and political economy factors that tend to lead to automatic spending of higher revenues. Higher pro cyclicality would also be expected in so far many non-renewable resource rich countries business cycles appear to be strongly associated with commodity price cycles. In such circumstances, it is likely that the political economy forces and financial sector pro cyclical behavior that lie behind observed pro cyclicality of fiscal policies in developing countries, may lead to especially strong pro cyclicality in fiscal policies of non-renewable resource rich countries.

Table 12
Co movement of business cycles and commodity prices (restricted sample)

Dep. Variable: GDP cycle	(1)	(2)	(3)	(4)	(5)	(6)
Cycle metal index	-0.00308					
	-0.0093					
Cycle energy index		0.0214**				
		-0.0104				
Cycle main commodity			0.0171**			
			-0.00814			
Cycle metal index (t-1)				0.0359***		
				(0.00933)		
Cycle energy index (t-1)					0.0527***	
					(0.00955)	
Cycle main commodity (t-1)						0.0515***
						(0.00801)
Constant	0.000699	0.000433	0.000713	0.00124	-0.00174	0.00113
	-0.00183	-0.0023	-0.00183	(0.00185)	(0.00218)	(0.00182)
Country Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,067	710	1,067	1,038	673	1,038
R-squared	0	0.006	0.004	0.015	0.046	0.040
Number of id	38	38	38	38	38	38

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 12 shows that coefficients of correlation of the cyclical components of GDP growth in countries deriving high fiscal revenues from non-renewable NR are indeed generally associated with the cyclical components of the prices of their main exportable commodities, though the coefficients for simultaneous co movement are relatively small (they are much higher for lagged correlations). Somewhat surprisingly the association is stronger with energy prices.

Tables A4 and A5 in the Appendix show that indeed the contemporaneous and lagged association between GDP cycles and main commodity export price cycles is quite uneven. The coefficient is actually negative for Cameroon, Colombia, Ecuador, Iraq, Norway, Oman, Qatar, Sudan, Syria, Uzbekistan, Venezuela and Yemen. Table A4 in the Appendix show that the association is much stronger with lagged prices

Measuring fiscal policy pro-cyclicality through the correlation coefficient between growth in public expenditures and growth in GDP, as is commonly done in the literature and side-stepping by now potential endogeneity problems, we obtain the results shown Figure 8 and table 13 below. Figure 8 suggests that, if anything, pro cyclicality of public expenditures seems to be lower for countries deriving high fiscal revenues from non-renewable resource resources, though the difference is non-significant statistically. However, this is not the case for countries such as Iraq, Zambia, Bolivia, Peru and Colombia, which seem to have higher pro cyclicality than their peers.

Figure 8
Pro cyclicality of expenditures and non-renewable resource abundance

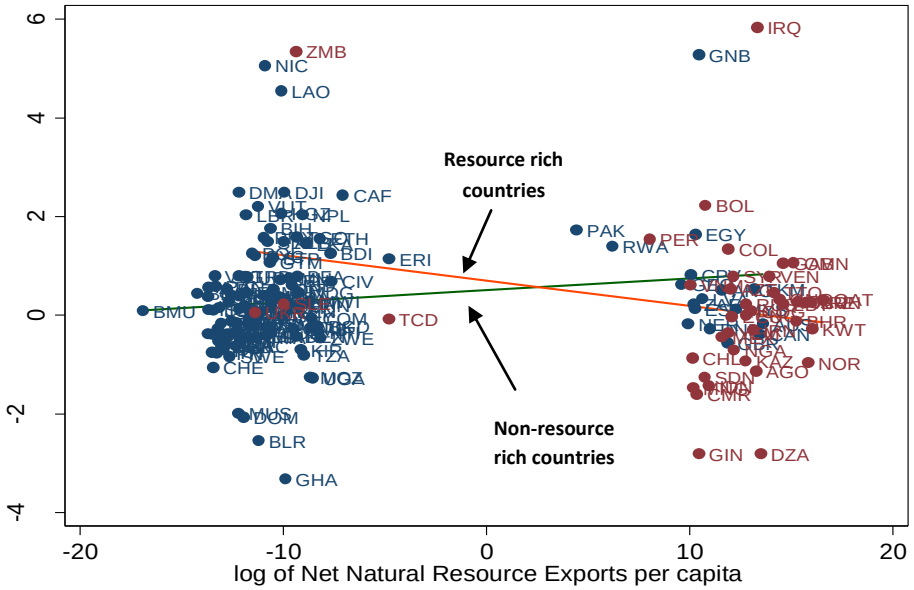


Table 13 shows a significant and robust correlation between the cyclical components of public expenditures and GDP, which, non-withstanding potential endogeneity effects, is suggestive of pro cyclicality of public expenditures. We find, however, no significant differences in this correlation between countries rich or fiscally dependent on non-renewable resources and the rest, using any indicator of abundance or dependence (the coefficients on the interactions of the GDP cyclical

component and any measure of non-renewable resource abundance or fiscal dependence are not significant). On the other hand, there is also a significant and robust association between the cyclical components of public expenditures and fiscal revenues derived from non-renewable resources. In other words, non-renewable resource wealth appears to contribute to the volatility of public expenditures but not to their pro cyclicality. This latter result is probably explained by the fact that the contemporaneous association of GDP and commodity prices is relative weak on average among non-renewable resource rich countries, as shown above

Table 13
Are public expenditures more volatile and pro-cyclical in non-renewable resource rich countries?

Dep.Var. Expenditure cycle	(1)	(2)	(3)	(4)	(5)	(6)
GDP cycle	0.520***	0.578***	0.423***	0.394***	0.290**	0.436***
	(0.106)	(0.11)	(0.135)	(0.096)	(0.143)	(0.134)
log NRFR/GDP (cycle)	0.072***	0.071***	0.066**	0.083***	0.081***	0.074***
	(0.012)	(0.013)	(0.027)	(0.01)	(0.01)	(0.009)
GDP cycle x RRICH		-0.26				
		(0.174)				
Log NNRE/pc x GDP cycle			-0.013			
			(0.011)			
log NRFR/GDP x GDP cycle				-0.028		
				(0.017)		
log NRFR/FR x GDP cycle					-0.043	
					(0.027)	
Terms of trade cycle						0.003
						(0.063)
cons	-0.007	-0.006	-0.011	-0.006	-0.006	-0.017
	(0.011)	(0.011)	(0.02)	(0.011)	(0.011)	(0.012)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
r2	0.235	0.243	0.202	0.244	0.244	0.263
N	2442	2442	1953	2442	2442	1695

Robust standard errors in parentheses. *** p<0.01, ** p<0.05,* p<0.1

Table 14 show similar results for public investment. Pro cyclicality appears to be overall somewhat stronger for public investment (higher coefficients on the GDP cyclical component). The public investment cycle is also more responsive to the cycle of fiscal revenues derived from non-renewable resources. In contrast to table 13 results, however, the pro-cyclicality of public investment is significantly weaker for countries with higher fiscal revenues from non-renewable resources (columns 3 to 6). Further, pro cyclicality of public investment is even lower the higher the interaction between the index of Government Effectiveness and the level of fiscal revenues derived from non-renewable resources (Column 6).

Table 14
Pro cyclicality of public investment

Dep. Var. Public investment cycle	(1)	(2)	(3)	(4)	(5)	(6)
GDP cycle	0.743***	0.552***	0.601***	0.874***	0.615***	0.452***
	(0.111)	(0.127)	(0.054)	(0.056)	(0.041)	(0.08)
Log NRFR/GDP (cycle)	0.117*	0.145**	0.124**	0.150**	0.149**	0.133**
	(0.06)	(0.067)	(0.06)	(0.063)	(0.065)	(0.056)
GDP cycle x RRICH				-0.371***		
				(0.096)		
Log NNRE/pc x GDP cycle		-0.012				
		(0.008)				
log NRFR/GDP x GDP cycle			-0.027**		-0.038***	-0.046**
			(0.013)		(0.008)	(0.021)
Terms of trade cycle				0.173	0.08	
				(0.175)	(0.142)	
Terms of trade cycle x RRICH				-0.123		
				(0.257)		
log NRFR/GDP x Terms of trade cycle					-0.014	
					(0.027)	
govt_eff_index						0.064
						(0.054)
govt_eff_index x log NRFR/GDP x GDP cycle						-0.049***
						(0.017)
cons.	-0.023	-0.015	-0.021	-0.031*	-0.030*	-0.019
	(0.026)	(0.03)	(0.026)	(0.018)	(0.018)	(0.036)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
r2	0.25	0.186	0.254	0.289	0.29	0.171
N	2037	1543	2037	1515	1515	1475

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

To control for reverse causality effects (due to fiscal multipliers), we used external partners demand growth and TOT changes as instruments for the GDP cyclical component. Results reported in Table 15 confirm that public investment is on average procyclical and that its cycle also depends on the cycle of fiscal revenues derived from non-renewable natural resources. Nonetheless, significant evidence of procyclicality for total government expenditures was not found. These estimates suggest that on average countries with large fiscal revenues derived from non-renewable resources do not appear to have more pro cyclical public expenditures, or public investment, than the rest. The OLS result of lower

pro cyclicality of public investment in non-renewable rich countries is not confirmed by the IV estimations

Table 15
Pro cyclicality of public expenditures and public investment. IV estimations

Dep. Variable:	Public expenditures cycle (1)	Public expenditures cycle (2)	Public investment cycle (3)	Public investment cycle (4)
GDP cycle	2.177	0.381	1.217*	0.819*
	(5.522)	(0.659)	(0.65)	(0.478)
Difference of log NRFR/GDP	-0.044		0.081*	
	(0.187)		(0.042)	
log NRFR/GDP x GDP cycle	0.123	0.009	0.046	0.02
	(0.35)	(0.042)	(0.044)	(0.033)
Public expenditures cycle (t-1)	0.044	0.263***		
	(0.694)	(0.086)		
log GDP/pc PPP	0.012	0.012	0.272***	0.216***
	(0.062)	(0.026)	(0.076)	(0.074)
govt_eff_index	-0.017	0.007	0.069*	0.056
	(0.077)	(0.015)	(0.041)	(0.038)
Public investment cycle (t-1)			0.171**	0.203***
			(0.083)	(0.062)
Terms of Trade		0.022		0.044
		(0.019)		(0.036)
log NRFR/GDP x Terms of trade		-0.001		-0.008
		(0.005)		(0.012)
cons.	-0.082	-0.21	-2.292***	-2.014***
	(0.581)	(0.215)	(0.651)	(0.608)
Country fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
N	1151	1155	1003	1009

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Do resource rich countries have lower efficiency of public expenditures and quality of institutions?

Tables 16 and 17 below test the hypothesis of lower efficiency of public expenditures in countries fiscally dependent on non-renewable resource revenues, with respect to measures of efficiency in education and health expenditures estimated by Pang and Herrera (2005)[21]. As can be seen from Table

[21] Pang and Herrera (2005) estimate efficiency in the health and education sector as the distance between observed input-output combinations and an efficiency frontier that is estimated by the Free Disposable Hull (FDH)

16, output efficiency indexes in both primary and secondary public education, whether estimated by FDH or DEA econometric methods, are positively and statistically significantly related to countries level of development (as measured by GDP per capita) and negatively and statistically significantly related to the share of non-renewable natural resource revenues in total fiscal revenues. Table 17 shows similar results for output efficiency indexes for Public Expenditures in Health, measured with respect to life expectancy and immunizations levels. These results are consistent with the predictions of public choice theory discussed in Section 2.

Table 16

Efficiency of Public Education expenditures and fiscal dependence on non-renewable resource revenues

Dep. Variable:	Primary Education Output Eff. FDH (1)	Primary Education Output Eff. DEA (2)	Secondary Education Output Eff. FDH (3)	Secondary Education Output Eff. DEA (4)
Log GDP/pc	0.07***	0.07***	0.19***	0.18***
	(0.012)	(0.011)	(0.014)	(0.012)
log NRFR/FR	-0.01	-0.02*	0.02*	-0.02**
	(0.009)	(0.008)	(0.01)	(0.009)
Constant	0.11	0.08	-1.11***	-1.11***
	(0.108)	(0.104)	(0.128)	(0.109)
Observations	122	122	122	122
R-squared	0.228	0.245	0.617	0.674

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

and Data Envelopment Analysis (DEA) techniques. They used a sample of 140 countries for years from 1996 to 2002.

Table 17

Efficiency of Public Health expenditures and fiscal dependence on non-renewable resource revenues.

Dep. Variable:	Life expectancy Output Eff. FDH	Life expectancy Output Eff. DEA	Immunization Output Eff. FDH	Immunization Output Eff. DEA
	(1)	(2)	(3)	(4)
Log GDP/pc	0.08***	0.08***	0.08***	0.08***
	(0.007)	(0.007)	(0.011)	(0.011)
log NRFR/FR	-0.01*	-0.01*	-0.02**	-0.02***
	(0.006)	(0.006)	(0.009)	(0.009)
Constant	0.11	0.11	0.02	0.02
	(0.07)	(0.07)	(0.107)	(0.107)
Observations	132	132	132	132
R-squared	0.48	0.48	0.305	0.304

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

We also tested whether these results depend on the quality of governmental institutions. We only found statistically significant results in the case of Public Health output efficiency indexes measured with respect to immunization levels. These results are reported in Table 18 below

We turn now to test the hypothesis of a negative association between fiscal dependence on non-renewable resource revenues and transparency of the budgetary process. We use the OECD Open Budget index for this purpose. Results in Table 19 below show indeed a negative and statistically significant association between these budget transparency indexes and both the ratio of (non-renewable) resource revenues to total fiscal revenues or to GDP, and a positive association with income levels. We should, however, be cautious to interpret these results as proof of causal relationships as there are endogeneity problems due to potential reverse causality links, as discussed above.

Table 18

Quality of governmental institutions and efficiency of public health expenditures

Dep. Var: Immunization output efficiency (measure using DEA method)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log GDP/pc	0.06***	0.06***	0.05***	0.05***	0.06***	0.07***	0.08***	0.07***
	(0.015)	(0.015)	(0.017)	(0.017)	(0.013)	(0.013)	(0.017)	(0.016)
log NRFR/FR	-0.02*	-0.01	-0.01	-0.00	-0.02	-0.01	-0.02*	-0.06**
	(0.010)	(0.010)	(0.010)	(0.011)	(0.010)	(0.011)	(0.009)	(0.027)
corruption	0.07**	0.15***						
	(0.027)	(0.047)						
corruption X non-NRFR/GDP		0.03**						
		(0.011)						
govt_eff_index			0.09***	0.20***				
			(0.030)	(0.056)				
govt_eff X non-NRFR/GDP				0.03**				
				(0.013)				
Political Stability					0.05***	0.10**		
					(0.020)	(0.043)		
Political Stability X non-NRFR/GDP						0.01		
						(0.010)		
ICRF - Quality of government							0.60***	0.99***
							(0.157)	(0.259)
ICRF - Quality of government X non-NRFR/GDP								0.11*
								(0.057)
Constant	0.28*	0.29**	0.41**	0.42**	0.23*	0.25*	-0.16	-0.32**
	(0.149)	(0.147)	(0.168)	(0.165)	(0.129)	(0.129)	(0.118)	(0.143)
Observations	131	131	131	131	131	131	96	96
R-squared	0.333	0.358	0.345	0.371	0.340	0.348	0.539	0.556

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 19
Budget transparency and non-renewable resource revenues.

Dep. Variable: OECD open budget index	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log GDP/pc	0.35***	0.37***	0.20*	0.20*	0.35***	0.38***	0.23**	0.24**
	(0.069)	(0.064)	(0.109)	(0.110)	-0.067	-0.061	-0.107	-0.108
Log NRFR/FR		-0.18***	-0.13***	-0.12**				
		(0.041)	(0.048)	(0.052)				
Log NRFR/GDP						-0.28***	-0.22***	-0.21***
						-0.054	-0.062	-0.066
Gov. effectiveness index			0.32**	0.42*			0.28*	0.24
			(0.161)	(0.247)			-0.156	-0.171
Gov. Eff. X log NRFR/FR				0.03				
				(0.056)				
Gov. Eff. X log NRFR/GDP								0.04
								-0.069
Constant	0.65	-0.14	1.23	1.22	0.69	0.62	1.55*	1.49
	(0.589)	(0.578)	(1.045)	(1.049)	-0.58	-0.524	-0.919	-0.928
Observations	119	119	118	118	124	124	118	118
R-squared	0.204	0.316	0.339	0.341	0.195	0.347	0.365	0.367

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Finally, Tables 20 and 21 show also a negative and statistically significant association between government effectiveness and control of corruption indexes and the ratios of non-renewable revenues to both total fiscal revenues and GDP, while there is a positive and statistically significant association between those indexes and the level of GDP. Again, we must caution about endogeneity problems due to potential reverse causality links.

Table 20

Government Effectiveness Index (WB) and Non-renewable Resource revenues

	(1)	(2)	(3)
Dep. Var: Government efficiency Index			
Log GDP/pc	0.52***	0.54***	0.55***
	(0.010)	(0.009)	(0.009)
log NRFR/FR		-0.17***	
		(0.009)	
log NRFR/GDP			-0.24***
			(0.013)
Constant	-4.31***	-5.23***	-4.51***
	(0.098)	(0.102)	(0.090)
Observations	1,701	1,701	1,701
R-squared	0.608	0.676	0.676

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 21

Control of Corruption Index (WB) and Non-renewable Resource revenues

	(1)	(2)	(3)
Dep. Var.: Corruption Index			
Log GDP/pc	0.49***	0.52***	0.53***
	(0.011)	(0.010)	(0.010)
log NRFR/FR		-0.19***	
		(0.010)	
log NRFR/GDP			-0.25***
			(0.014)
Constant	-4.11***	-5.09***	-4.31***
	(0.108)	(0.112)	(0.100)
Observations	1,701	1,701	1,701
R-squared	0.543	0.618	0.614

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

7. CONCLUSIONS AND POLICY IMPLICATIONS

Summary of Empirical Results

Our empirical results confirm in general the theoretical expected effects of natural resource abundance on fiscal and macro performance discussed in Section 2 above. In particular, natural resource abundant countries tend to accumulate more total assets (fixed plus financial), tax less other activities, have more volatile and less efficient public expenditures and lower quality of fiscal institutions than countries with similar income levels.

Also as expected from theory, many effects of resource abundance on macro and fiscal performance differ according to country income levels and the quality of its institutions. Specifically,

- Lower income resource abundant countries invest more, but higher income resource abundant countries invest less and save more abroad than other countries with similar income levels. Investment levels are higher in resource rich countries with better institutions, controlling by income levels.

- Low income commodity fiscally dependent countries have larger public expenditures than other countries with similar income levels. On the contrary, higher income commodity fiscally dependent countries tend to have smaller governments, though larger public investment, than other countries with similar income levels. Total public expenditures are lower in resource rich countries with better institutions, controlling by income levels.

- Low income commodity fiscally dependent countries have higher public debts, but high income commodity fiscally dependent countries have lower debts than other countries with similar income levels. Public debt levels are higher in non-renewable resource rich countries with better institutions, controlling by income levels.

- The higher inefficiency of public expenditures in commodity fiscally dependent countries is in some cases mitigated by the presence of better quality of institutions, controlling by income levels.

An interesting additional result is that though public expenditures are more volatile in commodity fiscally dependent countries, they do not appear to be more pro cyclical in genera and there is even some evidence that public investment is less pro cyclical. This apparent puzzle is explained by the fact that the contemporaneous co- movement of commodity fiscal revenues and GDP is not strong on average (though it is higher for oil dependent countries and it is much stronger when we use lagged commodity price cycles). Such a co movement varies significantly across commodity fiscally dependent countries.

Finally, resource abundant countries do not appear to invest more in education or health than other countries with similar income levels. If anything, they appear to invest less in health.

Policy implications

Table 22 below summarizes policy implications based on our review of existing technical literature and our empirical findings

Table 22
Policy implications

	Low Low NRA	Income High NRA	Middle Low NRA	Income High NRA	High Low NRA	Income High NRA
Consumption	++ Focused CT	+++ Focused CT Low VAT		++ Focused CT		
Private Investment	++ Low Margin. Enhanced	+++ Tax Rates Institutions	++ Low Margin. Enhanced	++++ Tax Rates Institutions		+ Low Marg. Tax Rates
Public Investment	+++ Enhanced Enhanced	++++ Budget Inst Planning	+++ Enhanced Enhanced	++++ Budget Inst PPP		++ Enhanced PPP
Human Capital	+++ Basic	++++ Basic, Sec.	+++ Sec., Tertiary	++++ Sec., Tertiary		++ Post Tertiary
Financial Assets Abroad				++ Wealth Funds	++ Wealth	++++ Funds
Non NR Taxes	-- LMTRI	---- LMTRI, VAT	- LMTRI	-- LMTRI		

As indicated in section 2, theory suggests that among non-renewable natural resource abundant countries, those with lower incomes should use their wealth to increase present consumption, especially of the poorest members of their societies, and invest more domestically as long as the marginal rate of return exceeds the marginal return of foreign financial assets. On the contrary, higher income countries should save more abroad. Our empirical results confirm that non-renewable natural resource abundant countries actually behave in practice, on average, with respect to these macro outcomes as they should in theory.

Probably the most effective policies for low income countries to use some of their non-renewable natural resource revenues to increase present consumption of the poor is through focused cash transfers. Middle Income Countries with large non-renewable natural resource revenues and still large numbers of poor (as happens in highly unequal countries such as most Latin American Middle Income Countries') should also use this kind of policies in order to increase present consumption of their poorer groups. Low income countries with very large non-renewable natural resource revenues

probably should also have lower rates of indirect taxes in order to further increase present consumption. In the region, only Bolivia would fit into this latter category.

In order to increase the marginal rate of return to private and public domestic investment, resource rich countries should:

(1) Improve institutions: rule of law, property rights protection, control of corruption, government effectiveness and budget transparency. In particular, given the demonstrated lower efficiency of public expenditures in most resource rich countries, high priority should be given to enhancing the working of budgetary institutions, public investment (and public-private partnerships –PPP's-) planning, design, execution and supervision procedures, utility regulation and education and health policies and institutions. Enhancing institutions is an important priority for most Latin American and Caribbean countries, but especially so in non/renewable resource rich countries that, as shown in this paper, tend to have weaker institutions and lower efficiency of public expenditures than other countries with similar income levels.

(2) As the lack of the tax-expenditure link seems to be behind the low efficiency of public expenditures in resource-rich countries, in order to facilitate the enhancement of budgetary and public expenditure institutions and policies, reformist Governments should:

    a. Promote public awareness about the fact that non-renewable resources are finite and there should be civil society oversight over the use of commodity-related rents. Establishing institutional procedures for the effective participation of civil society organizations in the allocation and supervision of the use of commodity-related rents should be a high priority in institutional reform. It would also be of particular importance that Latin American and other non-renewable resource rich countries conform to the IMF guidelines on *Resource Revenue Transparency* go through the transparency validation of the Extractive Industries Transparency Initiative (EITI) [22] and require all large and medium size oil, gas and mining companies operating in their countries to also go through EITI validation. At present EITI reports only 10 countries that are compliant with their transparency standards after undergoing a validation procedure: one developed (Norway) and 9 developing countries, though unfortunately none of them from Latin America. Other 24 countries are reported as Candidates (which have registered and are going through a validation process) including only 3 are from Latin America: Peru, Trinidad and Tobago and

[22] EITI was proposed by Tony Blair as UK Prime Minister in 2002, was supported by the G-8 Summit and the World Bank in 2005, became operative in 2007 with a secretariat based in Oslo, a Governance structure proposed by an International Advisory Group set by the G-8 for this purpose (an Assembly and a Board composed of representatives of resource rich countries –that must have signed up as candidates-, Donor countries, private companies and NGO's) and 15 countries that signed as Candidate countries. The Board approved the validation standards and procedures in 2008. Source: EITI webpage.

Guatemala[23]. The absence of countries like Chile (which could easily be validated given its own transparency standards), Mexico, Colombia and Venezuela from joining this initiative is notorious.

b. Increase non-commodity related tax collections. This should be achieved mostly by broadening bases and controlling evasion, as low and middle income countries with high abundance non renewable resources should use part of their rents to increase private investment (and thus should keep low marginal investment rates) and low income countries also to increase present consumption (and thus keep low also tax rates on consumption).

(3) Countries with very large commodity-related revenues should reduce or maintain low marginal rates of taxation of investment by private firms and reduce other distorting taxes that maybe reducing the efficiency of private investment (such as taxes on formal labor and financial transactions that have become common in Latin America). As mentioned above, there is a delicate balance between the convenience of reducing marginal rates on investment and distorting taxes with the need to increase tax collections on non-commodity related activities in order to restore the tax-expenditure link. The way out of this dilemma is through the broadening of tax bases and the elimination of unwarranted exemptions and other tax privileges which are so common in the region, as well as through enhanced enforcement, especially on personal income taxes, on Value Added Taxes and other consumption taxes (except in low income countries) and on informal firms. This type of structural tax reform (that can increase collections while reducing marginal taxation of investment and distorting taxes) is convenient in all countries, but much more so in resource abundant countries

Resource abundant countries should further establish fiscal institutions and policies oriented to reduce the volatility and pro cyclicality of their public expenditures. Countries with low institutional capabilities, such as most low income countries, should probably use simple measures such as those implemented by Nigeria in 2004 that prescribe that budgets must be based on benchmark and not on actual commodity prices[24]. Countries with higher institutional capabilities but severe political economy problems that lead to pro cyclical fiscal policies should probably also "tie their hands" through the use of more sophisticated counter cyclical (or cyclically neutral) rules like those successfully enacted by Chile and being presently imitated in Colombia and Mexico.

Middle-income countries with large resource revenues should also save some fraction of them for future generations or at least to finance long term liabilities such as pension liabilities. Chile and Venezuela in the region are in this category. In fact, the savings achieved through the Chilean fiscal rule in good times are in part destined to a stabilization fund –in order to reduce the volatility and pro cyclicality of public expenditures- and in part destined to increased long term savings through reserves for low-income

[23] EITI webpage
[24] See Perry et al (2010)

pension subsidies and capitalization of the Central Bank. Colombia, who is increasing its fiscal dependence on non-renewable natural resources, has recently passed laws to establish a fiscal rule a la Chile and stabilization and savings funds to which a fraction of royalties will be destined. In order to effectively contribute to reduce macro volatility (and especially real exchange rate volatility) both temporary –stabilization- and long term savings should be invested in foreign currencies abroad, as is presently done in Chile and is proposed in the case of Colombia.

It should be mentioned that countries with even higher fiscal institutional capabilities and where political economy problems associated with the budgetary process seems more subdued, such as is the case in South Africa, New Zealand and Australia, do not appear to require explicit "rules" that tie Government and Congress hands in order to avoid pro cyclicality of fiscal policies[25]. Thus, the adoption of "price benchmarks" for budgetary processes or of more sophisticated "fiscal rules" a la Chile should be not be seen as a permanent feature of fiscal institutions in these countries: as fiscal institutions and political culture matures countries should probably transit from simpler (but more rigid) "benchmark" rules towards more sophisticated and flexible counter cyclical rules (a la Chile) and eventually towards no explicit rules but the internalization of a counter cyclical fiscal culture through more mature fiscal and political institutions.

[25] See Sachs, M (2011)

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Appendix

Table A1 – Data sources

Variable	Description / Source	Source
rgdpl	Real GDP per capita PPP	Penn World Tables
nnre	Net natural resources per capita.	Own elaboration using CEPII international trade database
nrfr	Natural resource fiscal revenue.	This data comes from Villafuerte, Lopez-Murphy and Ossowski 2010 for oil rich countries. For other countries we use the respective reports regarding IMF's article IV of different years
rrich	Resource rich countries	As indentified by the IMF
pinvtogdp	Public Investment to GDP	IMF
govexpgdp	Government expenditures to GDP	IMF
govrev	Government revenue to GDP	World Bank
govt_eff_index	Government Effectiveness Index	World Bank
repol_stab_index	Political Stability Index	World Bank
rule_law_index	Rule of Law Index	World Bank
icrg_qog	ICRG Indicator of Quality of Government	ICRG
wdi_ase	Agriculture's share of economy (% of GDP)	WDI
ngdp	Nominal GDP in local currency	WEO

Table A2 - Countries Fiscally Dependent on Natural Resource Revenues.
NRFR/GDP and NRFR/FR are period averages

Country code	Country	Initial year	Final year	NRFR/GDP	NRFR/FR
AGO	ANGOLA	1992	2008	33.46	78.47
ARE	UNITED ARAB EMIRATES	1992	2008	24.88	73.62
AZE	AZERBAIJAN	1998	2008	11.26	42.48
BHR	BAHRAIN	1992	2008	19.95	66.32
BOL	BOLIVIA	2002	2008	6.80	19.15
BRN	BRUNEI	1992	2008	35.30	82.01
BWA	BOTSWANA	1994	2007	21.45	54.49
CHL	CHILE	1997	2008	3.11	11.68
CMR	CAMEROON	1992	2008	4.45	27.92
COL	COLOMBIA	1993	2007	2.47	10.36
DZA	ALGERIA	1992	2008	23.65	66.91
ECU	ECUADOR	1992	2008	6.16	22.04
GAB	GABON	1992	2008	17.22	60.32
GIN	GUINEA	1991	2006	3.41	23.77
GNQ	EQUATORIAL GUINEA	1992	2008	18.18	63.14
IDN	INDONESIA	1992	2008	8.18	49.49
IRN	IRAN	1992	2007	16.41	61.06
KAZ	KAZAKHSTAN	1999	2008	7.08	26.94
KWT	KUWAIT	1992	2008	41.33	69.56
LBY	LIBYA	1992	2008	32.78	70.34
MEX	MEXICO	1992	2008	6.30	30.79
MNG	MONGOLIA	2002	2007	6.17	15.62
NAM	NAMIBIA	1994	2007	2.25	7.59
NGA	NIGERIA	1992	2008	24.24	78.72
NOR	NORWAY	1992	2008	9.44	16.94
OMN	OMAN	1992	2008	34.38	78.67
PER	PERU	1998	2008	2.09	10.92
PNG	PAPUA NEW GUINEA	1996	2008	6.35	19.63
QAT	QATAR	1992	2008	25.60	64.71
RUS	RUSSIA	1997	2008	7.27	18.32
SAU	SAUDI ARABIA	1992	2008	28.99	72.04
SDN	SUDAN	1999	2008	8.47	47.77
SLE	SIERRA LEONE	2004	2008	0.29	1.33
SYR	SYRIA	1992	2008	10.36	39.45
TCD	CHAD	2004	2008	11.69	54.82
TTO	TRINIDAD AND TOBAGO	1992	2008	9.28	37.66
UZB	UZBEKISTAN	1995	2008	1.05	2.98
VEN	VENEZUELA	1992	2008	14.43	46.29
VNM	VIETNAM	1998	2008	6.70	28.51
YEM	YEMEN	1992	2008	19.25	69.95
ZMB	ZAMBIA	1994	2006	0.93	4.89

Appendix 3 - Derivation of Net Assets Accumulation

Assuming and that

Whereby, INV is total domestic investment, CA is the current account balance, KA is the capital account balance, Port is portfolio investment, FDI is foreign direct investment and ORT is official reserve transactions. Superscripts “D”, “F”, “X” and “M” represent domestic, foreign, export (outflow of assets or inflow of funds) and import (inflow of assets or outflow of funds) respectively.

However, Net Asset is not totally “net” since it does not account for the depreciation of investment.

Table A 4

Relation between GDP cycle and cycle of main commodity prices

Country name	Coefficient	st. error		Country name	Coefficient	st. error	
Algeria	0.021	0.017		Norway	-0.016	0.015	
Angola	0.040	0.082		Oman	-0.056	0.026	**
Azerbaijan	0.024	0.133		Peru	0.069	0.055	
Bahrain	0.013	0.022		Qatar	-0.111	0.040	***
Brunei Darussalam	0.029	0.015	**	Russian Federation	0.040	0.088	
Cameroon	-0.048	0.041		Saudi Arabia	0.020	0.023	
Chile	0.039	0.036		Sierra Leone	0.140	0.078	*
Colombia	-0.003	0.022		Sudan	-0.035	0.021	*
Ecuador	-0.009	0.021		Syrian Arab Republic	-0.002	0.035	
Gabon	0.008	0.051		Trinidad and Tobago	0.034	0.039	
Indonesia	0.040	0.028		United Arab Emirates	0.141	0.065	**
Iran	0.055	0.045		Uzbekistan	-0.020	0.020	
Kazakhstan	0.043	0.079		Venezuela	-0.036	0.047	
Mexico	0.009	0.021		Viet Nam	0.004	0.018	
Mongolia	0.080	0.062		Yemen	-0.006	0.010	
Nigeria	0.083	0.034	**				

Robust standard errors. *** p<0.01, ** p<0.05, * p<0.1

Table A 5

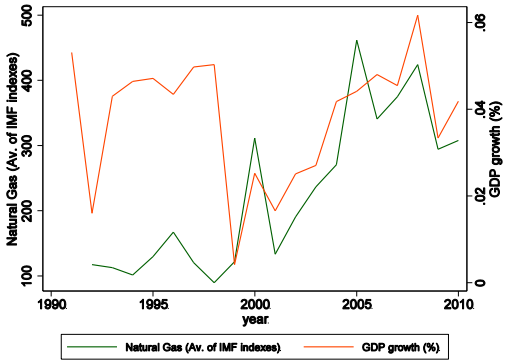
Relation between GDP cycle and lagged cycle of main commodity prices

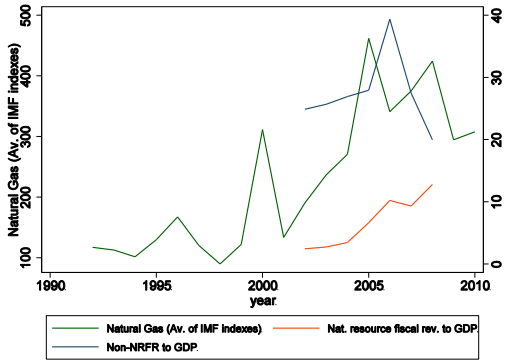
Country name	**Coefficient**	**St. error**		**Country name**	**Coefficient**	**St. error**	
Algeria	0.010	0.013		Norway	0.009	0.016	
Angola	0.073	0.075		Oman	0.039	0.026	
Azerbaijan	0.105	0.117		Peru	0.002	0.059	
Bahrain	0.036	0.022	*	Qatar	-0.031	0.058	
Brunei Darussalam	0.024	0.017		Russian Federation	0.118	0.041	***
Cameroon	-0.022	0.036		Saudi Arabia	0.073	0.025	***
Chile	0.104	0.033	***	Sierra Leone	0.077	0.083	
Colombia	0.030	0.018	*	Sudan	0.018	0.021	
Ecuador	0.058	0.022	***	Syrian Arab Republic	0.029	0.032	
Gabon	0.090	0.038	**	Trinidad and Tobago	0.070	0.030	**
Indonesia	0.062	0.030	**	United Arab Emirates	0.154	0.046	***
Iran	0.118	0.041	***	Uzbekistan	0.004	0.016	
Kazakhstan	0.096	0.059	*	Venezuela	0.096	0.043	**
Mexico	0.049	0.027	*	Viet Nam	0.020	0.016	
Mongolia	0.149	0.051	***	Yemen	-0.004	0.011	
Nigeria	0.077	0.040	*				

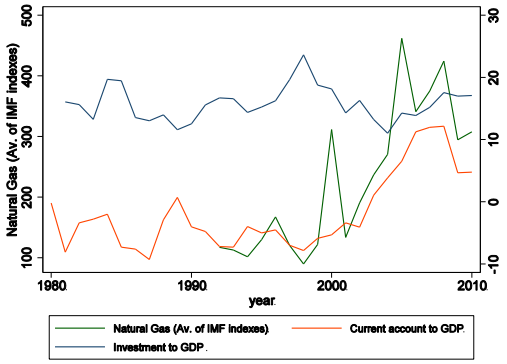
Robust standard errors. *** p<0.01, ** p<0.05, * p<0.1

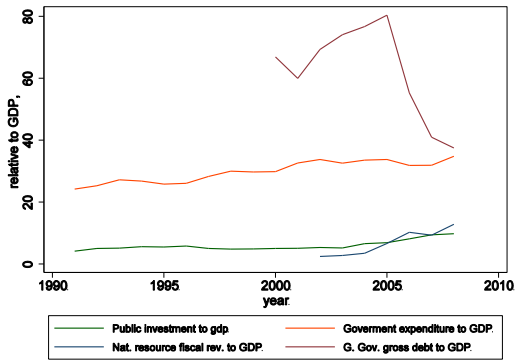
Non-Renewable Resource Rich Latin American countries during the recent commodity boom

Bolivia

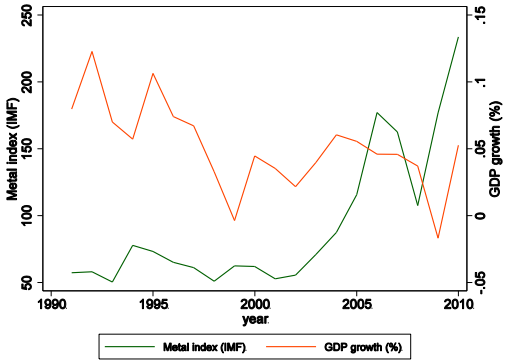


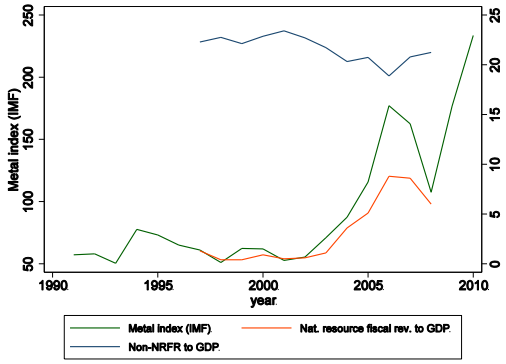


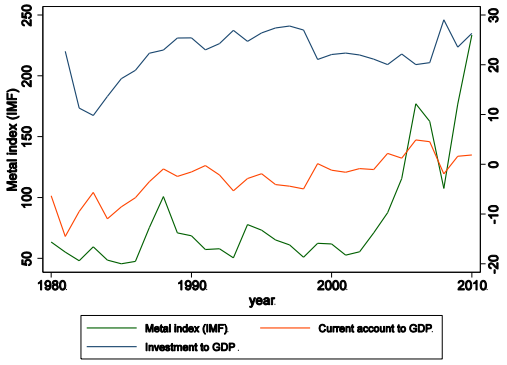


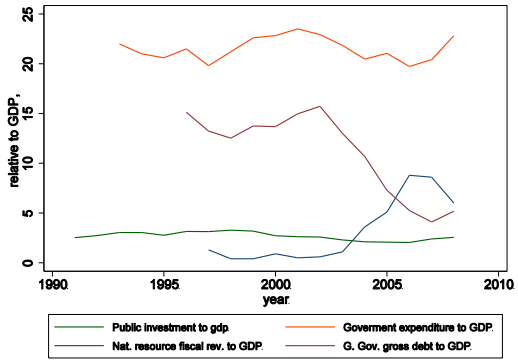


Chile

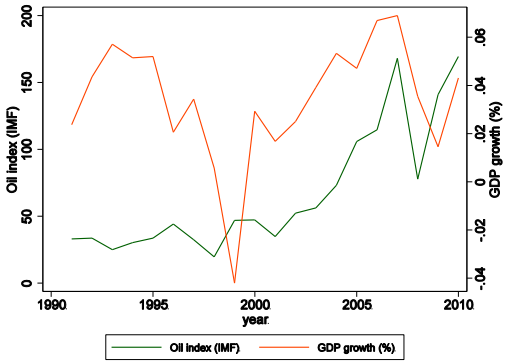


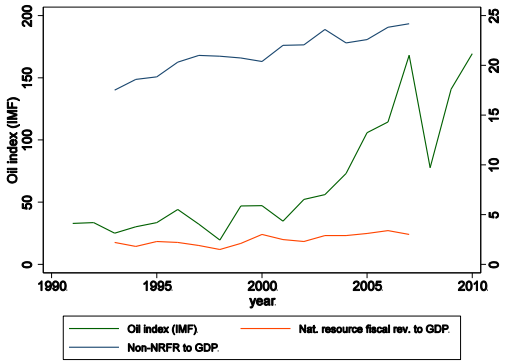


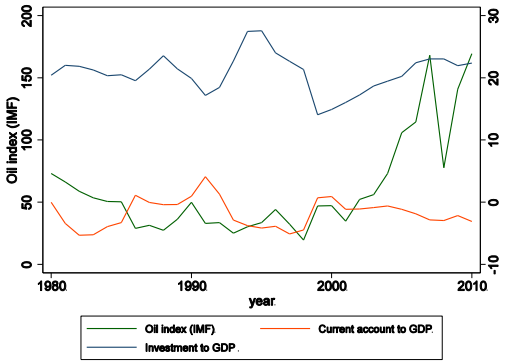


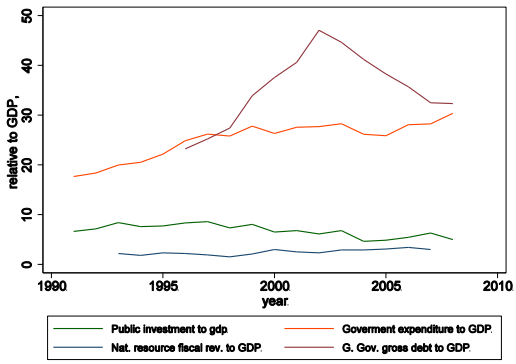


Colombia

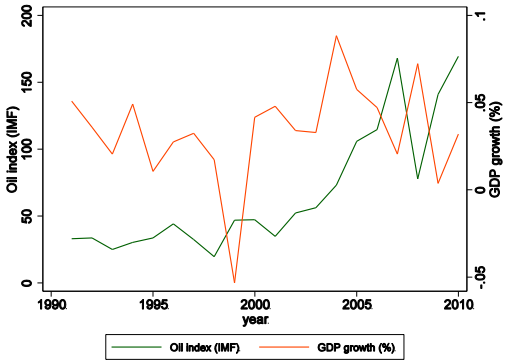


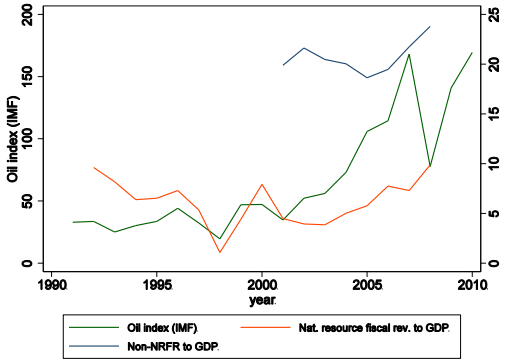


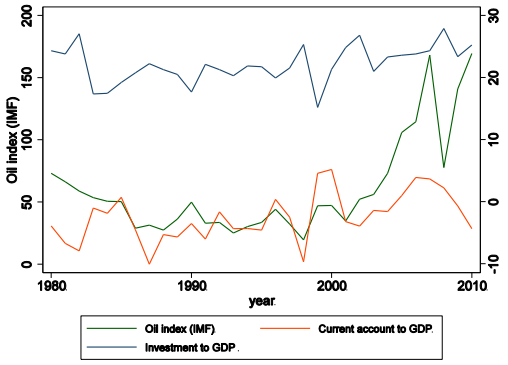


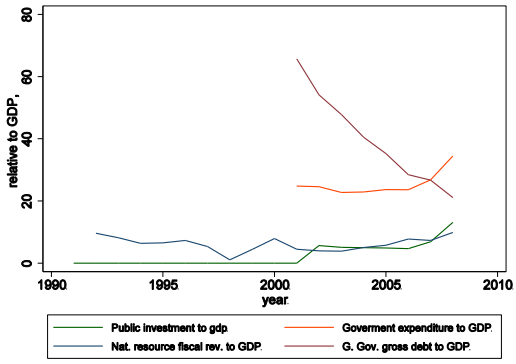


Ecuador

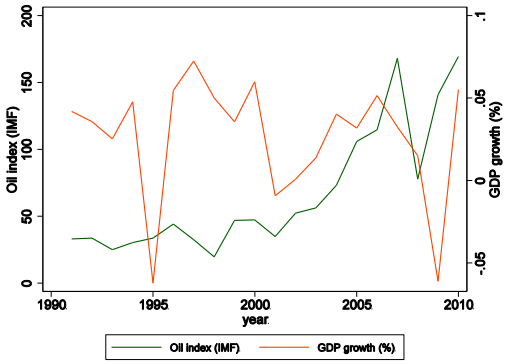








Mexico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GDP growth (%)
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Oil index (IMF)
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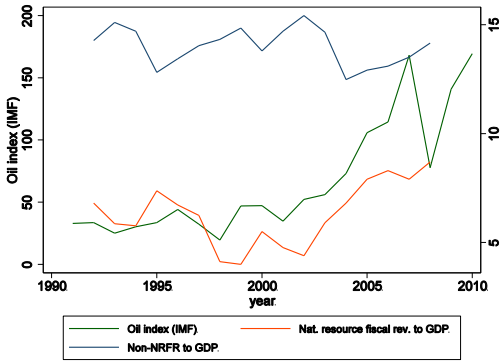
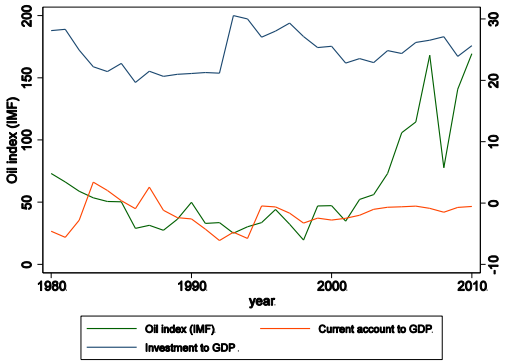
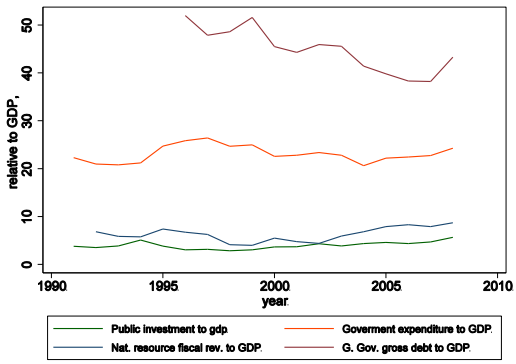
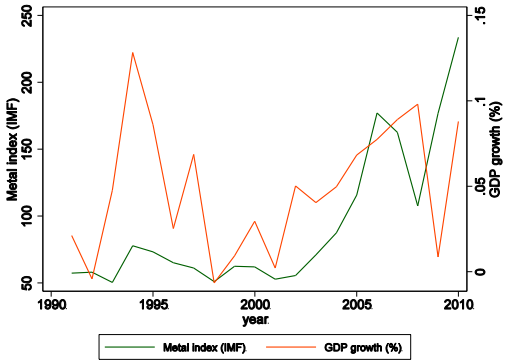
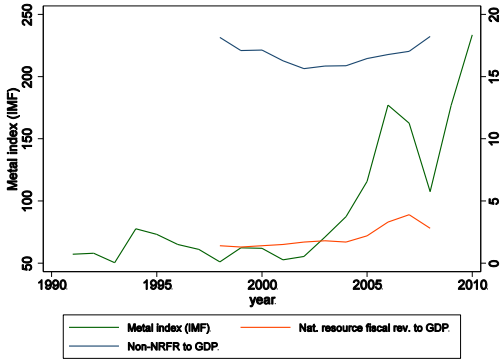

Oil index (IMF)
year
Oil index (IMF)
Nat. resource fiscal rev. to GDP.
Non-NRFR to GDP.

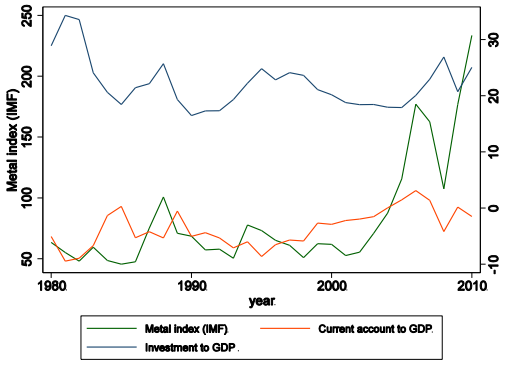

Oil index (IMF)
year
Oil index (IMF)
Current account to GDP.
Investment to GDP.

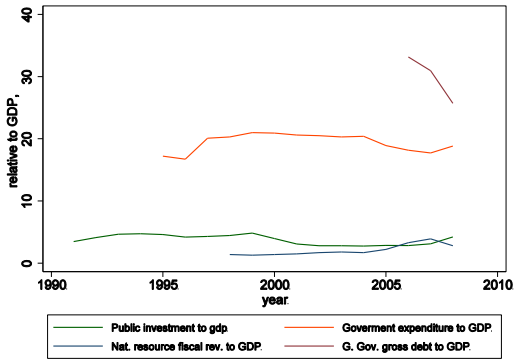

relative to GDP,
year
Public investment to gdp
Goverment expenditure to GDP.
Nat. resource fiscal rev. to GDP.
G. Gov. gross debt to GDP.

Peru

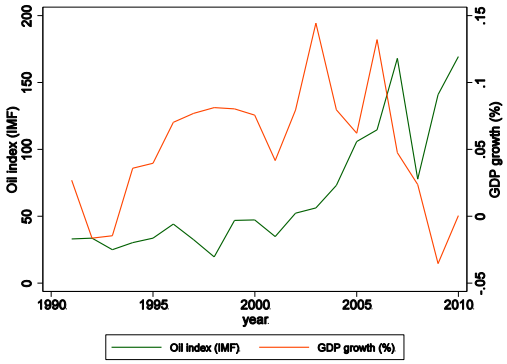

Metal index (IMF)
GDP growth (%)
year
Metal index (IMF)
GDP growth (%)

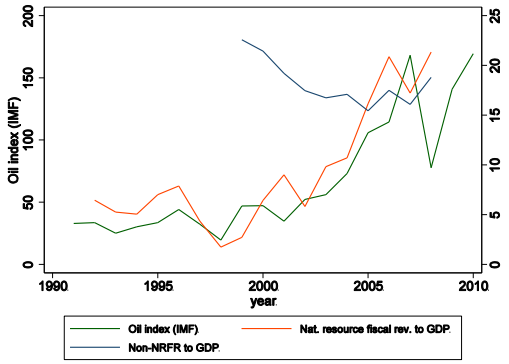

Metal index (IMF)
year
Metal index (IMF)
Nat. resource fiscal rev. to GDP.
Non-NRFR to GDP.

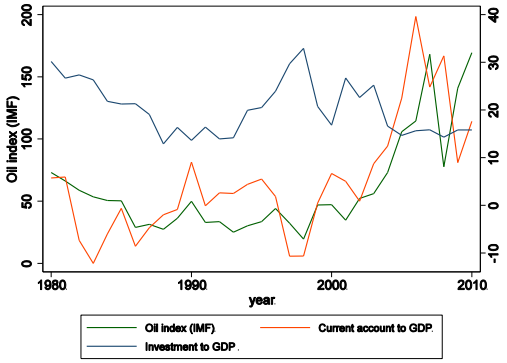

Metal index (IMF)
year
Metal index (IMF)
Current account to GDP.
Investment to GDP.

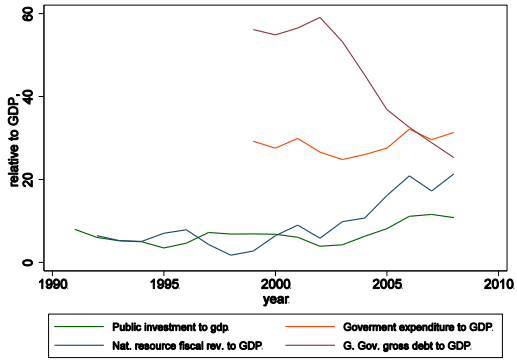

relative to GDP,
year
Public investment to gdp
Goverment expenditure to GDP.
Nat. resource fiscal rev. to GDP.
G. Gov. gross debt to GDP.

Trinidad and Tobago









Venezuela