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TESTING RESOURCE CURSE TRIANGLE HYPOTHESIS: EXTRACTIVES DEPENDENCE, GOVERNANCE QUALITY AND ECONOMIC GROWTH

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ABSTRACT

The aim of this paper is to examine so called resource curse triangle hypothesis. Employing panel of 43 resource rich countries for 2002-2011 period, authors apply panel ARDL and GMM techniques to investigate long-run relationship between extractive dependence index (EDI), governance quality indicators (voice and accountability; political stability and no violence; government effectiveness; regulatory quality; control of corruption; rule of law) and GDP per capita (PPP). Research reveals existence of strong bidirectional causality in all cases: low governance quality and higher GDP per capita leads to increasing dependence from extractives. In the long run, better governance quality brings higher GDP per capita growth. Increasing extractives dependence also affects GDP per capita growth positively. On the other hand, empirical results reveal positive long-run causality from GDP per capita and negative long-run causality from extractives dependence to governance quality indicators. According to empirical findings, improving governance quality should be priority in resource rich economies which will enhance GDP per capita growth and decrease dependence from extractives.

Key words: Resource curse; natural resources; governance quality; economic growth; resource rich economies.

Introduction

In conventional view, wealth of a country's stock of assets enhances better economic growth performance. Rich natural resources as part of stock of assets should be considered as blessing for resource rich economies in this context. However, modern empirical studies provide scientific evidence for somewhat paradoxical relationship. For example, findings in Sachs and Warner (1997, 2001) reveals that natural resource intensity actually decreases economic growth performance while a wide variety of variables are taken into consideration as control variables. This issue is still open to further empirical investigations which could be analyzed under resource curse framework. The central question is why such economies demonstrate lower economic growth performance compared to non-resource economies despite of owning substantial resource wealth.

Actually, negative externalities of being resource rich was already expected in 1970s by Juan Pablo Perez Alfonso – a Venezuelan politician who is one of the founders of Organization of Petroleum Exporting Countries (OPEC), argued that "Ten years from now, twenty years from now, you will see: Oil will bring us ruin… Oil is devil's excrement" (Gasimov, 2014). However, scientific explanations of this problem are many and different. In general, attempt to explain possible causes of resource curse could be combined as "Dutch disease" models, and "Nigerian disease" models (Willams, 2011). Williams (2011) makes this classification and states that major focus of Dutch disease models is "the re-allocation of resources toward the primary commodity sector, at the expense of the manufacturing sector" while Nigerian disease models specially concentrate on waste of resource revenues by the governments due to the lack of institutional capacity. In this context, economic (within Dutch disease models framework) and non-economic factors (within Nigerian disease models framework) should be differentiated while addressing resource curse issue.

While explaining the resource curse issue within Dutch disease framework, Bulte et al. (2005) argues existence of "little empirical support". For justification, authors refer to Auty (2001a) in which complexity and diversity of various resource rich economies' experiences, as well as studies which do not find terms of trade effects as major determinants of economic growth performance (see Leite and Weidmann, 2002; Sala-i-Martin and Subramanian, 2003). Many other empirical studies also consider institutional development related factors as the driving source for weak growth experience. In recent studies, the role of non-economic factors such as economic freedom (Farhadi, Islam and Moslehi, 2015), corruption (d'Agostino, Dunne and Pieroni, 2016a, b), bad governance (Tarek and Ahmed, 2017a, b; Kim, Wu and Lin, 2018; Alstine et al., 2014), institutional quality (Horvath and Zeynalov, 2016), political elections (Klomp and Haan, 2016) are studied empirically.

That is why we call this relationships as triangle framework. In resource rich economies, governments injects resource revenues to the economy through fiscal channels which raises EDI level, especially in countries with weak institutional capacity. In Keynesian theory framework, this "generous" spending increases overall national income as well as GDP per capita. Meanwhile, residents expect even more from the government overtime as explained within Wagner hypothesis. In order to satisfy voters, governments injects more resource revenues to the economy while ensuring also tax concessions. However, this generous behavior raises the problem of fiscal policy efficiency as the excessive of resource revenues may turn productive public spending units to the unproductive ones (Devarjan et al., 1996).

As the governance efficiency falls, contribution of fiscal spending to the national economy decreases. On the other hand, as the GDP per capita increases, voters are expected to call for more transparency or higher efficiency from governments which will result in larger GDP per capita.

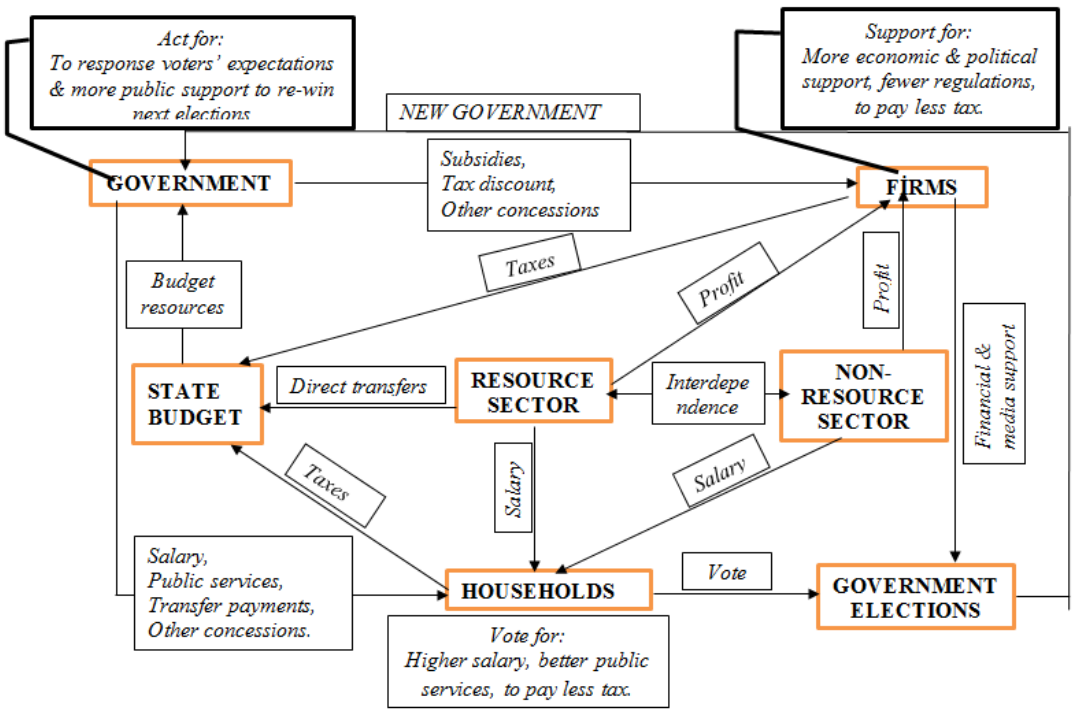
In this study, the relationship among three pillars of the resource curse triangle – extractives dependence, governance efficiency and economic growth is investigated. We use Extractives Dependence Index (hereafter EDI) developed by Hailu and Kipgen (2017) which is better to account for fiscal revenues dependency. For governance efficiency, World Bank Governance Indicators for all categories are taken into account. We expect bidirectional significant association among all three:

- negative causality from governance efficiency indicators to EDI;
- positive causality from GDP per capita (PPP) to EDI;
- positive causality from EDI to GDP per capita (PPP);
- positive causality from GDP per capita (PPP) to governance efficiency indicators;
- negative causality from EDI to governance efficiency indicators;
- positive causality from governance efficiency indicators to GDP per capita (PPP);

1. Theoretical framework

The association between dependence on natural resources, governance efficiency and economic growth performance resembles triangle view. There is bidirectional causality while the impact of one to another also pass through over the third one.

Figure 1. Behavioral framework



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Therefore, this is a complicated framework and requires extended approach to explain theoretical linkage.

As this issue is within resource curse literature, here, we argue that *resource curse is neither economic nor political, it is a behavioral issue*. More precisely, the relationships of interest is built over expectations of all sides – *households*, *firms*, and the *political party in government*. Interests of all sides of the "triangle" intersects on the distribution of national resource wealth and come to an agreement on time of governmental elections. Hence, there is a "resource cake" in the middle and all sides treat towards to maximize its share in this cake for their own self-interest and acts within this behavioral framework.

To understand expectations of households, firms and the government, we might review the association on a diagram. Figure 1 describes the issue in an extended view. If we separate the economy as resource and non-resource sectors in which all these three agents act, the linkage between "corners" of the triangle will be identified.

Households sell their labor force to the firms operating in both sectors of the economy as well as to the government and receive a certain payments as salary. Firms perform production process and gain the profit. According to their salary or profits, both households and firms pay taxes to the state budget over which the political party in government implements major economic policies, so called fiscal policy.

Here, it is supposed that each political party is elected for the government for a certain time, until the year "t" when new elections are held. Therefore, the year "t" is essential determining factor for the behavior of all agents in this framework. Here, it is also supposed that political election outcomes depend decision of voters, i.e. households which is made on the bases of economic expectations (ceteris paribus). Voters support the political party who promises more benefit (salary, public services, and other concession) and less cost (for example, income tax). On the other hand, firms or companies provide financial and media support to a political party during the election process with the aim of to receive more benefit (subsidies, less regulation, etc.) with less cost after the elections compared to the pre-elections period.

The political party in the government could renew its administration if maintains public support, in other words, support of households and individuals. In this context, active tax policy (decreasing tax weight) is an effective tool accompanied by concessions to a certain groups of voters. Meanwhile, the government also increases public spending, the amount of subsidies and transfer payments as well as the quality of public services. This tendency further expands the gap between budget expenditures and tax revenues. The easiest way of closing this gap is to transfer resource revenues to the state budget.

This is the point where the "resource curse triangle" begins. Transfer of resource revenues to the state budget increases fiscal dependency on natural resources overtime. On the other hand, comparatively more spending & less taxation stimulates economic growth according to Keynesian framework which addresses expectations of both households and firms. At the next stage, households and firms expect even more from the government. Root of this claim goes to Wagner's hypothesis in which economic growth is found to be the major cause of fiscal expansion as households/voters with higher GDP per capita continuously demand for better public services. Therefore, political party in the government even transfers more from the resource sector to the state budget to keep the level of public support, which as a result worsens the fiscal dependence more. All these are reliable even if the governance efficiency remains stable, in reality, it is expected to fall. Massive injection of resource revenues to the economy

will weakens efficiency of the governance ("paradox of plenty") especially in the countries with lower GDP per capita. This is because households living in poor conditions are irresponsive major governance efficiency issues as well as inclined to more violence. From this point of view, positive association between GDP per capita and governance efficiency indicators are anticipated.

2. Literature review

Unluckily, resource rich economies have faced with the failure of using their abundant natural resources because of the influence of economic and political channels (Gelb, 1988; Auty, 1990; Berge et al., 1994; Brückner, 2010). That is why Brunnschweiler (2008) noted that "natural resources seem to have been more of a curse than a blessing for many countries". Ross (1999) reviewed a comprehensive set of these both economic and political channels to examine the "resource curse". His conclusion was that while the economic channels are clear, the little is known about the political channels. Collier and Hoeffler (2005) provided that in the economic channels, "resource curse" causes to low economic growth and thus it leads for rebellion and civil war in the countries. Conversely, the political channels literature focus on the relationship between natural resources and rent seeking/weak institutions (Lane and Tornell, 1996; Tornell and Lane, 1999; Baland and Francois, 2000; Torvik, 2002; Acemoglu et al., 2004; Hodler, 2006). In case of 28 resource rich countries for 1985-2010, Ouaba (2016) reveals no positive impact of resource abundance over economic growth.

Jensen and Wantchekon (2004) found an empirical evidence of negative association between resource abundance and democratic transition for the resource-rich countries in Africa, particularly Nigeria and Gabon. According to the prior researches, Lane and Tornell (1995) provided that low economic growth in resource rich economies is associated with excessive rent-seeking behavior, as governments in these countries are grabbing the most of the earnings from natural resources. In addition, other studies also emphasize the importance of the corruption level (Mehlum, Moene, and Torvik, 2006; Robinson, Torvik, and Verdier, 2014). Kolstad and Wiig (2009) suggests that the corruption level can be reduced in resource rich countries by introducing transparency only under certain conditions. According to Kolstad and Wiig (2009), "lack of transparency can create or exacerbate the problems associated with resource-rich economies".

Bulte, Damania and Deacon (2005) has extended the "resource curse" literature by taking into consideration of welfare and development indicators. The rationale was that lower levels of human development may in turn leads to resource rich countries to suffer. Also, other empirical analyses found significant link between resource abundance and human capital (see, Gylfason, 2001; Bravo-Ortega and De Gregorio, 2005; Stijns, 2006 for details). Auty (1997, 2001a, 2001b) emphasized that resource-deficient countries do not have chance to use the inefficient land-holding system such as development strategy, weaker political and economic performance which resource rich countries follow. Auty (1997, 2001a, 2001b) believe that because of the aforementioned patterns resource-deficient countries outperform resource rich countries.

Using two different alternative indicators for measuring natural resource wealth (measured as per capita mineral and total natural resource wealth, respectively), Brunnschweiler (2008) found that there is a positive association between resource abundance and economic growth when the institutional quality is controlled in the model. Corrigan (2017) stresses the importance of revenue transparency in the resource industries which significantly improves control of

corruption. Resource funds are useful to minimize negative effects of natural resource abundance (Tsani, 2013). Farhadi, Islam and Moslehi (2015) uses panel data of 99 countries for 1970-2010 period to examine the impact of economic freedom over negative effects of resource rents. GMM estimations reveal that higher economic freedom minimizes negative growth effects of resource rents – even turns to be positive (Farhadi et al., 2015).

3. Data and methodology

To test so called resource curse triangle hypothesis, we take 43 resource rich countries with different income level[1] within a panel framework for 2002-2011. For empirical estimation, resource dependence is defined according to Extractive Dependence Index developed by Hailu and Kipgen (2017). For governance efficiency, Worldwide Governance Indicators (WGI) are used. As a measure of economic growth performance across countries included, GDP per capita PPP data is taken from World Bank database. Below, more detailed information about EDI and governance efficiency indicators is provided. Table 1 tabulates general descriptive statistics of empirical model variables.

Table 1: Descriptive statistics of the variables

Variable	Obs. No.	Mean	Maximum	Minimum	Std. Dev.
EDI	430	47.76	94.10	4.190	24.28
V_A	430	-0.525	1.720	-1.940	0.817
P_S	430	-0.301	1.510	-2.390	0.942
G_E	430	-0.253	2.100	-1.780	0.846
REG_L	430	-0.213	1.850	-1.730	0.822
C_C	430	-0.305	2.220	-1.710	0.901
RULE_L	430	-0.354	1.990	-1.730	0.873
GDP_P	430	20018	132514	405.48	24930

Source: Authors' own completion

Hereafter, abbreviations of the variables will be as follows: EDI – Extractive Dependence Index, V_A – voice and accountability, P_S - political stability and no violence, G_E – government effectiveness, REG_L - Regulatory quality, C-C - control of corruption, RULE_L - Rule of law, GDP_P – GDP per capita PPP.

3.1. Extractive Dependence Index (EDI)

Various resource dependence measures are used in existing literature. These are primary/natural resource exports in GDP or GNP (Sachs and Warner, 1995; Manzano and Rigabon, 2001; Neumayer, 2004; Brunnschweiler and Bulte, 2008), primary/natural resource exports in total exports (Davis, 1995; Lederman and Maloney, 2003), net exports of resources per worker (Lederman and Maloney, 2003), mining share in GDP (Sala-i-Martin et. al. 2004), share of natural capital in total capital (Ding and Field, 2005; Gylfason, 2001; Gylfason and Zoege, 2006), mean contribution of minerals to GDP, exports and revenues (Auty, 1990), oil, gas and

[1] Classification is done according to World Bank database in 2016. *High income – 11* (Australia, Bahrain, Brunei Darussalam, Chile, Kuwait, Norway, Oman, Qatar, Saudi Arabia, Trinidad and Tobaga, and United Arab Emirates); *upper middle income – 16* (Algeria, Angola, Azerbaijan, Botswana, Brazil, Colombia, Ecuador, Equatorial Guinea, Gabon, Iran, Kazakhstan, Libya, Malaysia, Mexico, Namibia, and Russian Federation); *lower-middle income – 12* (Bolivia, Cameroon, Congo, Cote d'lvoire, Egypt, Ghana, Indonesia, Kysgyzstan, Mauritania, Mongolia, Nigeria, and Papua New Guinea); *low-income – 4* (Congo DRC, Guinea, Niger, and Sierra Leona).

mineral export (% total exports) and revenues (% total fiscal revenue) (Baunsgaard et al., 2012), oil, gas and mineral exports (% total exports) (Haglund, 2011). From McKinsey Global Institute, Dobbs et al. (2013) take resource exports (%total exports), resource revenue (% total government revenue) and resource rents (%GDP). International Council of Mining and Metals (2012) uses share of exports (% total exports), increase/decrease of mineral export contribution, and mineral production (% GDP) as an indicator for resource Dependence. Note that all those proxies are comparatively discussed in Hailu and Kipgen (2017).

After reviewing pros and cons of previous indexes, Hailu and Kipgen (2017) suggests new proxy called the extractives dependence index (hereafter EDI) which we also employ in our empirical estimations. Borrowed from Hailu and Kipgen (2017), the equation to calculate the EDI for each country is as below:

$$EDI_{ct} = \sqrt{[EIX_{ct} * (1 - HTM_{ct})] * [Rev_{ct} * (1 - NIPC_{ct})] * [EVA_{ct} * (1 - MVA_{ct})]} \quad (1)$$

Where EDI displays Extractives Dependence Index for a country (c) at a given time (t). EIX is the share of export revenues from natural resources (oil, gas and minerals) in total export revenues of the corresponding country. HTM denotes share of the country' export revenue from high-skill and technology-intensive manufactures in world total HTM exports. Rev indicates the share of extractive industry in total fiscal revenue generation. $NIPC$ is the total tax receipts from non-resource sector as a share of GDP. Meanwhile, EVA represents the share of extractives industries value added in GDP, and MVA stands for per capita manufacturing value added which is employed as a proxy to take into account domestic industrial capability.

In equation (1), the first term $[EIX_{ct} * (1 - HTM_{ct})]$ allows to compute an aggregate measure of the dependence level on the extractive sector for foreign exchange. The second term $[Rev_{ct} * (1 - NIPC_{ct})]$indicates fiscal dependence on the extractive sector while the last term $[EVA_{ct} * (1 - MVA_{ct})]$ presents value added contribution of extractive sector. EDI gets value 0-100 where higher value means more severe dependence. From this point of view, we consider that EDI is superior to other proxies to represent fiscal dependence on resource sector.

In Hailu and Kipgen (2017), EDI for 81 countries in our sample is computed for 2000-2011. Because of missing values and data unavailability, many of them are not included to our analysis. Hence, only 43 countries are selected from this list for those yearly governance efficiency indicators are also achievable for 2002-2011 period.

In Appendix (A), graphical illustration of extractives dependence distribution is given. To be more informative, we classify taken countries according to their income level as well. For all sample, average EDI value is 47.76 while it is 55.62 for high income group members, 52.12 for upper middle income countries, 39.97 for those in lower middle income level, and lastly 31.82 for the countries belonging low income level class. This directly addresses to our hypothesis that higher economic growth is positively associated with fiscal dependence on extractives. More precisely, central tendency indicates more severe dependence as income level raises.

3.2. Worldwide Governance Indicators (WGI)

To proxy for governance efficiency, the Worldwide Governance Indicators (WGI) which is computed and yearly published in World Bank database. WGI indicators are gathered from survey institutes, non-governmental organizations, think tanks, international organizations, as

well as private sector firms for 215 countries and territories. Six dimensions of governance are measured which covers election, monitoring and replacement of governments, government's capacity for effective formulation and implementation of sound policies as well as respect to the institutions those govern social and economic interactions among the citizens and the state. Namely, the dimensions are defined as *voice and accountability*, *political stability and absence of violence/terrorism*, *government effectiveness*, *regulatory quality*, *control of corruption*, and *rule of law*. Indicators get the value between -2.5 and 2.5. In Appendix B, definitions of the each dimension are given.

Table 2: Governance efficiency vs income level

Income groups	Voice and accountability	Political stability and no violence	Government effectiveness	Regulatory quality	Control of corruption	Rule of law
All included	-0.523	-0.300	-0.253	-0.210	-0.305	-0.354
High income	-0.152	0.581	0.745	0.808	0.823	0.770
Upper middle income	-0.656	-0.337	-0.396	-0.426	-0.541	-0.575
Lower middle income	-0.572	-0.761	-0.670	-0.587	-0.789	-0.815
Low income	-0.864	-1.192	-1.177	-1.018	-1.014	-1.175

Source: Authors' own completion.

Mean value analysis of governance efficiency indicators at different income levels (see table 2) supports our hypothesis of existence of negative association. Across all dimensions, governance efficiency fall is accompanied by lower income level.

4. Empirical methodology

Because the research aims to identify direction and strength of the causality between extractive dependence, governance efficiency, and economic growth, three different model specifications are estimated:

$$\log(EDI)_t = \gamma_i + \gamma_i' * \log(GDP_{Pc})_t + \delta_i * X_{i,t} + u_{i,t} \quad (2)$$

$$\log(GDP_{Pc})_t = \alpha_i + \alpha_i' * \log(EDI)_t + \varphi_i * X_{i,t} + \theta_{i,t} \quad (3)$$

$$X_{i,t} = \beta_i + \beta_i' * \log(EDI)_t + \vartheta_i * \log(GDP_{Pc})_t + \varepsilon_{i,t} \quad (4)$$

In all specifications, GDP_{Pc} stand for GDP per capita PPP, and X_i represents governance efficiency indicators. Therefore, $X_i \in$(V_A, P_S, G_E, REG_L, C_C, RULE_L). t denotes the time, u, θ and ε are error term of the corresponding regression equation. As the X_i includes 6 different measures of governance efficiency, in total, 18 model specification (six model for each base equations, equation (2), (3), and (4), respectively. According to the hypothesis of the research, we expect $\gamma_i' > 0$, $\alpha_i' > 0$, $\delta_i < 0$, $\varphi_i > 0$, $\beta_i' < 0$, and $\vartheta_i > 0$.

As our sample covers 43 countries for 2003-2011 period, we employ panel data analysis tools to estimate the so called resource triangle hypothesis. Before deciding the method for empirical estimation, stationarity of the variables should be examined. Therefore, in empirical estimation stage, we firstly check for stationarity of the variables, secondly apply corresponding panel data estimation method.

To get more reliable evidence about the stationarity of the variables, we employ four different panel unit root tests - LLC (Levin, Lin and Chu, 2002), IPS (Im, Pesaran and Shin, 2003), and Fisher-ADF and Fisher-PP of Maddala and Wu (1999). Note that LLC tests for common unit root process while IPS, Fisher-ADF and Fisher-PP examines existence of individual unit root process in variables. Table 3 represents unit root test results for all employed methods with only intercept as well as with intercept and trend.

LLC test rejects existence of common unit root process in all variables with and without trend at level. Coming to checking for individual unit root process, IPS, Fisher-ADF nd Fisher-PP tests produce a little conflicting results. According to IPS, EDI, V_A, P_S, G_E and GDP_P are I(0) at 5% significance level while remaining ones are found to be I(1). Fisher-ADF excludes GDP_P from this list. In contrast, Fisher-PP finds all variables I(0) or stationary at level. Overall conclusion is that variables are mostly I(0), and for some cases I(1) depending on which test results are taken into consideration. Result when trend is included do not significantly meaningful as we don't find any trend stationary process.

Table 3: Unit root test results

	Panel A: Individual intercept							
	LLC		**IPS**		**Fisher-ADF**		**Fisher-PP**	
	I(0)	*I(1)*	*I(0)*	*I(1)*	*I(0)*	*I(1)*	*I(0)*	*I(1)*
EDI	-12.09***	-9.104***	-2.649***	-2.264***	130.98***	117.55***	161.83***	253.57***
V_A	-7.445***	-14.73***	-3.484***	-9.862***	146.44***	257.82***	154.88***	420.41***
P_S	-5.836***	-7.259***	-3.441***	-8.451***	141.71***	226.48***	178.39***	477.25***
G_E	-6.345***	-18.55***	-3.660***	-12.45***	159.79***	273.57***	136.79***	467.99***
REG_L	-2.389***	-5.695***	-0.379	-6.103***	81.711	180.29***	143.11***	431.31***
C_C	-3.347***	-4.128***	-1.401*	-6.331***	105.48*	182.19***	179.55***	455.39***
RULE_L	-4.340***	-6.138***	0.023	-6.869***	94.771	200.45***	133.66***	417.63***
GDP_P	-7.729***	-10.39***	-1.179	-4.782***	116.33**	158.39***	182.15***	195.94***
	Panel B: Individual intercept and trend							
EDI	-10.12***	-12.09***	0.210	-1.043	86.687	119.07***	123.69***	235.12***
V_A	-7.555***	-16.13***	-1.979**	-7.238***	119.09**	207.69***	102.99*	372.59***
P_S	-4.546***	-8.574***	-0.975	-6.210***	104.95*	189.11***	188.29***	448.01***
G_E	-8.874***	-17.48***	-4.264***	-8.447***	151.89***	197.55***	192.69***	428.59***
REG_L	-2.405***	-6.228***	0.804	-3.775***	79.231	147.32***	144.37***	402.99***
C_C	-2.601***	-1.966**	0.944	-3.331***	66.065	135.41***	173.29***	436.09***
RULE_L	-4.674***	-6.957***	0.688	-5.887***	83.886	181.82***	118.77***	416.69***
GDP_P	-10.27***	-13.39***	-1.272	-4.146***	113.59***	154.52***	55.188	235.88***

*Note:. ***, **, and * denote rejection of the null hypothesis at the 1%, 5% and 10% significance levels respectively. Probabilities of Fisher-ADF and Fisher-PP are computed by using an asymptotic χ^2distribution while all the rest of the tests assume asymptotic normality. Maximum lag length set to two and optimal length is specified automatically by Schwarz (SC) criterion.*

Considering unit root test results, autoregressive distributed lag (ARDL) model in error correction form presented by Pesaran and Smith (1995), Pesaran (1997) and Pesaran and Shin (1999) seems to be more reliable as a new cointegration test. Hence, panel ARDL can be estimated by using variables with the same order of integration (I(0) or I(1)) as well as even if the variables with different order of integration, in other words, combination of I(0) and I(1) (Pesaran and Shin, 1999). Moreover, ARDL model allows to simultaneously estimate short-run and long-run effects by employing a data set with large cross-section and time dimensions (Samargandi, Fidrmuc and Ghosh, 2015). In addition, ARDL model produces consistent coefficients, especially when pooled mean group (hereafter PMG) (Pesaran et al., 1999), and mean group (MG) (Pesaran and

Smith (1995) estimators are used because, it covers lags of both dependent and independent variables which overcome possible negative effects of endogeneity.

A sampling issue which the estimation method should address is that time period is relatively short. More precisely, number of cross-sections is more than time period ($N > T$). According to Roodman (2006), if number of countries (N) is more than the time period (T) in a panel data structure, the GMM-difference estimator suggested by Arellane and Bond (1991) and GMM system estimator developed by Arellano and Bover (1995) and Bond (2002) are better to work with. On the other hand, GMM ignores stationarity of the variables and covers only the short-run dynamics due to being mostly restricted to short time series (Samargandi et al., 2015).

For robustness of estimation results, we are going to employ both panel ARDL with PMG estimators, and panel GMM-difference estimator with 2SLS instrument weighting matrix. Panel ARDL lag specification is done according to Akaike info criterion (AIC) from defined maximum 1 lag for dynamic regressors. Maximum lag length is restricted to 1 lag due to keep sample size and time period.

5. Empirical results and interpretations

On the basis of equations 2-4, empirical results are tabulated in following tables. ARDL results with PMG estimators are given in following tables. Table 4 present empirical results on the relationship between extractive dependence and governance indicators as well as per capita income. As expected, research reveals existence of negative association from governance quality indicators to extractive dependence level. Dependence from natural resource industries decrease in response to the increase in the governance quality or institutional developments.

Table 4: ARDL results: dependent variable $\log(\mathrm{EDI})_t$

	1	2	3	4	5	6
Long run equation						
V_A	-0.016	-	-	-	-	-
P_S	-	-0.037***	-	-	-	-
G_E	-	-	-0.324***	-	-	-
REG_L	-	-	-	-0.305***	-	-
C_C	-	-	-	-	-0.368***	-
RULE_L	-	-	-	-	-	-0.261***
$\log(GDP\_P)$	0.300***	0.237***	0.253***	0.281***	0.204*	0.179***
Short run equation						
COINTEQ01	-0.487***	-0.542***	-0.468***	-0.418***	-0.416***	-0.555***
D(V_A)	-0.043*	-	-	-	-	-
D(P_S)	-	0.001	-	-	-	-
D(G_E)	-	-	-0.077	-	-	-
D(REG_L)	-	-	-	-0.016	-	-
D(C_C)	-	-	-	-	0.151*	-
D(RULE_L)	-	-	-	-	-	0.100
$D(\log(GDP\_P)$	1.398***	1.494**	1.195***	1.531***	1.275***	1.245***
C	0.390***	0.734***	0.545***	0.375***	0.635***	1.092***

*Note: ***, **, and * denote statistical significance at 1%, 5%, and 10% level of significance.*

According to the results, voice and accountability does not significantly affect the level of dependence in the long-run while political stability does of which economic significance is not so strong. However, remaining other indicators of governance quality are economically and statistically very important factors in determining the level of dependence. At 1% level of

significance, the impact of all those over extractive dependence is statistically significant. 1 point increase government effectiveness, regulatory law, control of corruption and rule of law decreases the level of dependence from extractives by 32.4%, 30.5%, 36.8%, and 26.1% respectively in the long-run. It is noteworthy to mention that findings show insignificant impact of institutional improvements in the short-run, except voice and accountability. Therefore, the hypothesis of negative link from governance quality indicators to extractive dependence level is confirmed. Especially, this happens in the long-run. Only enhancing voice and accountability has strong negative impact in the short-run.

Regarding the impact of per-capita GDP level over extractive dependence, research reveals statistically significant positive impact in all cases. Long-run elasticity coefficient is around 0.2-0.3 while in the short-run, it is between 1.2-1.5. In other words, increase in GDP per capita pushes extractive dependence upward both in the long- and short-run. However, the influence is 5-6 times stronger in the short-run. This result also supports the hypothesis of positive association between income level and extractive dependence in the context of Wagner's law (Wagner, 1890). Considering more political interests in the short-run, finding much more strong relationship should not be surprising.

Table 5: ARDL results: dependent variable $\log(\text{GDP\_P})_t$

	1	2	3	4	5	6
			Long-run equation			
V_A	0.551***	-	-	-	-	-
P_S	-	0.352***	-	-	-	-
G_E	-	-	0.115**	-	-	-
REG_L	-	-	-	0.286***	-	-
C_C	-	-	-	-	0.073***	-
RULE_L	-	-	-	-	-	0.141***
$\log(EDI)$	0.990***	0.330***	1.269***	1.442***	1.199***	2.050***
			Short-run equation			
COINTEQ01	-0.081***	-0.299***	-0.125***	-0.128***	-0.132***	-0.116***
D(V_A)	- 0.041	-	-	-	-	-
D(P_S)	-	- 0.057***	-	-	-	-
D(G_E)	-	-	0.047	-	-	-
D(REG_L)	-	-	-	0.035	-	-
D(C_C)	-	-	-	-	0.021	-
D(RULE_L)	-	-	-	-	-	-0.026
D($\log(EDI)$)	0.094	0.133	-0.040	-0.026	-0.092	-0.109
C	0.514***	2.448***	0.627***	0.551***	0.695***	0.227***

*Note: ***, **, and * denote statistical significance at 1%, 5%, and 10% level of significance.*

As the second part of the triangle, how institutional developments and increase in the level of extractives dependence affects GDP per capita in resource rich economies is given in Table 5. Note that research reveals positive and statistically significant impact ($p\ value < 0.01$) of all indicators of governance quality in the long-run. 1 point increase in voice and accountability enhances GDP per capita growth by 55.1%. Next the most important governance quality indicators are political stability and regulatory law with 35.2% and 28.6% positive impact in response to one point increase, respectively.

Finding positive long-run association is highly noteworthy. However, in the short-run, the relationship is statistically insignificant, even negative for 3 of 5. This also reminds that increasing governance quality of improving institutions will strongly turn back with higher economic

growth in the long-run. Therefore, the hypothesis about positive causality from governance quality indicators to GDP per capita growth is confirmed according to empirical results.

What about the impact of extractive dependence over GDP per capita in resource rich economies? Empirical findings all together display significant long-run positive association. As expected, increasing of extractives dependence or the higher use of resource revenues to finance public spending will trigger GDP per capita growth. However, this also happens in the long-run. Therefore, the hypothesis of positive causality from extractive dependence to GDP per capita is also confirmed in the long-run.

What about the direction and strength of causality from extractive dependence rise and GDP per capita increase to governance quality indicators? Table 6 tabulate ARDL results for this purpose.

Table 6: ARDL results: dependent variable – governance quality indicators

Independent variables	**Dependent variables**					
	V_A	P_S	G_E	REG_L	C_C	RULE_L
			Long run equation			
$\log(EDI)$	-0.218***	0.525***	0.083***	-0.040	-0.042	-0.750***
$\log(GDP\_P)$	0.181***	0.308***	0.032	0.374***	-0.040*	-0.300***
			Short run equation			
COINTEQ01	-0.453***	-0.539***	-0.665***	-0.532***	-0.693***	-0.353***
$D(\log(EDI))$	0.039	-0.364	-0.252	-0.045	0.153	-0.217
$D(\log(GDP\_P))$	0.052	0.152	0.033	0.442	0.329	0.175
C	-0.641***	-2.684***	-0.499***	-1.885***	0.166**	1.900***

*Note: ***, **, and * denote statistical significance at 1%, 5%, and 10% level of significance.*

Research results show that increasing extractive dependence (EDI) affects governance quality indicators but, the impact is not always in the same direction. It decreases voice and accountability (-21.8%) and rule of law (-75.0%) while brings more political stability (52.5%) and better government effectiveness (8.3%) in the long-run. Long-run impact over regulatory law and control of corruption is also negative but statistically insignificant ($p\ value > 0.10$). In the short-run, no statistically significant impact is revealed ($p\ value > 0.10$). Despite of positive influence over political stability, the long-run causality from EDI to governance quality should be considered as in the negative direction. Especially, as expected, it increases political pressure over voice and accountability and rule of law. Hypothesis of negative causality from extractive dependence to governance quality is confirmed.

The impact of GDP per capita growth over governance quality indicators also varies across the type of indicators. It affects voice and accountability, political stability and regulatory law significantly ($p\ value < 0.01$) and positively in the long-run. However, the impact is negative over control of corruption and rule of law. Like EDI, GDP per capita also does not significantly matter for governance quality in the short-run ($p\ value > 0.10$). According to the results, we can generalize that the hypothesis of positive causality from GDP per capita to governance quality indicators is confirmed.

As noted in the methodology section, panel GMM also employed for robustness of ARDL results. Table 7 presents panel GMM results which covers all empirical results in three parts. It is noteworthy to mention that panel GMM results almost totally supports long-run ADRL outcomes. It also ends with existence of statistically significant negative causality from governance quality indicators, and positive causality from GDP per capita to extractives dependence. P-value is always less than 1%.

When the impact of governance quality indicators and EDI over GDP per capita growth is examined, GMM also conclude with very close results to panel ARDL. There is always positive and statistically significant association ($p\ value < 0.01$).

Regarding the impact over governance quality indicators, there is some but not big difference between GMM and ARDL results. Although ARDL ended with not always positive or negative coefficients, GMM presents that extractive dependence affects all aspects of governance quality negatively which are statistically significant at all ($p\ value < 0.01$). About the impact of GDP per capita, GMM produces that the causality to all governance quality indicators are positive and statistically significant ($p\ value < 0.01$).

Table 7: Panel GMM results for robustness

Panel A: dependent variable – $log(EDI)$						
	1	2	3	4	5	6
V_A	-0.380	-	-	-	-	-
P_S	-	-0.148***	-	-	-	-
G_E	-	-	-0.493***	-	-	-
REG_L	-	-	-	-0.494***	-	-
C_C	-	-	-	-	-0.375***	-
RULE_L	-	-	-	-	-	-0.417***
$\log(GDP\_P)$	0.203***	0.245***	0.379***	0.361***	0.334***	0.362***
C	1.644***	1.416***	0.099	0.289	0.520**	0.232
Panel B: dependent variable – $log(GDP\_P)$						
	1	2	3	4	5	6
V_A	0.567***	-	-	-	-	-
P_S	-	0.884***	-	-	-	-
G_E	-	-	1.118**	-	-	-
REG_L	-	-	-	1.127***	-	-
C_C	-	-	-	-	0.976***	-
RULE_L	-	-	-	-	-	1.061***
$\log(EDI)$	1.150***	0.652***	1.049***	1.087***	0.956***	0.911***
C	5.227***	7.039***	5.586***	5.398***	5.953***	6.192***

Panel C: dependent variable – governance quality indicators						
Independent variables	*Dependent variables*					
	V_A	P_S	G_E	REG_L	C_C	RULE_L
$\log(EDI)$	-0.764***	-0.217***	-0.636***	-0.638***	-0.568***	-0.529***
$\log(GDP\_P)$	0.201***	0.489***	0.520***	0.483***	0.517***	0.536***
C	0.455	-3.988	-2.680***	-2.290	-2.956***	-3.318***

*Note: ***, **, and * denote statistical significance at 1%, 5%, and 10% level of significance.*

To sum up, panel GMM results strengthens robustness of the ARDL results.

Conclusion and discussion

Economic and institutional issues in resource rich economies has been at the center of numerous studies in the worldwide. Existence of association between resource abundance, governance quality and economic growth has been investigated theoretically and empirically before. However, to our best knowledge, this is the first attempt to examine the association as a triangle of which dependence from extractives stands in one side wile governance quality and economic growth positions in other remaining edges of the triangle. A behavioural framework is developed to describe theoretical background of the triangle. Authors argue that "resource curse is neither economic, nor political, it is a behavioural issue".

Using the extractive dependence index calculated by Hailu and Kipgen (2017) and governance quality indicators provided by World Bank and GDP per capita (PPP) within a panel of 43 resource rich countries, authors estimate existence of bidirectional long-run association between these indicators. ARDL and GMM results all together supports existence of strong bidirectional causality between each pair of three.

Because dependence from extractives is one of the most important issues for resource rich countries, findings suggests that the dependence can be decreased by improving institutional quality. Better governance quality results in substantially less dependence from extractives in the long-run. However, GDP per capita growth further increases expectations citizens which in turn stimulates governments to transfer more resources from extractives (i.e., increase extractive dependence) to finance economic policy and enhance economic growth performance. Research findings provide strong scientific evidence for this claim. So that, increasing resource dependence significantly increases GDP per capita growth while assuming governance quality remains the same. However, findings reveals governance quality as a strong stimulating factor for better GDP per capita growth performance. Therefore, in both cases, improving governance quality appears as preferred policy option which will allow to grow at lower level of extractive dependence in resource rich economies.

On the other hand, governance quality itself also significantly depends on the level of extractive dependence and GDP per capita growth. Research findings provide strong scientific evidence of that as extractive dependence increases, governance quality generally decreases. Especially, control of corruption performance significantly falls. However, increasing GDP per capita makes voters more responsive to governance quality issues. This is also supported by results of empirical estimations.

Research results allow to propose a roadmap for resource rich countries. Institutional quality or better governance performance is the key point. To minimize extractive dependence, the country should have high level of governance quality. However, here, there is one issue must be taken into consideration: political interests of parties in the government, and the interests of voters and firms. Everyone must accept that extractives dependence is dangerous for all sides in the long-run. Therefore, voters and firm owners should try to increase the level of control over use of natural resource revenues in order to avoid negative consequences. Otherwise, excessive use of resource revenues will increase extractive dependence which will result in lower governance quality. Also, seemingly more EDI value is associated with higher GDP per capita growth, this is temporary and national income may fall as the resources ends. Meanwhile, GDP per capita growth will decrease due to governance quality fall.

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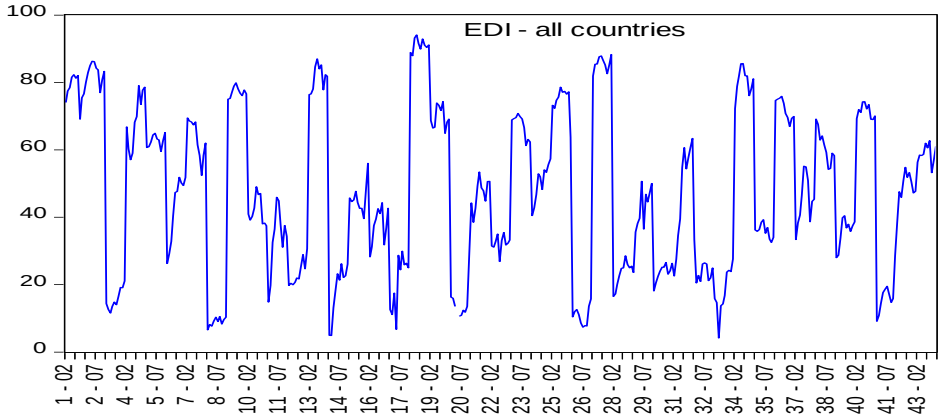
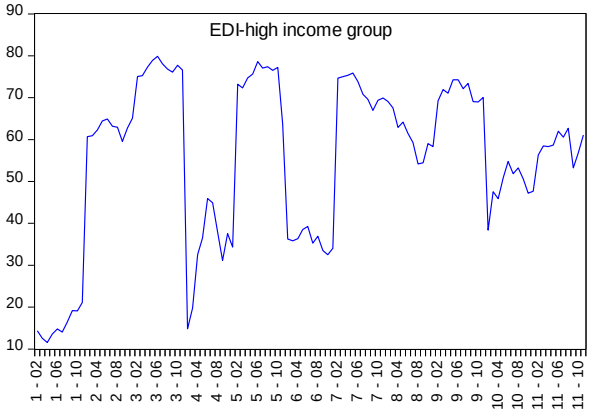
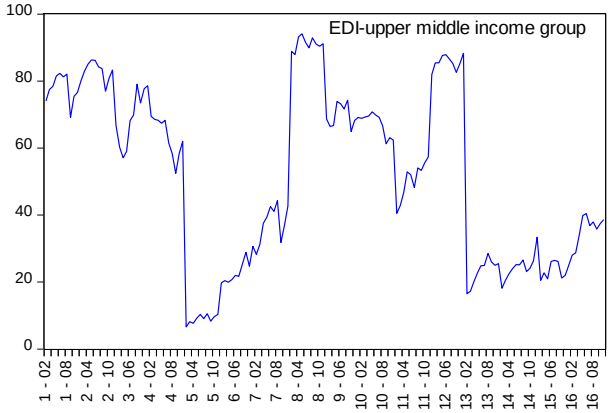
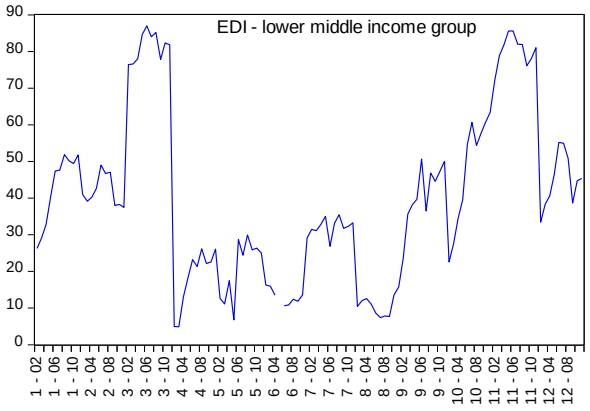
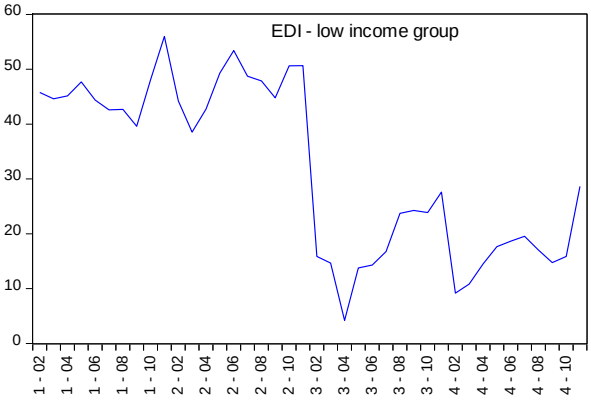
APPENDIX A: *Value of Extractive Dependence Index (EDI)*











APPENDIX B: *Definitions of governance efficiency indicators*

Dimensions of governance	*Definitions*
Voice and accountability	Perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media
Political stability and absence of violence/terrorism	Perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism
Government effectiveness	Perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.
Regulatory quality	Perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development
Control of corruption	Perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests
Rule of law	Perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.

Source: Worldwide Governance Indicators. See http://info.worldbank.org/governance/wgi/#doc/ , 28/05/2017.