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Abstract

An important economic paradox in the economic literature is that countries with abundant natural resources are poor in terms of real gross domestic product per capita. This paradox, known as the 'resource curse', is contrary to the conventional intuition that natural resources help to improve economic growth and prosperity. Using panel data for 95 countries, this study revisits the resource curse paradox in terms of oil resources abundance for the period 1980–2017. In addition, the study examines the role of trade openness in influencing the relationship between oil abundance and economic growth. The study finds trade openness is a possible avenue to reduce the resource curse, in our sample, trade openness reduces oil curse by around 25%. Trade openness allows countries to obtain competitive prices for their resources in the international market and access advanced technologies to extract resources more efficiently. Therefore, natural resource–rich economies can reduce the resource curse by increasing exposure to international trade.

1. Introduction

The conventional intuition is that natural resources help to increase a country's economic growth and development. Contrary to this, the literature reports that countries rich in natural resources tend to have lower real gross domestic product (GDP) per capita than resource-poor countries—this paradox is known as the 'resource curse' [see, e.g., Auty (1993), Sachs and Warner (1995), Gylfason (2000) and Van der Ploeg (2011)].[1] For example, oil-rich countries such as Venezuela, Nigeria and the Republic of the Congo are poor in terms of real GDP per capita, while some resource-poor countries such as Singapore, South Korea and Hong Kong have very high real GDP per capita.[2] The literature identifies several factors that explain this paradox such as poor institutional quality, political rent-seeking, commodity price volatility and lack of diversification. However, several other factors remain unexplored.

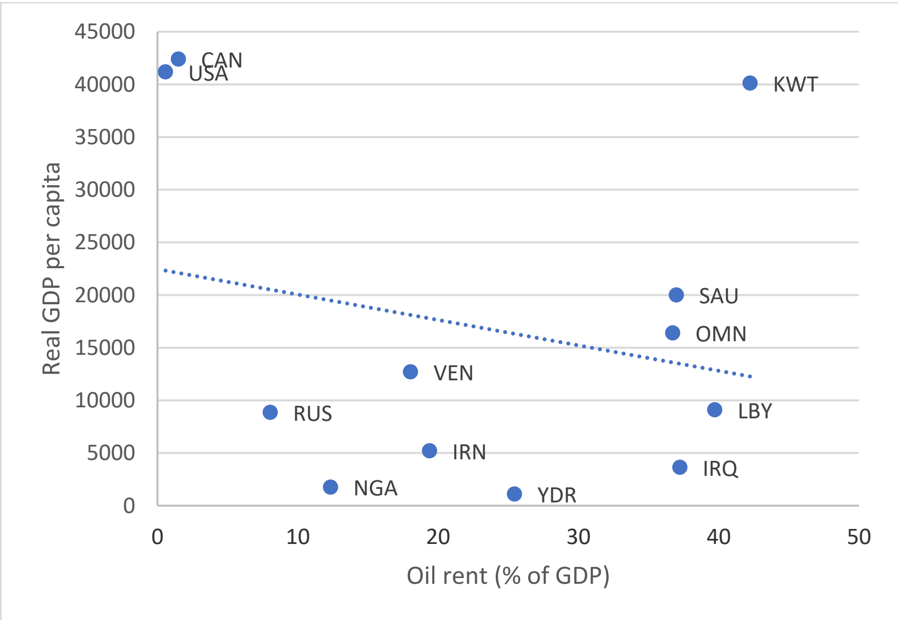
The main objectives of this paper are to: (i) estimate the oil curse (rather than the resource curse) in dynamic panel data setting; (ii) investigate the impact of the World Trade Organization (WTO), which was established in 1995 on the oil curse; (iii) examine the role of trade openness as a channel that may reduce the oil curse.

Trade openness increases real GDP per capita in a resource-rich country in different ways. Our hypothesis is that increased trade helps to lessen the resource curse by reallocating resources more efficiently. It provides countries access to the international market and higher prices for their products. This access to international prices increases the country's income and real GDP per capita. Trade openness also makes available opportunities to use advanced technologies for more efficient extraction of natural resources. With the use of new technologies, natural resource–rich countries can produce intermediate and final goods from

[1] The term 'resource curse' was first coined by Auty (1993) to explain the negative relationship between resource dependency and economic growth.
[2] Note that this is not true for all countries. For example, oil-rich countries such as Norway, Saudi Arabia and Qatar have high GDP per capita.

primary goods and earn more profits. Trade openness helps to modernise the entire economy by improving other related sectors such as roads and transport systems (Pedersen 2000), financial sectors (Braun & Raddatz 2008) and bureaucratic systems (Dutt 2009). Overall, trade openness plays a crucial role in converting natural resources into a blessing rather a curse. Figure 1 shows the relationship between real GDP per capita and oil rent (% of GDP) for the period 1980–2017.[3]

Figure 1: Relation between real GDP per capita and oil rent (% of GDP) in countries with high oil reserves.



Source: Author's calculations based on World Bank (2019).

Arezki and Van der Ploeg (2011) investigate the role of trade and institutions in reducing the resource curse and find that the resource curse becomes weaker in countries with a high degree of trade openness. In their seminal study, Sachs and Warner (1995) also find that trade openness improves economic growth by reducing the resource curse. However, most of these studies are based on cross-section growth models, where the average growth over recent decades is regressed on a measure of resource abundance and a selection of control variables.

[3] Throughout this study, we use change in real GDP per capita and economic growth interchangeably.

In this study, we use a dynamic panel data framework to investigate the impact of trade openness on the resource curse. A dynamic panel framework has the advantage of reducing serial correlation.[4] This is one of the few studies to explore the relationship between the resource curse and trade openness in a dynamic panel data framework (rather than cross-sectional long-term perspective).[5]

This study uses an unbalanced dynamic panel data model that covers 95 countries for the period 1980–2017. The period of study and choice of countries included in the study are based on data availability from the World Bank (WB) and International Monetary Fund (IMF). Before 1980, the data is only available for few countries. Therefore, unbalanced panel data is preferred to maximise the degree of freedom as for some countries data only starts in 1992.

We use the data for the full sample period (1980–2017) and also provide estimation by splitting the sample period into two subsample periods: 1980–1994 (before the WTO) and 1995–2017 (after the WTO). We concur that the commencement of the WTO in 1995 contributed to significant increases in international trade and the increased trade helps to lessen the resource curse through efficient allocation of resources. Moreover, many countries reduced their trade tariffs under the WTO agreements which has helped to boost international trade during the last two decades.[6] For example, China abolished non-tariff barriers and reduced tariffs in the manufacturing sector after it joined the WTO in 2001. This significantly increased the demand for metals such as copper, aluminium, and steel (Coates & Luu 2012). This

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[4] In our dynamic panel data model (equation 1), the Durbin-Watson (DW) statistic is 2.02 that indicates there is no serial auto-correlation. However, when we exclude the lag dependent variable from the model, the value of the DW statistic is 1.16 which is much lower than the standard value that indicates the presence of serial autocorrelation.

[5] Few studies use panel data models to discuss the resource curse hypothesis. By using a panel data model consisting of 56 countries from 1972–2000, Mavrotas, Murshed and Torres (2011) found that point resource dependence harms economic growth in developing countries. Similarly, Goderis (2008) found the existence of resource curse by using panel data for 130 countries for the period 1963–2003.

[6] The WTO is an intergovernmental organisation that deals with the regulation of trade in goods, services and intellectual property between participating countries by providing a framework for negotiating trade agreements and a dispute resolution process.

increased demand probably had an exogenous impact on the growth of other countries. For example, Andersen et al. (2014) empirically found that China's access to the WTO contributed to improving the growth rate in sub-Saharan African countries.

This study focuses on oil as a natural resource because it is a highly tradeable commodity. As oil price is directly linked to the production process, it may have a significant impact on inflation, employment and output (Guo & Kliesen 2005). Moreover, point-source resources such as oil are more prone to rent-seeking that leads to resource curse (Isham et al. 2005; Boschini, Pettersson & Roine 2007).[7] In this study, we use oil rent (% of GDP) as a measure of natural resource abundance.[8] Although our study finds the existence of the resource curse, trade openness significantly decreases the resource curse problem, especially after the introduction of the WTO.

This study contributes to the literature in the following ways. First, to the best of our knowledge, no previous studies have examined trade openness as a transmission channel for reducing the resource curse by using dynamic panel data models. Second, using panel data allows us to evaluate the effect of trade openness over time and, particularly, the impact of the dramatic changes that followed the commencement of the WTO. Finally, the time dimension of the panel data allows us to include periods of importance such as the global financial crisis and European sovereign debt crisis.

The study proceeds as follows. Section 2 provides an overview of the resource curse literature. Section 3 describes the conceptual framework of the importance of trade. The

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[7] A point-source resource is a resource concentrated in a single identifiable location (i.e., not diffused in wide areas).

[8] Following Bjorvatn, Farzanegan and Schneider (2012); Arezki and Brückner (2011); Bhattacharyya and Hodler (2010), we use oil rents (% of GDP) as a proxy of natural resource abundance. Rents are basically net profits from resource extraction, defined as the value of the product minus total cost of production. Rents measure the value of natural resources for a country. More precisely, they provide a less ambiguous measure of resource dependence compared with those previously used such as primary commodity exports, oil exports and reserves. For robustness, we use the natural resource rent (% of GDP). We define 'abundance' as the resource contributing a large share of a country's GDP.

methodology of this study is described in Section 4. Section 5 describes the data and description of the variables and Section 6 presents the empirical results from panel data estimations. Section 7 provides our conclusions and directions for future studies.

2. Overview of the resource curse literature

To study the role of natural resources in economic growth, it is essential to investigate the mechanisms that link endowments of natural resources to poor economic performance. In the literature, various economic and political reasons have been discussed for the failure to transform natural resources into economic growth including the 'Dutch disease', political rent-seeking and corruption, poor institutional quality, commodity price volatility and lack of diversification. We discuss these factors in detail in the following sections.

2.1. The Dutch disease

One of the most common economic reasons suggested for the resource curse is the popularly known Dutch disease. In most resource-rich countries, sectors other than resources are likely to suffer from a real appreciation of the national currency due to natural resource earnings, in part, being absorbed by the domestic non-tradeable sectors.[9] This results in exports from the non-resources sectors (usually manufacturing) become more expensive relative to the world market, thus making those sectors less competitive. Consequently, total national income is reduced, ultimately causing economic growth to slow. This mechanism is known as the 'spending effect'.

2.2. Political rent-seeking and corruption

[9] Corden (1984) first developed the Dutch disease model. Iimi (2007) described Dutch disease as the most prominent channel of the resource curse. Sachs and Warner (1995) argued that the Dutch disease is responsible for the slow economic growth of resource-rich African countries.

According to Gylfason (2000), the powerful political elites of resource-rich countries can control revenues from natural resources. These elites tend to distribute the windfall revenues for the benefit of their own existing business and personal networks, instead of investing them in the development sectors. Such conflict discourages both domestic and international investment which also leads to lower economic growth. Antonakakis et al. (2017) suggest that controlling for the quality of political institutions is important in terms of the resource curse hypothesis. They argue that the resource curse is prevalent mainly in the developing and medium-high income countries.

2.3. Poor institutional quality

According to Mehlum, Moene and Torvik (2006) and Mavrotas, Murshed and Torres (2011), a country's institutional quality plays an important role in determining whether an abundance of natural resources is a blessing or a curse. It is argued that high levels of growth in resource-rich countries are due to the way in which rents from natural resources are distributed through existing institutional arrangements. If institutional quality is good, a generous endowment of natural resource is a blessing. Mehlum, Moene and Torvik (2006) argue that the adverse effect of natural resource abundance on economic growth will be dissipated if institutional quality is improved.

2.4. Commodity price volatility

Commodity price volatility is another important channel for the resource curse. According to Bellemare, Barrett and Just (2013), and Dwyer, Gardner and Williams (2011) commodity price volatility generates uncertainty in the economy, delays stability in the budget, undermines the predictability of economic planning and potentially contributes to lower economic growth. Moreover, countries in this situation can expect to face stringent constraints on their borrowing capacity as financial markets are not only aware of the default risk that volatility generates but will also be mindful that aggregate consumption and real investment decrease in times of commodity price volatility. These dynamics will likely lead to lower economic growth.[10]

2.5. Lack of diversification

Another reason for the resource curse is the lack of economic diversification in countries with abundant natural resources. The major share of export earrings in these countries is generated from just one or a few resources. This leads to economic vulnerability from exogenous shocks and results in slow economic growth (De Ferranti et al. 2002).

There is considerable literature on the above-mentioned transmission channels that give rise to the resource curse, but only scant discussion about the dynamics associated with trade openness are found. Therefore, this study, which investigates the role of trade openness using panel data models, brings a new dimension to the resource curse literature.

3. Conceptual framework: Importance of trade in resource-rich countries

The uneven geographical distribution of resource endowment between countries plays a critically important part in explaining the significance of trade openness. Most of the world's natural resources are concentrated in a relatively small number of countries, while many countries have limited or no natural resources. For example, about 90 per cent of the world's proven oil reserves are in just 13 countries (BP 2017).[11] Consequently, international trade plays

[10] According to Salim and Rafiq (2011); and Guo and Kliesen (2005), consumer demand decreases due to the adoption of a precautionary savings mindset by consumers who are worried and uncertain about future income and unemployment levels as they are fearful that these levels may be adversely impacted during a period of commodity price volatility. Consequently, real investment decreases during periods of price volatility (Masih, Peters & De Mello 2011; Henriques & Sadorsky 2011 and Guo & Kliesen 2005). Antonakakis et al. (2018) shows that oil price volatility impacts the stock value of large oil and gas companies.

[11] The Middle East countries (Saudi Arabia, Iran, Iraq, Kuwait, Syria, United Arab Emirate, Qatar, Yemen and Oman) contain about 48 per cent of the world's total oil reserve, and Venezuela contains nearly 18 per cent as of 2016. The distribution of other fuels is also concentrated in a very small number of countries. For example, 10 countries possess 80 per cent of global natural gas reserves in 2016, and just nine countries have 90 per cent of the world's coal reserves.

a significant role in reducing the disparity in natural resource endowment of countries by allowing resources to move from areas of excess supply to areas of excess demand. Moreover, due to the excessive fixed costs in extracting the resources, large-scale extraction is required to achieve economies of scale. Large-scale production is only beneficial if there is a large market for exports of that resource. Overall, international trade is associated with a more efficient allocation of natural resources that leads to an increase in social welfare.

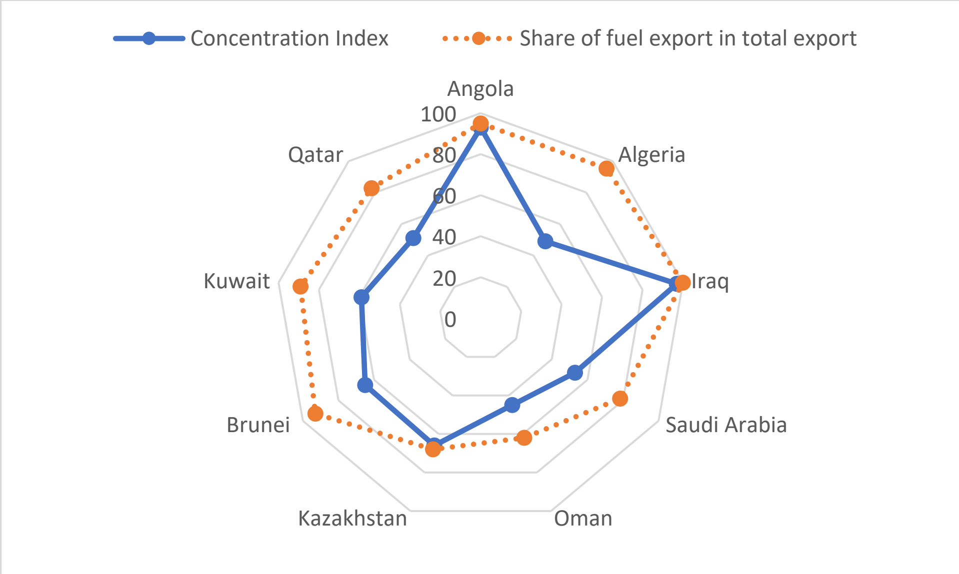
Another important feature of natural resources is the dominant position of this sector in national economies. Many of resource-rich countries tend to rely on a narrow range of export products. Figure 3 shows the value of export product concentration index (PCI) of different countries along with shares of natural resources in total merchandise exports for selected economies.[12] The PCI is based on the number of products in the Standard International Trade Classification (SITC) at the three-digit level that exceeds 0.3 per cent of a given country's exports collected from the United Nations Conference on Trade and Development (UNCTAD).

Figure 3: Dominance of fuel resource exports countries with high PCI

[12] The PCI shows to what extent exports and imports of individual countries or country groups are concentrated on several products rather than being distributed homogeneously among products. It is measured as:

$$PCI = \sqrt{\frac{\sum_{i=1}^{n} \frac{(x_{i,j})^2}{X_j} - \sqrt{1/n}}{1 - \sqrt{1/n}}} \text{ x100}$$

where, $x_{i,j}$ is the value of exports of products *i* from economy *j* and *n* is the number of product groups according to SITC, Revision 3, at the three-digit level.



Source: Author's calculation based on UNCTAD (2016) and WB (2019).

Figure 3 shows that the share of fuel in Kuwait, Brunei, Iraq and Angola is close to 100 per cent of total merchandise exports by 2015. With very few exceptions, countries with a high concentration index also have a high share of fuel resources in their total merchandise exports. The dominance of natural resources in exports follows the hypothesis of comparative advantage theory, arguing that countries will specialise in the production of goods where they have a comparative advantage and export them in exchange for other products. This is a direct implication of the Heckscher-Ohlin model which proposes that countries export what they can produce.

Overall, the above-described two characteristics of natural resources explain the importance of international trade to the efficient distribution of natural resources. As the government's revenue in resource-rich countries depends on one or few resources, if there are trade barriers then total revenue will decrease, causing slower economic growth. For example, Iran's government revenue and economic growth largely depended on the export of crude oil. However, due to some international restrictions, Iran cannot produce and sell oil at the optimum level and thus is forced to sell in the domestic market at a lower price. Consequently, Iran loses revenue, hampering economic growth. In general, economic growth largely depends on trade openness, especially for resource-rich economies.

4. Methodology

To explore the impact of oil rent (% of GDP) on economic growth, we use the cross-section and period fixed effect model (combined model). Other five-panel data estimation models—pooled least square (PLS) model, cross-section fixed effect model, cross-section random effect model, period fixed effect model, period random effect model—are also considered for robustness. The combined model allows us to eliminate bias arising from both unobservable variables that differ over time and across countries. For example, real GDP, trade and oil rent will differ between countries due to their differing geographies, natural endowments, political and cultural systems and other basic factors. These variables, however, do not differ over time. On the other hand, technological development or international agreements can change productivity growth globally which increases output over time. Period fixed effect model removes the effect of those country-invariant characteristics. Consequently, the combined fixed effect model removes the effect of those time-invariant and cross-section invariant characteristics from the model so that we can assess the net impact of oil rent (% of GDP) on economic growth. We adopt the following combined model to examine the impact of oil rent on economic growth:

$$\Delta LGDP_{i,t} = \beta_{0i} + \beta_{0t} + \beta_1 \Delta LGDP_{i,t-1} + \beta_2 LOIL_{i,t} + \beta_3 LUN_{i,t} + \beta_4 LFDI_{i,t} + \beta_5 LCAB_{i,t} + \beta_6 LMI_{i,t} + \beta_7 LMOR_{i,t} + \beta_8 LT_{i,t} + \beta_9 LT_{i,t} * LOIL_{i,t} + \mathcal{E}_{i,t} \quad (1)$$

Where $\Delta LGDP_{i,t}$ is the change in log of real GDP per capita; $\Delta LGDP_{i,t-1}$ represents the lag in the change in log of real GDP per capita; $LOIL_{i,t}$ indicates the log in oil rent (% of GDP); $LUN_{i,t}$, $LFDI_{i,t}$, $LCAB_{i,t}$ and $LMI_{i,t}$ indicate log in unemployment rate (% of total labor force), log in foreign direct investment (% of GDP), log in current account balance (% of GDP) and log in military expense (% of GDP) respectively; $LMOR_{i,t}$ is the log of the infant mortality rate (per 1,000 live births); and $LT_{i,t}$ represents the log of trade openness (% of GDP). A detailed description of the variables included in equation (1) is presented in Table A1 in Appendix A.

The subscripts i and t denote country and period respectively. β_{0i} and β_{0t} are the unobserved time-invariant and country-invariant individual effect respectively and the idiosyncratic disturbance term is denoted by $\varepsilon_{i,t}$. By using lag dependent variable, we capture autocorrelation in the model. In this study, we also include an interaction term in equation (1), denoted by $LT_{i,t} * LOIL_{i,t}$, to examine the hypothesis that trade openness significantly reduces the resource curse. The trade openness variable has been interacted with other variables in the literature. For example, Haddad et al. (2013) estimate the interaction term between trade openness and economic growth volatility. They find that trade openness reduces economic growth volatility. Oil resources has been used as an interactive term with government fractionalization by Bjorvatn, Farzanegan & Schneider (2012). More broadly, natural resources endowments have been interacting with institutional quality (see, e.g., Boschini, Pettersson & Roine 2007). They show that the impact of natural resources on economic growth is non-monotonic in institutional quality.

In equation (1), we use estimates for the full sample period (1980–2017) and for the two subsample periods (1980–1994 and 1995–2017) to allow us to examine the role of WTO on the resource curse. We also estimate equation (1) for the alternative measures of trade openness [such as exports (% of GDP) and imports (% of GDP)] and natural resource rents (% of GDP).

5. Data and description of the variables

In this section, we discuss the definition of the variables and sources of the data. We also discuss the characteristics of the data such as unit root, descriptive statistics and correlation matrix of the variables.

5.1. The data

To estimate the models, this study employs an unbalanced annual panel data dataset for 95 countries covering the period 1980–2017, where the countries and period included are determined by data availability. List of 95 countries are documented in Table A2 in Appendix A. The data for real GDP per capita, oil rent, foreign direct investment, current account balance, military expense, infant mortality rate and trade openness are collected from the World Development Indicator (WDI) of the WB. Unemployment rate data are collected from the World Economic Outlook of the IMF.

5.2. Unit root test, descriptive statistics and correlation matrix

We test the stationarity for all variables using the Im, Pesaran and Shin W-stat (assume individual unit root process) and the Levin, Lin and Chu test. A stationary variable is characterised of having constant mean and variance over time, and the covariance between two values in the series depends on the length of the time rather than on the actual times when the value is observed. With the exception of log of real GDP per capita, all variables included in the model are stationary ($p = 0.05$). The p-value of log real GDP per capita is >0.05 in case of Im, Pesaran and Shin W-stat, indicating that this variable is not stationary. To make the series stationary, we take the first difference of this series. The results of the unit root, descriptive statistics and correlation matrix are presented in Tables A3, A4 and A5 respectively in Appendix A.

6. Results and discussion

In this section, we describe all empirical results estimated by six estimation methods—pooled OLS model, cross-section fixed effect model, cross-section random effect model, period fixed effect model, period random effect model, and combined fixed effects model. In Section 6.1, we describe the estimated coefficients for the full sample period (1980–2017) and two subsample periods (1980–1994 and 1995–2017) estimated with the combined fixed effect model.

6.1. Main results

Table 1 reports the results. In this section, we only discuss the coefficient of the variables of interest—log in oil rent, log in trade openness and the interaction term between log in oil rent and log in trade openness. Other coefficients are consistent with the literature. The coefficient of the oil rent is negative, indicating that the change in real GDP per capita decreases with the increase in oil rent and the estimated elasticity is –0.04 (see column 1 in Table 1). Other things being equal, a one per cent increase in oil rent is associated with a decrease in change in real GDP per capita of around 0.04 per cent. This negative association between growth in real GDP per capita and oil rent is evidence of the resource curse.

The positive coefficient of trade openness indicates that trade openness positively affects growth in real GDP per capita. The coefficient of the interaction term between log in trade openness and log in oil rent is also positive, indicating that opening to trade reduces the negative impact of oil rent on the change of real GDP per capita. These results are significant ($p = 0.01$) and consistent with different time and country fixed effect and random effect models. The growth impact of a marginal increase in oil rent implied from equation (1) is:

$$\frac{d(\Delta LGDP_{i,t})}{d(LOIL_{i,t})} = -0.04 + 0.01\,(trade\ openness)$$

We see that the resource curse is weaker when there is a higher level of trade openness. The coefficient of oil rent is –0.04, but when we add the value of the interaction term, the value of the coefficient becomes smaller (–0.04 + 0.01 = –0.03 < –0.04). Statistically, we can observe that resource curse decreases by 25% with the opening to trade. In the case of cross-section fixed effect model (column 3 in Table 1), the size of the coefficients of oil rent, trade openness and interaction term are similar to the combined model. However, the size of the coefficients is much smaller in the PLS and random effect models (columns 2, and 4 in Table 1). One plausible reason is that in the PLS and random effect models, the unobservable variables are assumed to be uncorrelated with all the observed variables. As a result, the size of the coefficient is smaller than the combined fixed effect model (–0.02). There are some major differences in the coefficients for the combined fixed effect and random effect models, which might reflect the importance of omitted variable bias in the latter. In the period fixed effect and period random effect models, the size of the coefficient is smaller than the cross-section fixed effect and the combined fixed effect models, indicating that country-invariant unobservable variables such as different agreements and laws are not correlated with the observed variables (see columns 5 and 6 in Table 1).

Table 1: Change in real GDP per capita and oil rent (% of GDP) in sample period (1980–2017).

	Dependent variable: $\Delta LGDP_{i,t}$					
	Cross-section and period fixed (1)	Pooled OLS (2)	Cross-section fixed (3)	Cross-section random (4)	Period fixed (5)	Period random (6)
$\Delta LGDP_{i,t-1}$	0.40***	0.46***	0.36***	0.46***	0.51***	0.51***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
	[0.03]	[0.03]	[0.03]	[0.03]	[0.03]	[0.03]
$LOIL_{i,t}$	–0.04***	–0.02***	–0.04***	–0.02***	–0.01***	–0.01***
	(0.01)	(0.007)	(0.01)	(0.007)	(0.006)	(0.006)
	[0.01]	[0.01]	[0.01]	[0.01]	[0.009]	[0.009]
$LUN_{i,t}$	–0.0007	0.0008	–0.0008	0.0008	0.0001	0.0001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.0009)	(0.0009)
	[0.003]	[0.001]	[0.003]	[0.001]	[0.001]	[0.001]
$LFDI_{i,t}$	–0.002	0.002	0.005	0.002	–0.003	–0.003
	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]
$LCAB_{i,t}$	–0.08**	–0.04*	–0.05*	–0.04*	–0.06**	–0.06**
	(0.03)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)
	[0.04]	[0.03]	[0.04]	[0.03]	[0.03]	[0.03]
$LMI_{i,t}$	–0.01***	–0.002*	–0.01***	–0.002*	–0.001	–0.001
	(0.003)	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)
	[0.004]	[0.001]	[0.004]	[0.001]	[0.001]	[0.001]
$LMOR_{i,t}$	0.01***	0.002***	0.01***	0.002***	0.001**	0.001**
	(0.004)	(0.0008)	(0.002)	(0.0008)	(0.0008)	(0.0008)
	[0.004]	[0.001]	[0.002]	[0.001]	[0.0009]	[0.009]
$LT_{i,t}$	0.009**	0.003**	0.01***	0.003***	0.002**	0.002**
	(0.003)	(0.001)	(0.004)	(0.001)	(0.001)	(0.001)
	[0.004]	[0.001]	[0.004]	[0.001]	[0.001]	[0.001]
$LT_{i,t}$*$LOIL_{i,t}$	0.01***	0.005***	0.01***	0.005***	0.004***	0.004***
	(0.002)	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)
	[0.003]	[0.002]	[0.004]	[0.002]	[0.002]	[0.002]
R^2	0.31	0.26	0.16	0.26	0.42	0.42
Observations	2,499	2,499	2,499	2,499	2,499	2,499

Note: The number of countries are 95 and the number of periods are 38 for all the regressions in this table. Standard errors are presented below the corresponding coefficients in the bracket. ***, ** and * indicate the significance at the 1%, 5%, and 10% level respectively. Cluster standard errors are presented in square brackets.

To investigate the impact of the WTO, we split our full sample period (1980–2017) into two subsample periods (1980–1994 and 1995–2017). We hypothesise that the introduction of the WTO on 1st January 1995 may have significantly increased international trade and thereby, reduced the resource curse.[13] According to Goldstein, Rivers and Tomz (2007) and Tomz, Goldstein and Rivers (2007), participation in the WTO substantially increased trade for the whole world. Moreover, Nicita, Olarreaga and Silva (2013) show that the average country would face a 32 per cent increase in tariffs on their exports in the absence of the WTO.

In Table 2, we present the empirical findings on the nexus between real GDP per capita and oil rent for the two subsample periods (1980–1994 in column 1 and 1995–2017 in column 2) and compare these with the full sample period. The coefficient of the oil rent in the period 1980–1994 is negative, and the estimated elasticity is –0.05 (column 1 in Table 2). All other things being equal, a one per cent increase in the oil rent is associated with a significant decrease in the change of real GDP per capita of around 0.05 per cent on average. The size of the coefficient is about 40% and 20% higher than subsample period 1995–2017 (column 2 in Table 2) and the full sample period 1980–2017 (column 3 in Table 2) respectively.

From column 2 in Table 2, we observe that the coefficient of interaction term (between log in oil rent and log in trade openness) is positive and statistically significant during the period 1995–2017. This result indicates that trade openness has a significant impact on reducing the resource curse during that period. However, we do not find any statistically significant impact of trade openness during the period 1980–1994 (refer to column 1), although the coefficient is positive and similar with the other periods.

[13] We split sample periods based on the introduction of the WTO, not the GATT, because most economies started following the WTO's rules and regulations in 1995 (124 countries in 1995 and 164 in 2017), prior to the GATT in 1947.

Table 2: Change in real GDP per capita and oil rent (% of GDP) in different sample periods.

	Dependent variable: $\Delta LGDP_{i,t}$		
	1980–1994	1995–2017	1980–2017
	(1)	(2)	(3)
$\Delta LGDP_{i,t-1}$	0.32***	0.36***	0.40***
	(0.04)	(0.02)	(0.01)
	[0.05]	[0.03]	[0.03]
$LOIL_{i,t}$	–0.05*	–0.03*	–0.04***
	(0.03)	(0.01)	(0.01)
	[0.03]	[0.02]	[0.01]
$LUN_{i,t}$	–0.004	–0.002	–0.0007
	(0.004)	(0.002)	(0.001)
	[0.005]	[0.003]	[0.003]
$LFDI_{i,t}$	0.25	–0.001	–0.002
	(0.24)	(0.005)	(0.005)
	[0.23]	[0.004]	[0.004]
$LCAB_{i,t}$	–0.28**	–0.07**	–0.08**
	(0.11)	(0.03)	(0.03)
	[0.22]	[0.04]	[0.04]
$LMI_{i,t}$	–0.04***	–0.01***	–0.01***
	(0.01)	(0.004)	(0.003)
	[0.02]	[0.005]	[0.004]
$LMOR_{i,t}$	–0.00009	0.01***	0.01***
	(0.02)	(0.005)	(0.004)
	[0.02]	[0.005]	[0.004]
$LT_{i,t}$	0.02*	0.01***	0.009**
	(0.01)	(0.004)	(0.003)
	[0.01]	[0.006]	[0.004]
$LT_{i,t}*LOIL_{i,t}$	0.01	0.01***	0.01***
	(0.008)	(0.004)	(0.002)
	[0.008]	[0.005]	[0.003]
R^2	0.15	0.29	0.31
Periods	15	23	38
Countries	57	95	95
Observations	564	1,935	2,499

Note: Standard errors are presented below the corresponding coefficients in the bracket. ***, ** and * indicate the significance at the 1%, 5%, and 10% level respectively. Cluster standard errors are presented in square brackets.

From the above discussion, it is concluded that there is a negative relationship between the oil rent and the change of real GDP per capita; that is, the resource curse. We also provide evidence that trade openness can reduce the resource curse.

6.2. Marginal effect

Marginal effect tells us how the dependent variable changes when a specific explanatory variable change in the regression analysis. In the case of continuous variables, marginal effect measures the instantaneous rate of change. Marginal effect provides a good estimate to the amount of change in the dependent variable that is observed due to a change in the independent variables. In the context of commodity prices and economic growth, marginal effects have been used in the literature. For example, Arezki & Brückner (2012) evaluate the marginal effect of commodity windfalls on net foreign assets. Van der Ploeg (2011) found that marginal effect of natural resources increases economic growth. Brueckner, Norris, & Gradstein (2015) estimate the marginal effect of economic growth on income inequality.

In this study, we compute the marginal effect of oil rent on the change in GDP per capita. Based on the estimates in Table 1, this produced:

$$\frac{d(\Delta LGDP_{i,t})}{d(LOIL_{i,t})} = -0.04 + 0.01\,(trade\ openness) \quad (2)$$

From the above equation, we can see that the marginal effect of oil rent on the change in real GDP per capita is an increasing function of trade openness. Figure 4a plots the marginal effect, $\frac{d(\Delta LGDP_{i,t})}{d(LOIL_{i,t})}$, on the Y-axis and trade openness on the X-axis. From this plot, we can observe that the marginal effect of the oil rent on economic growth is an increasing function of trade openness in the full sample period. We also observe from Figure 4a that this effect becomes positive and significant with higher trade openness. In Figures 4b and 4c, we present the marginal effect of trade openness on GDP for the sample period 1980–1994 and 1995–2017 respectively, and we observe that in the sample period 1980–1994 there is no significant impact of trade openness on GDP. So, the results in the sample period 1995–2017 led to the results for the full sample period.[14]

Figure 4a: Marginal effect of oil rent on economic growth (full sample period 1980–2017)

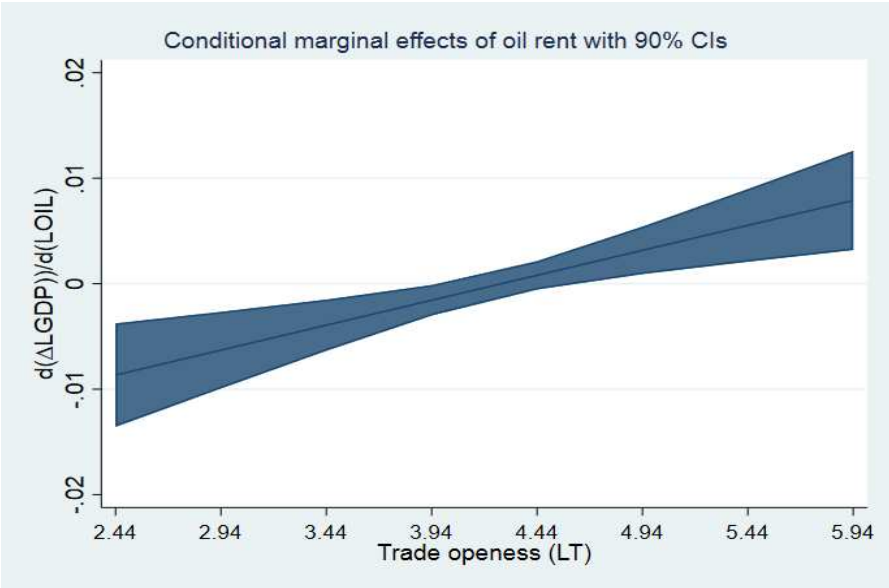
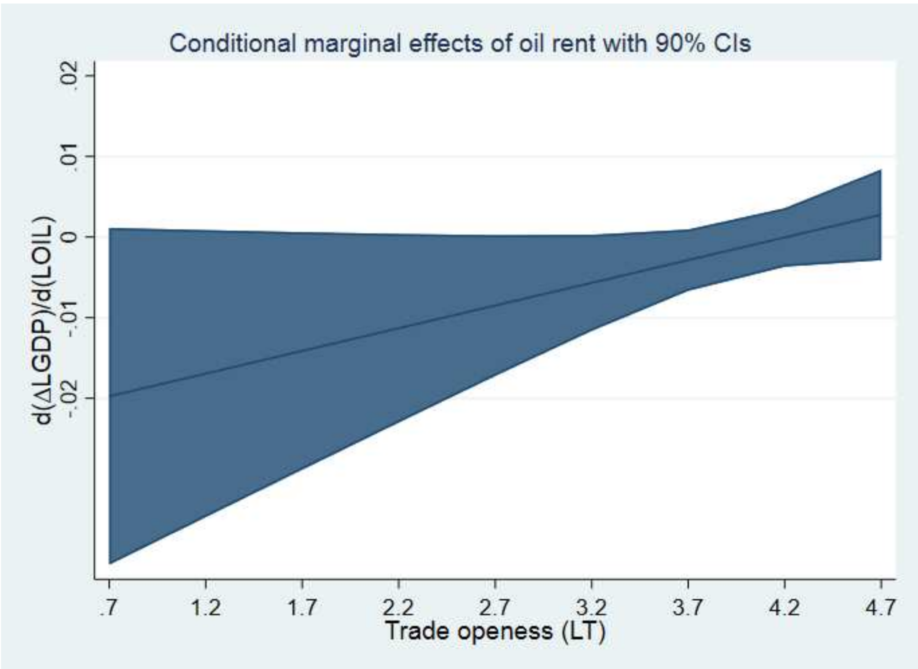
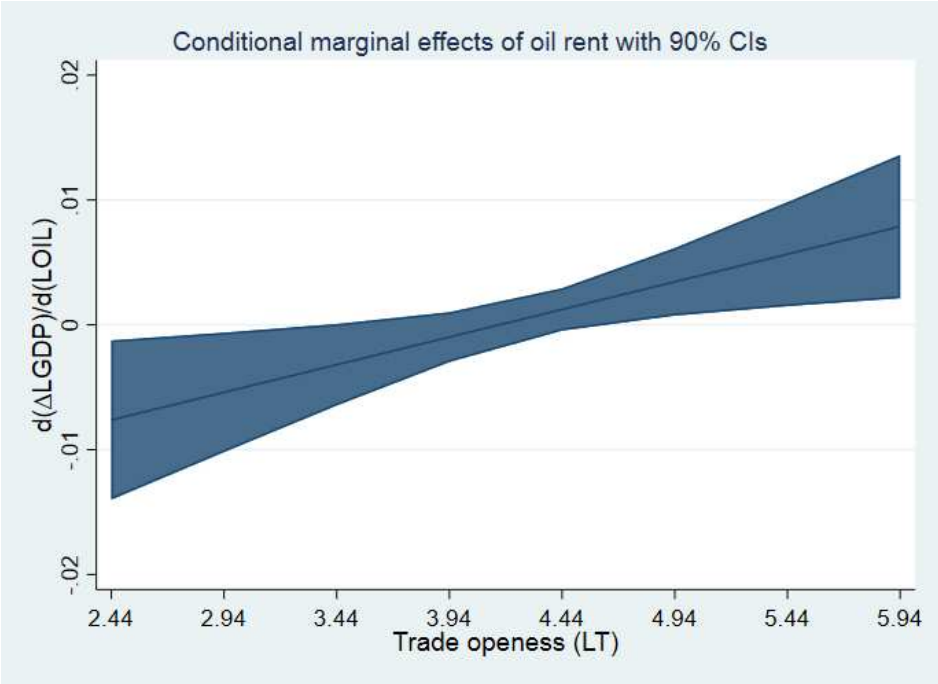


Figure 4b: Marginal effect of oil rent on economic growth (sample period 1980–1994)



[14] The figures of all robust analysis are presented in online Appendix C (Figures C1, C2, C3, C4, and C5).

Figure 4c: Marginal effect of oil rent on economic growth (sample period 1995–2017)



6.3. Robustness results

To check the robustness of the results, we use two alternative measures of trade openness—exports (% of GDP) and imports (% of GDP).[15] Our empirical findings show that the resource curse reduces with the increase of both exports and imports. With the increase of exports, economies can gain access to international prices and earn more revenue from royalties, thereby increasing real GDP per capita. On the other hand, countries can import advance technologies to more efficiently extract oil resources and/or produce final products to earn more revenue that increases real GDP per capita. For further robustness, we use natural resource rent (% of GDP) instead of oil rent (% of GDP) as a measure of resource abundance and find similar results.[16] All robustness findings are presented in Tables B1–B5 in online Appendix B. We

[15] Exports (% of GDP) and Imports (% of GDP) represent the value of all goods and services provided and received to and from the rest of the world respectively.

[16] Natural resource rent (% of GDP) is the sum of oil rents, natural gas rents, coal rents, mineral rents and forest rents. Data for Exports (% of GDP), Imports (% of GDP) and natural resource rent (% of GDP) are collected from the WDI of the WB.

also use a dummy variable that contains the value 1 for the years following the establishment of the WTO and, 0 otherwise in the regression but not shown in the Tables.

6.3.1 The Mediation Model

To identify trade openness as a channel of mitigating the resource curse, we further use a structural equation model. In particular, we follow Powdthavee and Wooden (2015) methodology (mediation model) but in a different context; to identify the direct and indirect effects of oil rent on GDP growth through the trade openness. Table 3 presents the direct and indirect effects of oil rent on GDP growth.[17] The coefficient of oil rent is - 0.003 in case of direct effect. In terms of the indirect effect, when oil rent effects GDP growth through the trade openness, the coefficient is - 0.0007 which is lower than the direct effect. Our empirical findings indicate that the adverse impact of oil rent on GDP growth decreases with the presence of trade openness supporting our hypothesis that trade openness reduces the oil resource curse.

Table 3: Estimated direct and indirect effects of oil rent on GDP growth through the trade openness

Variable	GDP growth		
	Direct	Indirect	Total
Oil rent	- 0.003***	- 0.0007***	- 0.004***
	(0.008)	(0.0001)	(0.0008)

Note: Standard errors are presented below the corresponding coefficients in the bracket. ***, ** and * indicate the significance at the 1%, 5%, and 10% level respectively.

6.4. Discussion of the results

Overall, the panel data regression models suggest that having an abundance of oil resources plays a significant role in slowing economic growth—that is, it serves as a resource curse. Many reasons have been put forward in the literature for this surprising result, including rent-seeking behaviour, poor institutional quality, commodity price volatility and lack of

[17] Although we are calling the product of two coefficients the ‘indirect effect’, it is nothing more than just a simple indirect association between oil rent and GDP growth via a mediating variable namely trade openness. It does not imply any causality.

diversification. In this study, we investigated the impact of trade openness in reducing the resource curse. Our empirical findings show that trade openness significantly decreases the resource curse in our full sample period (1980–2017). More open trade policies provide access to advanced technologies that increase efficiency by reallocating the factors of production. These trade policies also facilitate access to large markets where increasing competition drives innovations and strengthens managerial skills which in turn generates substantial economic growth. Accordingly, Arezki and Van der Ploeg (2011) report that the resource curse has turned into a blessing in countries with a high degree of trade openness such as Australia, Bolivia, Barbados, Canada, Chile, Malaysia and the United States.

To understand the role of the WTO in increasing merchandise trade, we split our sample period into two subsample periods, 1980–1994 (pre-WTO) and 1995–2017 (post-WTO). Our empirical findings suggest that trade openness had a significant impact on reducing the resource curse for the sample period 1995–2017. However, there was no significant effect for the sample period 1980–1994, possibly due to the fact that total merchandise trade increased after the commencement of the WTO in 1995, which helped to weaken the strength of the dynamics driving the resource curse.

Overall, based on our empirical findings, we can argue that outward-looking trade policy is helpful for economic growth and reduces the risk of experiencing the resource curse. Therefore, policymakers should concentrate on how they can make the economy more open by reducing existing tariffs and non-tariff barriers. Increased international trade (both export and import) helps economies to be more efficient by enabling the adoption of new technologies and sharing of advanced knowledge which generates long-run economic growth.

7. Conclusion

This study aims to revisit the resource curse paradox and examines the role of trade openness in reducing the resource curse. Using different dynamic panel data models for 95 countries for the period 1980–2017, this study finds that economic growth decreases with the increase of oil resource abundance. A one per cent increase in oil rent causes a 0.04 per cent decrease in real GDP per capita. Although our empirical findings support the resource curse hypothesis, the study finds that trade openness is a possible channel to reduce the resource curse. On average, trade openness reduces the negative effect of oil rent on real GDP per capita by 25%. Trade openness allows countries to obtain competitive prices for their resources in the international market and access advanced technologies to more efficiently extract resources. We also find that trade openness significantly affects the resource curse after the introduction of the WTO. An important policy implication is that natural resource–rich economies that want to reduce the resource curse should consider further opening their economies.

The policy implications of this study are that international trade policies that promote trade openness (such as, tariff reduction or free trade agreements) reduces the oil curse. Our study shows that around 25% of the decline in GDP per capita caused by the oil curse can be mitigated by trade opening policies. In this regard policies adopted from WTO since 1995 has had a significant impact on reducing the oil curse.

This study can be extended by focusing on other possible transmission channels of the resource curse such as income inequality. According to Fum and Hodler (2010) and Parcero and Papyrakis (2016), income inequality is high in resource-rich countries, especially those with point-source resources. One reason is that inefficient allocation of resources among sectors increases income inequality. Trade openness plays an important role in reallocating resources in the sectors where a country has a comparative advantage. This efficient distribution of resources helps to reduce income inequality in resource-rich countries and, thus, spurs economic growth.

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Appendix A

Table A1: Description of the variables

Variables	Mnemonic	Description	Source
Dependent variable			
Real GDP per capita	$LGDP_{i,t}$	GDP per capita is gross domestic product divided by mid-year population. Data are in constant 2010 US dollars.	WDI, WB
Control variables			
Oil rents (% of GDP)	$LOIL_{i,t}$	Oil rents are the difference between the value of crude oil production at regional prices and total costs of production. We add 1 before converting into logarithmic form.	WDI, WB
Unemployment rate (% of total labour force)	$LUN_{i,t}$	Unemployment rate can be defined by the OECD harmonised definition. The OECD harmonised unemployment rate gives the number of unemployed persons as a percentage of the labour force.	World Economic Outlook, IMF
Foreign direct investment, net outflows (% of GDP)	$LFDI_{i,t}$	Foreign direct investment refers to direct investment equity flows in an economy. This data series shows net outflows of investment from the reporting economy to the rest of the world and is divided by GDP. We add 100 before converting into logarithmic form.	WDI, WB
Current account balance (% of GDP)	$LCAB_{i,t}$	Current account balance is the sum of net exports of goods and services, net primary income and net secondary income. We add 250 to convert logarithmic form.	WDI, WB
Military expense (% of GDP)	$LMI_{i,t}$	Military expenditures data from SIPRI are derived from the NATO definition, which includes all current and capital expenditures on the armed forces. We add 1 to convert logarithmic form.	WDI, WB
Mortality rate, infant (per 1,000 live births)	$LMOR_{i,t}$	Infant mortality rate is the number of infants dying before reaching one year of age, per 1,000 live births in a given year.	WDI, WB
Trade openness (% of GDP)	$LT_{i,t}$	Trade is the sum of exports and imports of goods and services measured as a share of GDP.	WDI, WB

Note: We use first difference to get the data in stationary in real GDP per capita series and expressed as $\Delta LGDP_{i,t}$.

Table A2: List of countries (n = 95)

Albania	China	Indonesia	Mexico	Serbia
Algeria	Colombia	Iran	Moldova	Seychelles
Argentina	Costa Rica	Irelands	Mongolia	Singapore
Armenia	Croatia	Israel	Morocco	Slovak Rep.
Australia	Cyprus	Italy	Netherlands	Slovenia
Austria	Czech Rep.	Jamaica	New Zealand	South Africa
Azerbaijan	Denmark	Japan	Nicaragua	Spain
Bahrain	Dominican Rep.	Jordan	Nigeria	Sri Lanka
Belarus	Ecuador	Kazakhstan	Norway	Sweden
Belgium	Egypt, Arab Rep.	Korea, Rep.	Pakistan	Switzerland
Belize	El Salvador	Kuwait	Panama	Thailand
Bolivia	Estonia	Kyrgyz Rep.	Paraguay	Tunisia
Bosnia & Herzegovina	Finland	Latvia	Peru	Turkey
Brazil	France	Lithuania	Philippines	Ukraine
Brunei Darussalam	Georgia	Luxemburg	Poland	The UK
Bulgaria	Germany	Macedonia, North	Portugal	The USA
Cabo Verde	Greece	Malaysia	Romania	Uruguay
Canada	Honduras	Malta	Russian Federation	Venezuela
Chile	Hungary	Mauritius	Saudi Arabia	Vietnam

Table A3: Unit root test

	Im, Pesaran and Shin W-stat				Levin, Lin & Chu t*			
	At level		1st difference		At level		1st difference	
	statistics	*p*-value	statistics	*p*-value	statistics	*p*-value	statistics	*p*-value
$LGDP_{i,t}$	5.58	0.99	-25.43	0.00	-3.18	0.00	-	-
$LOIL_{i,t}$	-33.10	0.00	-	-	-102.41	0.00	-	-
$LUN_{i,t}$	-6.78	0.00	-	-	-6.78	0.00	-	-
$LFDI_{i,t}$	-11.55	0.00	-	-	-6.71	0.00	-	-
$LCAB_{i,t}$	-9.97	0.00	-	-	-7.49	0.00	-	-
$LMI_{i,t}$	-1.96	0.02	-	-	-5.28	0.00	-	-
$LMOR_{i,t}$	-2.5	0.00		--	-6.92	0.00	-	-
$LT_{i,t}$	-3.60	0.00	-	-	-5.21	0.00	-	-

Note: $LGDP_{i,t}$ = Log of real GDP per capita, $LOIL_{i,t}$ = Log of oil rent, $LUN_{i,t}$ = Log of unemployment rate, $LFDI_{i,t}$= Log of foreign direct investment, $LCAB_{i,t}$ = Log of current account balance, $LMI_{i,t}$= Log of military expense, $LMOR_{i,t}$ = Log of mortality rate, $LT_{i,t}$ = Log of trade openness.

Table A4: Descriptive statistics

	$\Delta LGDP_{i,t}$	$LOIL_{i,t}$	$LUN_{i,t}$	$LFDI_{i,t}$	$LCAB_{i,t}$	$LMI_{i,t}$	$LMOR_{i,t}$	$LT_{i,t}$
Mean	0.02	0.56	1.98	4.62	5.51	1.06	2.41	4.29
Median	0.02	0.04	2.01	4.61	5.51	1.02	2.39	4.28
Maximum	0.28	4.13	3.61	5.76	5.68	3.05	4.76	6.08
Minimum	–0.18	0.000	–3.68	2.33	5.32	0.00	0.53	2.44
Std. Dev.	0.03	0.90	0.64	0.11	0.02	0.46	0.87	0.56
Skewness	–0.35	1.83	–0.80	–5.42	0.62	0.54	0.17	0.11
Kurtosis	7.28	5.66	6.50	162.17	9.06	4.11	2.29	3.54
Observations	2506	2506	2506	2506	2506	2506	2506	2506

Note: $\Delta LGDP_{i,t}$ = Change in log of real GDP per capita, $LOIL_{i,t}$ = Log of oil rent, $LUN_{i,t}$ = Log of unemployment rate, $LFDI_{i,t}$ = Log of foreign direct investment, $LCAB_{i,t}$ = Log of current account balance, $LMI_{i,t}$ = Log of military expense, $LMOR_{i,t}$ = Log of mortality rate, $LT_{i,t}$ = Log of trade openness.

Table A5: Correlation matrix

	$\Delta LGDP_{i,t}$	$LOIL_{i,t}$	$LUN_{i,t}$	$LFDI_{i,t}$	$LCAB_{i,t}$	$LMI_{i,t}$	$LMOR_{i,t}$	$LT_{i,t}$
$\Delta LGDP_{i,t}$	1.00							
$LOIL_{i,t}$	–0.02	1.00						
$LUN_{i,t}$	–0.03	–0.14	1.00					
$LFDI_{i,t}$	0.008	–0.01	–0.04	1.00				
$LCAB_{i,t}$	–0.09	0.36	–0.26	0.07	1.00			
$LMI_{i,t}$	–0.06	0.18	–0.02	–0.02	0.15	1.00		
$LMOR_{i,t}$	0.04	0.28	0.17	–0.14	–0.20	0.09	1.00	
$LT_{i,t}$	0.13	–0.16	–0.17	0.09	0.06	–0.19	–0.32	1.00

Note: $\Delta LGDP_{i,t}$ = Change in log of real GDP per capita, $LOIL_{i,t}$ = Log of oil rent, $LUN_{i,t}$ = Log of unemployment rate, $LFDI_{i,t}$ = Log of foreign direct investment, $LCAB_{i,t}$ = Log of current account balance, $LMI_{i,t}$ = Log of military expense, $LMOR_{i,t}$ = Log of mortality rate, $LT_{i,t}$ = Log of trade openness.