Fuelling Growth or Stalling Prosperity? The Impact of Oil Price Fluctuations on Economic Growth in Net Oil-Exporting Countries

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Abstract

This dissertation examines the impacts of oil price fluctuations on economic growth for 15 net oil-exporting countries over a 40-year period from 1980-2019. The 15 countries are split into 2 samples; 8 OPEC developing countries with high dependence on oil and 7 non-OPEC developed countries with low dependence on oil. The aim of this is to investigate whether high dependence on oil leads to larger fluctuations in economic growth. It is hypothesised that the overall impact of an oil price increase on economic growth in net oil-exporting countries will be positive and significant, but the impact will be larger in those countries with higher dependence on oil. The natural logarithm of GDP/capita is the dependent variable used as a proxy for economic growth and the natural logarithm of global crude oil prices is the main independent variable. Various control variables used are exports, government spending, FDI inflows and oil rents all as a percentage of GDP. A panel fixed effects methodology is employed to capture the time-invariant differences that change across countries and impact GDP/capita. This specification controls for unobserved heterogeneity between the sample countries by assuming different intercepts for each country. The main result of this study is that oil price increases have a statistically significant positive effect on economic growth in all net oil-exporting countries in the sample between 1980-2019. The results show that countries with a higher dependence on oil will see larger fluctuations in economic growth because of an oil price increase; for high dependence countries a 1% increase in global crude oil price leads to a 0.158% increase in GDP/capita, whereas for low dependence countries a 1% increase in global crude oil price leads to a 0.107% increase in GDP/capita. This indicates the potential volatility in economic growth that can be experienced, because of large oil price fluctuations, in net oil-exporters with high dependence on oil. The findings of this paper may encourage policymakers in high dependence countries to moderate their reliance on oil by diversifying their economies, growing alternative sectors, and investing oil revenues in diversified portfolios so oil price fluctuations have a lesser bearing on economic growth. All net oil-exporting countries can use the results from this paper to understand that current/future oil prices should be considered when deciding on whether expansionary/contractionary policies will be pursued.

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1. Introduction

Crude oil is the most traded commodity globally making up 15% of the entire global commodity market (eToro, 2024), with 101.8 million barrels/day being produced in 2023 (EIA, 2023). It is pivotal for the efficient functioning of the industrialised global economy; it is an important source of income for many countries and an important input-factor of production for others. Oil prices have been subject to large fluctuations since the first major movements in the 1970's. The World Bank (WB, 2023) reports that world crude oil hit record high prices of over $105/barrel in 2012 after the Financial Crisis before plummeting to $43/barrel in 2016 due to excess supply of OPEC. A more recent sharp rise in oil prices in 2022 has meant they returned close to historical highs at $97/barrel due to the Russian invasion of Ukraine. Clearly, the inherent volatility of oil prices will play a significant role in the growth of economies.

Changes in oil prices impact different countries in different ways; net oil-exporters, who are richly endowed with oil, will likely be impacted positively by oil price increases due to higher energy export revenues and hence higher tax revenues. Whereas net-oil importers, who are scarcely endowed with oil, are impacted negatively due to oil price rises impacting their production costs and hence price levels (Alekhina & Yoshino, 2018). The focus of this paper will be on net oil-exporting countries.

This paper will add to the literature by examining whether one's relative dependence on oil results in oil price changes having differing effects on economic growth. Oil rich countries with poorly diversified economies who depend largely on oil as a proportion of GDP, typically developing countries, can suffer from what is known as the 'Resource Curse'. This depicts a negative relationship between high reliance on oil and economic growth as these countries may benefit from oil price increases, but the consequences of oil price decreases will be much more severe. Net oil-exporting countries with a lower dependence on oil typically have many other strong industries unrelated to oil which means they are less affected by the resource curse.

The complex nature of the relationship between economic growth, oil prices and relative oil dependence in net oil-exporting countries will be explored further in this paper. It will use panel data analysis and various other econometric techniques to do so. This dissertation hypothesises that oil prices have a statistically significant positive effect on economic growth in all net oil-exporting countries, however the impact will be larger in those countries with a higher dependence on oil. That higher dependence may however pose problems for developing countries when oil prices fall.

1.1 Oil Price Fluctuations Over Time

Figure 1 – Nominal/Real World Oil Prices in 2017 US$ **(Source – (WB, 2023) & (BLS, 2023))**

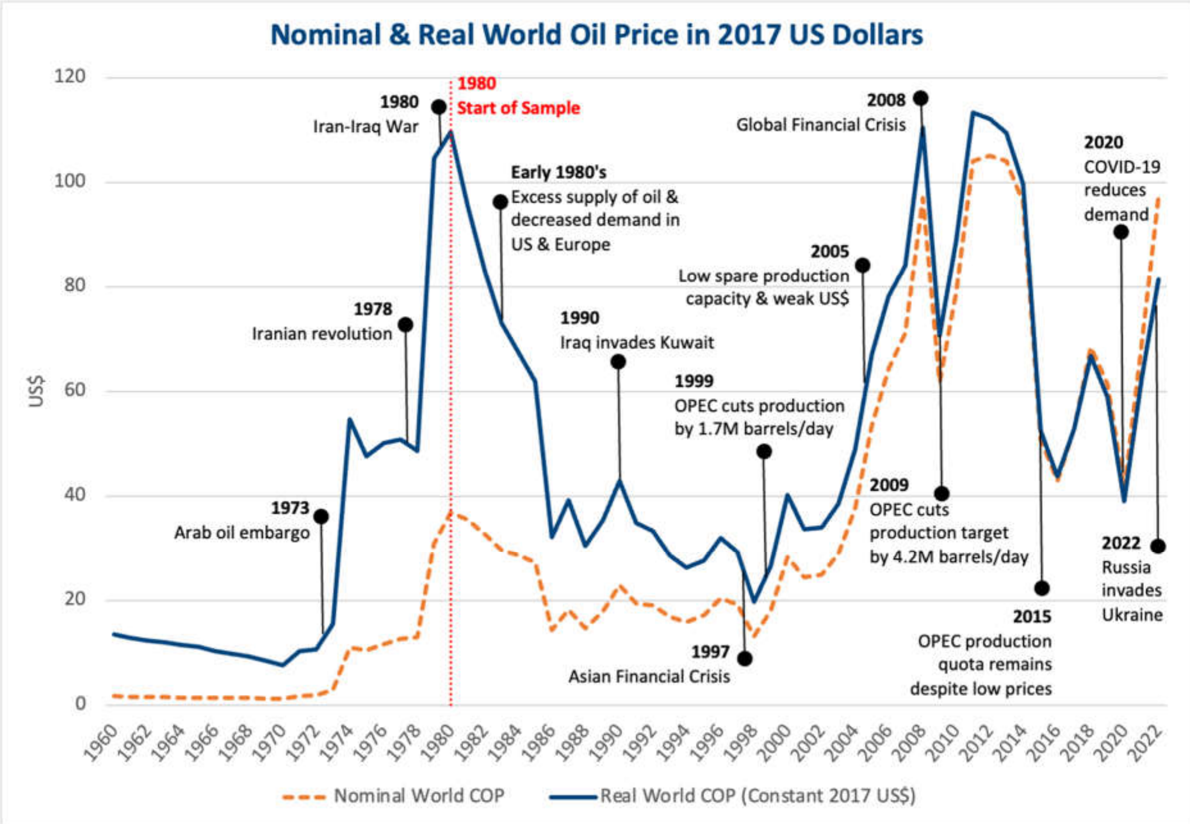


Figure 1 shows the volatility of oil prices, illustrating how much they have changed over time. This is because oil supply and demand are highly price inelastic, meaning small fluctuations in price do not affect supply and demand.

The first oil price shock of 1973, when OPEC placed an oil embargo on the US and other western countries, caused oil price to rise by around 360% and resulted in a global recession. This was the first pillar for OPEC countries to realize that oil could be used as both a political and economic tool (Kutalu, 2015). The Iranian Revolution followed by the Iran-Iraq war amplified the price increase, it was only after a fall in demand across Europe that oil prices stabilised in 1986.

The Asian Financial Crisis of 1997 caused a drop in oil price from around $20/barrel to $13/barrel due to decreased global demand, however after the global recovery oil prices grew once again. Globalisation and industrialisation then accelerated pulling up global oil prices until they reached their peak in 2008 at $97/barrel. The Global Financial Crisis, however, caused the quickest oil crash ever seen where prices fell to $42/barrel. Oil prices did recover in 2012, in line with the global economy, however excess supply and the refusal of OPEC to cut production meant prices fell sharply again in 2015. Recently there has been large fluctuations in oil price due to the 2020 COVID-19 pandemic which caused oil prices to plummet from decreased demand, then the 2022 Russian invasion of Ukraine which resulted in large price rises to hedge against potential supply disruptions.

1.2 Influential Factors Behind Oil Price Fluctuations

OPEC Production & Policy
The Organisation of the Petroleum Exporting Countries (OPEC) was formed in 1960 and currently holds 79.5% of the worlds discovered oil reserves and controls 39.7% of the world's oil production (OPEC, 2023). There are 12 member countries; Alegria, Congo, Equatorial Guinea, Gabon, Iran, Iraq, Kuwait, Libya, Nigeria, Saudi Arabia, UAE & Venezuela, which are considered an imperfect cartel by many despite their aim to create a stable oil market (Okullo, 2016). Due to their large market share, OPEC's production levels and trade policy have been found to significantly impact oil supply and hence price. Uncertainty around OPEC's future production also increases risk premiums causing oil price rises.

Global Supply
Despite the production of OPEC, other large producers of oil play a part in determining the price of oil. An increase in oil supply will lead to a lower price, in line with economic theory. As oil is a non-renewable resource, there must be investment in exploration/production and technology to improve the efficiency of the extraction process to keep up with growth in global demand. Recent advancements such as fracking have unlocked previously economically infeasible reserves, substantially increasing the global supply of oil.

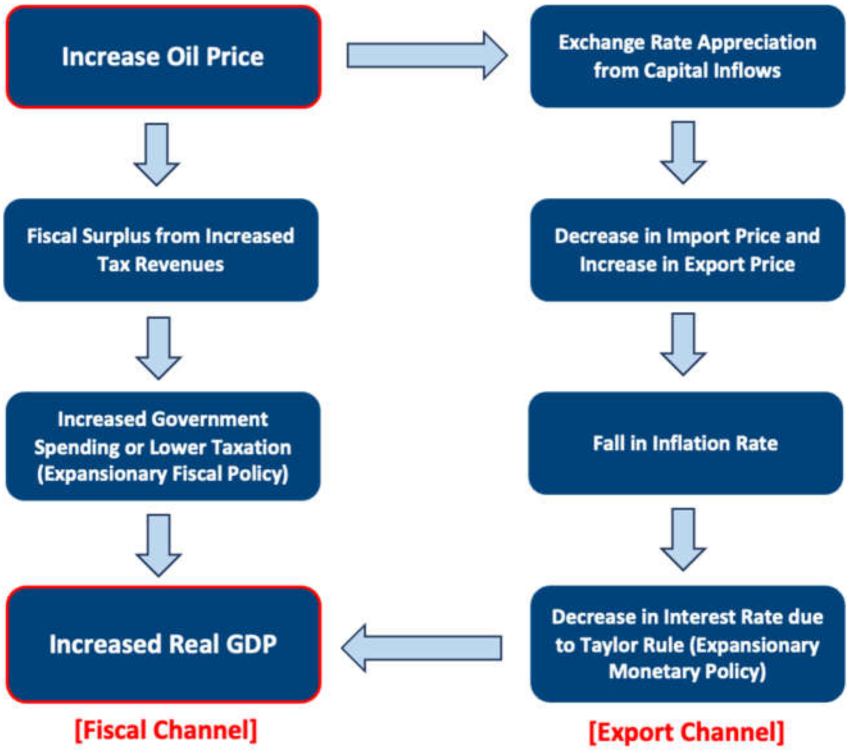
Global Economic Growth & Demand
Oil prices are directly affected by global demand, shown by economic theory & historical trends. In the early 2000's, when the world experienced rapid economic growth and development, there was a large increase in oil price to fuel the expansion of newly industrialised economies. However, when growth stagnated and demand began to fall after the 2008 recession oil prices fell, illustrating the link between global demand and oil price fluctuations.

Financial Markets Speculation & Currency Fluctuations
Many investors/traders speculate on the oil market, trading oil futures contracts based on their own assumptions about demand/supply conditions, economic fluctuations, and geopolitical news. This influences short-term oil price movements as futures act as a benchmark for current prices. Also, as oil prices are denominated in US$, fluctuations in the value of the dollar can impact the affordability of oil for foreign buyers and profits of producers.

Geopolitical Tensions
Many worldwide oil reserves sit in turbulent political areas such as Russia, Iran/Iraq & Venezuela. Tensions in these countries can impact oil price. Their trade policy can also be combative such that oil production benefits themselves, this all adds a risk premium which increases the price of oil.

1.3 Transmission Mechanisms from Oil Price Changes to Economic Growth

Figure 2 – Transmission Pathway of Oil Prices to Oil-Exporting Economy



As outlined by Alkehina & Yoshino (2018), there are two main transmission mechanisms from an increase in oil prices to an increase in economic growth for net oil-exporting countries. Figure 2 illustrates these as the fiscal and export channels. The fiscal channel states that an increase in oil price will lead to higher tax revenue due to energy exports being highly taxed, hence the government will see an improvement in their fiscal position. This will allow more headroom for expansionary fiscal policy which in turn will increase economic growth.

The export channel states that when oil prices increase, the exporting country experiences a greater capital inflow of foreign currency. This leads to domestic exchange rate appreciation causing a rise in export prices and fall in import prices. Import goods usually make up a large proportion of consumption, so the fall in price will lead to a fall in inflation. The Taylor Rule suggests that after a fall in inflation the monetary policy response will be to reduce interest rates, which again leads to an increase in GDP (SIEPR, 2023).

2. Literature Review

The first oil shocks of 1973 and 1978 cemented oil as the most important global commodity, the potential that changes in its price could impact economies became of interest to economists who began to conduct studies to understand the relationship between oil prices and economic growth.

Early research into this field was first pioneered by Hamilton (1983), who illustrated the importance of oil price changes on the US economy. His research responded to the large and persistent oil shocks of 1973/1978, where reductions in oil supply caused upward price shocks. Hamilton (1983) suggested seven of eight post-war recessions in the US, between 1948-1980, had been preceded by dramatic increases in oil price. Using Granger Causality analysis, he accepted the null hypothesis that oil prices cause GDP fluctuations, establishing a link between oil prices and US GDP. Gisser & Goodwin (1986) endorsed Hamilton's research, finding that oil prices have a significant impact on a range of macroeconomic indicators, particularly growth and inflation in the US economy. Further research conducted by Mork (1989) expanded Hamilton's findings. It was stated that Hamilton's initial research pertained to a period where all oil price movements were upwards, so this paper extended to a period of oil price collapse. Mork used a vector autoregressive (VAR) model to confirm that Hamilton's conclusions persisted in longer samples, but found evidence of an asymmetric relationship, where the relationship with price decreases was different and not significantly different from zero.

Hooker (1996) opposed the initial research and found oil prices Granger cause variation in a range of US macroeconomic indicators to 1973, but thereafter the relationship wasn't robust, particularly from 1985. However, a paper by Hamilton (2003) disproved Hooker's claims, considering misspecification in Hooker's functional form and establishing a non-linear relationship using a structural vector autoregressive (SVAR) model, capturing the dynamics of the oil market. He emphasised the asymmetric relationship and stated oil price increases are more important than oil price decreases, increases also have significantly less impact on indicators if they correct earlier decreases. The early research clearly focussed on the US (net oil-importer) and illustrated a statistically significant link between oil price shocks and economic growth.

The next strand of literature introduced panel analysis, expanding the research to groups of developed OECD countries, to investigate whether the relationship held for wider samples. Mork (1994) examined 7 oil-importing OECD countries monthly from the mid-1970s to early-1990s using a VAR model and determined a significant and negative relationship between oil price increases and GDP. This relationship, however, wasn't uniform across countries, particularly Norway, whose oil-producing sector was large. His research showed that oil prices significantly impact business cycles, which will persist whenever oil is a major energy source. Jimenez-Rodriguez & Sanchez (2005) analysed a larger sample of countries using a multivariate VAR model. They found that oil price increases have a significant impact on GDP growth to a larger magnitude than oil price decreases, with decreases being insignificant. Granger-causality analysis showed significance in the interaction between oil and macroeconomic variables. Both papers above found evidence of the asymmetric effects earlier outlined by Mork (1989) and Hamilton (2003), confirming its existence.

In the same strand of literature, Barsky & Killian (2004) used a SVAR model to show that oil price increases derived from supply shocks have significant negative effects on GDP in oil-importing countries. They found oil shocks can contribute to recessions without being pivotal, an alternative viewpoint to the initial literature by Hamilton. Blanchard & Gali (2007) compared the impacts of oil price shocks in industrialised economies in the 1970s to the same countries in the 2000s using a SVAR model. They found that there was a dampening of the relationship between GDP and oil price over time, improved conduct of monetary policy in industrialised economies was the main driver.

More recent literature was sparked by a renewed interest in the topic due to the sharp oil price increases in the early 2000s and then immediate drop in 2008 propagated by the Great Recession (WB, 2023). The research developed into investigating different subsets of countries, particularly developed/developing and net oil-importer/oil-exporter. Taghizadeh-Hesary (2017) used a simultaneous equation model through a weighted two-stage least squares method to investigate 21 countries quarterly over a 15-year period. They found oil-exporters consistently benefit from oil price increases, whereas oil-importers experience negative supply shocks. A study by Gonzalez (2009) found that the magnitude of impact of oil price shocks on GDP growth depends on the share oil has on overall energy production. Sweden, an economy with low dependence on oil, didn't show any correlation between GDP growth and oil price increases, whereas USA, the largest oil consumer, was sensitive to oil price increases. Rentschler (2013) endorsed this work stating an economy that heavily depends on oil trade will see larger effects of oil price changes.

Nguyen (2020) looked at the issue from a different perspective and found an increase in uncertainty in oil prices has a significantly negative effect on real GDP and stock market returns in Vietnam. The analysis of Rentschler (2013) reinforces this by using a VAR model to conclude higher volatility of oil prices has negative impacts on the economic growth of a range of oil-importing and exporting countries. Although these are important findings, there's a pivotal distinction between oil price volatility and oil price fluctuations. Oil price volatility measures day-to-day percentage difference in oil prices and is beyond the scope of this paper; the focus will remain on oil price fluctuations throughout.

The most recent literature has progressed to having maintained focus on net oil-exporting countries. Research has broadened to developing oil-exporting countries, providing valuable insights for a wider range of counties. Many of these studies bring to light a positive relationship between oil prices and economic growth. Bolganbayev (2021) used panel dynamic least squares methods for 4 oil-exporting countries bordering the Caspian Sea between 2007-2020 and found a significant positive long-term relationship between oil price and economic growth. They show a 1% increase in oil price causes a 0.69% increase in economic growth. Berument (2010) used a VAR model to show that a one standard deviation upward shock in oil prices has a statistically significant and positive effect on growth in MENA oil-exporting countries, from the 1970s-2000s. Alkehina & Yoshino (2018) studied a single non-OPEC oil-exporter monthly between 1993-2016 using a VAR model and the Taylor Rule equation. They found increased oil prices positively affect real GDP growth, particularly oil price increases from 1999. They highlighted the importance of considering unexpected oil shocks when setting monetary policies.

Moshiri (2015) contradicted the above research, finding an asymmetric relationship. They examined 9 significant oil-exporting countries (6 developing and 3 developed) between 1970-2010 using a VAR model. They state that lower oil prices lead to revenue reductions and stagnation but increasing oil prices and subsequent higher revenues don't result in sustained economic growth, all effects of oil price changes are insignificant in developed economies. They conclude that reactions of economies to oil price shocks are heterogeneous, explained by differences in institutional quality, particularly government effectiveness.

Research from Santillán-Salgado & Venegas-Martínez (2015) opposed that of Moshiri using a Fixed Effects method to capture idiosyncratic differences and omitted variables by allowing different intercepts for each economy. Their analysis of Latin American oil-exporting economies between 1990-2004 illustrated no asymmetric effects, showing that countries benefit when prices increase, and output growth diminishes when there's a downturn. This approach captured unobservable components that change across time/country and impact GDP growth, reasoning why this method will be used in this paper. Ahmadi & Manera (2021) applied a Threshold Structural VAR on a sample of oil-exporting countries also finding little evidence of asymmetric responses of output to the direction of oil price shocks. The two papers suggest that the relationship between oil price changes and GDP growth is positive and significant but is dependent on the: underlying cause of the shock, state of the economy and relative importance of the oil industry.

Using World Bank (World Development Indicators) & International Monetary Fund (International Financial Statistics) data, Boheman & Maxen (2015) conducted a study on developing net oil-exporting countries, all of whom were highly dependent on oil revenues, from 1980-2008. They focussed on OPEC and non-OPEC countries by using two separate unrestricted bivariate VARs. Their results show a 1% increase in the change of oil price increases GDP growth rate by 0.145% (OPEC) against 0.141% (non-OPEC). Boheman also found, in OPEC countries', 2.82% of the variation in growth rate is explained by oil price shocks, and 2.81% in non-OPEC countries, suggesting both samples see almost equal variation in GDP due to oil price shocks. The use of a VAR in most papers is efficient because of the optimal choice of lag length by the authors, however this model and lag length selection is beyond the scope of this paper. The research in this paper will extend Boheman's study by looking at the difference in impact on GDP growth due to relative dependence on oil not just classification of OPEC/non-OPEC.

Evidently, the literature in this field has progressed a long way since the pioneering research of Hamilton. There remains to be a conclusive view of the impact of oil price changes on economic growth, however, as presented, the majority of the literature points towards a positive relationship between oil prices and economic growth in net oil-exporting countries, aligning with the hypothesis of this paper. Various studies dispute the existence of an asymmetric relationship in oil-exporting countries. The focus of many papers is on a subset of either developed or developing countries, however, to fill a gap in the literature, the analysis in this paper will study oil-exporting countries categorised by their relative dependence on oil as a percentage of GDP. It will discuss, using a panel fixed effects method (in line with Santillán-

Salgado & Venegas-Martínez (2015)), whether countries with a higher dependence on oil see larger fluctuations in GDP after oil price changes.

3. Data

3.1 Panel Data Collection

Secondary market data is drawn from the World Bank, Penn World Tables & Bureau of Labour Statistics; all of which are regarded as highly credible economic data sources. The data is collected on an annual basis from 1980-2019 for 15 countries, totalling 600 observations creating a balanced panel dataset. To accurately answer the research question, the dataset is split into 2 samples based on the country's relative dependence on oil. It is assumed a country with average oil rents of over 10% across the time-series is a high dependence country. The high dependence sample is composed of 8 countries (320 observations) and the low dependence sample is composed of 7 countries (280 observations). All countries in the sample are net oil-exporters across the time-series.

The timeframe of 1980-2019 was chosen as data availability pre-1980 was limited for the chosen sample, this period ensured uniformity of the data. Although more data was available from 2019 onwards, this was excluded from the analysis due to abnormally large price fluctuations inducing significant outliners.

3.2 Selection of Countries

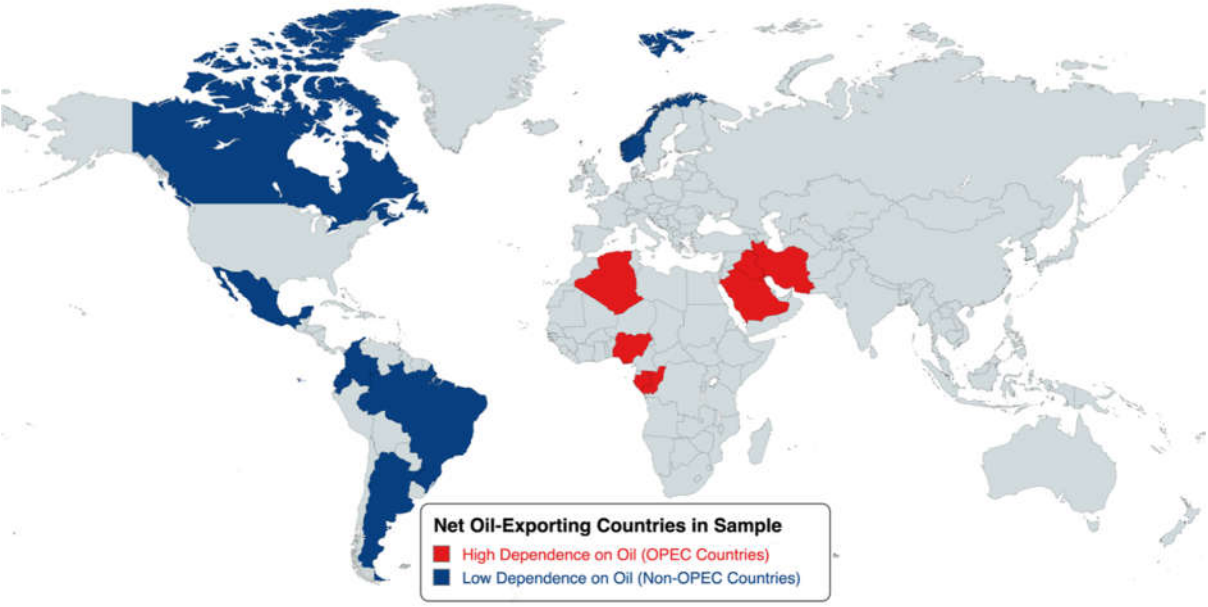
One of the objectives of this paper is to understand whether higher dependence on oil leads to larger fluctuations in GDP, hence, the sample is split by relative dependence on oil. Table 1 shows the 8 countries with high dependence on oil, all of which are OPEC countries, have an average oil rent of 27.65%. The 7 countries with low dependence on oil, all of which non-OPEC countries, have an average oil rent of 4.01%. Oil revenues account for over a quarter of the OPEC samples GDPs on average, compared to less than 5% in the non-OPEC sample, illustrating the rationale for comparing these countries to answer the research question.

Table 1 – Average Oil Rents of all Sample Countries from 1980-2019

OPEC Countries	Average Oil Rent (% of GDP)	Non-OPEC Countries	Average Oil Rent (% of GDP)
Algeria	17.33%	Argentina	2.29%
Congo Rep.	30.88%	Brazil	1.24%
Gabon	24.28%	Canada	1.44%
Iran	20.79%	Columbia	3.63%
Iraq	39.18%	Ecuador	9.15%
Kuwait	40.72%	Mexico	4.52%
Nigeria	12.18%	Norway	5.78%
Saudi Arabia	35.80%	-	-
Average	**27.65%**	**Average**	**4.01%**

The sample doesn't include all OPEC countries; Angola, Equatorial Guinea, Libya, UAE & Venezuela lacked sufficient data so ultimately weren't included. Additional non-OPEC countries were considered (i.e. Russia), however lacked data from 1980-1991 so were eliminated. Figure 3 shows the samples distribution across the globe; OPEC countries are oil-exporting developing nations (OPEC, 2024) typically located in the Middle East & Africa. The countries in the non-OPEC sample are more developed nations located in the Americas & Europe.

Figure 3 – Map of Net Oil-Exporting Countries in the Sample



3.3 Economic Growth & Oil Price

The main dependent variable collected is real GDP/capita, taken from Penn World Tables (PWT, 2023). This variable was collected in constant 2017 US$'s to ensure it is independent of price changes and accounts for exchange rate differences across countries, to derive an accurate relationship between the variables. GDP/capita was chosen to control for population differences and proxy for economic growth. The variable was logged with the natural logarithm to help with issues of stationarity and reduce the impact of outliers.

The independent variable is global crude oil price, collected from the World Bank (WB, 2023), consisting of a nominal yearly average of different global oil benchmarks. This series was manually deflated by the All-Urban Consumer Price Index, collected from the Bureau for Labour Statistics (BLS, 2023), into a constant (2017) price year in US$. This meant that price changes across the time series were implicitly controlled for. This was logged with the natural logarithm to ensure normality.

3.4 Variables in Regression

Table 2 – Description of Variables Included in Regression

Variable Codes	*Description*	*Unit*	*Source*
RGDPC	**Real GDP per Capita** Real Gross Domestic Product divided by population.	Constant 2017 US$	Penn World Tables (v10.01)
GlobalCOP	**Global Crude Oil Price** Annual global average spot price per barrel of Brent, Dubai & West Texas Intermediate, equally weighed. Deflated by the All-Urban Consumer Price Index.	Constant 2017 US$	World Bank Commodity Price 'Pink Sheet' Dataset & Bureau for Labour Statistics
X_GDP	**Exports as a % of GDP** Value of all goods and other market services provided to the rest of the world divided by GDP.	% of GDP	World Bank - World Development Indicators
G_GDP	**Government Consumption Expenditure as a % of GDP** All government expenditures for purchases of goods/services divided by GDP.	"	"
FDII_GDP	**Foreign Direct Investment Inflows as a % of GDP** Net inflows of investment to acquire a lasting interest in an enterprise, less disinvestment, from foreign investors divided by GDP.	"	"
OR_GDP	**Oil Rents as a % of GDP** The difference between the value of crude oil production at regional prices and total costs of production divided by GDP.	"	"
	Variables in Robustness Checks		
Inf	**Inflation Rate** Measured by CPI, the annual percentage change in the cost of a basket of goods/services to the average consumer.	Annual %	World Bank - World Development Indicators
Deposit_IR	**Deposit Interest Rate** Rate paid by commercial banks for deposits. Used as a proxy for Base Interest Rate as not all countries in the sample have data. Comparability is limited due to differing T&Cs.	"	"
C_GDP	**Household Final Consumption as a % of GDP** Market value of all goods/services, including durables, purchased by households divided by GDP.	% of GDP	World Bank - World Development Indicators
M_GDP	**Imports as a % of GDP** Value of all goods and other market services received from the rest of the world divided by GDP.	"	"

3.5 Descriptive Statistics

Table 3 presents the summary statistics for each sample. The average GDP/capita is higher in the non-OPEC sample, this is intuitive and reinforces the fact that OPEC countries are developing nations with lower standards of living. Whereas the non-OPEC oil-exporters included are nations that have developed to a higher degree. There is a larger standard deviation across all core variables in the OPEC sample, suggesting inherent volatility in developing countries key indicators as their economies grow, unlike developed non-OPEC countries which see higher levels of stability.

Table 3 – Descriptive Statistics of all Variables

	Mean	*Standard Deviation*	*Minimum*	*Maximum*	*Count*
OPEC Countries					
RGDPC	19,996.37	20,612.30	2,778.04	86,003.54	320
GlobalCOP	58.30	28.84	19.65	113.34	320
X_GDP	0.40	0.20	0.00	0.82	320
G_GDP	0.17	0.09	0.01	0.76	320
FDII_GDP	0.02	0.05	-0.11	0.40	320
OR_GDP	0.28	0.14	0.02	0.70	320
Non-OPEC Countries					
RGDPC	23,371.79	17,846.31	6,834.58	70,222.23	280
GlobalCOP	58.30	28.84	19.65	113.34	280
X_GDP	0.23	0.11	0.05	0.46	280
G_GDP	0.15	0.05	0.03	0.24	280
FDII_GDP	0.02	0.02	-0.05	0.09	280
OR_GDP	0.04	0.03	0.00	0.19	280

4. Empirical Methodology

4.1 Panel Fixed Effects Model

To analyse whether oil price changes cause greater fluctuations in GDP/capita for net oil-exporters with a high dependence on oil, regression analysis was performed through two separate panel fixed effects (FE) models. This method was chosen to avoid biased results that would be produced by an OLS model, where errors would be correlated with cross-sectional independent variables, meaning it is no longer the best linear unbiased estimator.

In this paper, the FE method captures the time-invariant differences that change across countries and impact GDP/capita, this specification controls for unobservable heterogeneity across countries. Baltagi (2005) suggests that the use of a FE model is advantageous as there is a greater number of observations, thus reducing multicollinearity between independent variables. Also, variables that don't change across entities can be eliminated, meaning omitted variables are less problematic.

Figure 4 – Panel Fixed Effects Equations

$$\boldsymbol{Equation\ 1}: \quad y_{it} = \beta_0 + \beta_1 x_{it} + \beta_2 x_{it} + \cdots + \beta_k x_{it} + \varepsilon_{it}$$

$$\boldsymbol{Equation\ 2}: \quad \varepsilon_{it} = \alpha_i + u_{it}$$

$$\boldsymbol{Equation\ 3}: \quad y_{it} = \beta_0 + \beta_1 x_{it} + \beta_2 x_{it} + \cdots + \beta_k x_{it} + \alpha_i + u_{it}$$

Equation 2 illustrates the decomposition of the error term in the FE model, into a random and idiosyncratic error component. Equation 3 replaces the decomposition, such that the error term now has one fixed constant for each country, α_i, and an idiosyncratic (random) term, u_{it} that satisfies OLS assumptions. This is equivalent to giving each country an independent intercept. Adding another degree of freedom means the idiosyncratic term captures differences between countries and potential omitted variables, meaning coefficients of exogenous variables accurately reflect their contribution to explaining the dependent variable. The test on differing intercepts was conducted and the null hypothesis was rejected (*OPEC - 131.060 & non-OPEC - 72.892*), suggesting that neither sample has a common intercept, hence a FE specification was correct.

A Random Effects (RE) model was considered in the econometric analysis, this assumes that variation across countries is random and uncorrelated with dependent/independent variables in the model. The Hausman Test was undertaken to determine which model should be used. The null hypothesis is that RE is preferred, and the alternative that FE is preferred. The test statistic in each sample exceeded the critical value (*OPEC - 255.286 & non-OPEC - 84.465*) meaning the null hypothesis was rejected and entity FE is preferred.

A two-way FE model was also considered, by integrating time effects into the entity FE model. This model controls for time and entity-invariant differences that change across countries and impact GDP/capita. When using an F-test to see if omission of time dummies had a significant impact, the null hypothesis was rejected in both samples, suggesting time FE should be included. However, in both samples, the omission of time FE improved 3 of 3 information criteria, meaning unobservable country-specific factors that impact economic growth don't add explanatory power. Hence, an entity FE model is the preferred model in this paper.

4.2 Robustness Tests

Stationarity Test

The methodology in this paper includes a time-series element, therefore it's important to ensure stationarity of the series such that there are not statistically spurious relationships. Typically, the Augmented Dickey Fuller (ADF) test is used when identifying unit roots in a time-series. However, due to the data being in panel format, the Im, Pesaran and Shin (IPS) test was used, this creates an average from ADF tests across all groups in the panel (Im et al, 2003). The null hypothesis states that all series in the panel have unit roots, whereas the alternative is some singular series have unit roots while others do not.

The IPS test determined that a constant should be included, as this specification rejected non-stationarity, see Table 4. GDP/capita was the only series to exhibit non-stationarity in its levels, hence the natural logarithm was taken to ensure stationarity. However, all other variables were stationary in their levels in both samples, so taking the natural logarithm or first differencing wasn't necessary.

Table 4 – IPS Stationarity Test

	IPS Test with Constant (IPS t-bar stat)	
	OPEC Sample	***Non-OPEC Sample***
GDPC	-1.619 (Non-stationary)	-0.281 (Non-stationary)
Ln_GDPC	*-2.664****	*-1.950**
GlobalCOP	-2.162**	-2.162**
Ln_GlobalCOP	*-2.335****	*-2.335****
X_GDP	-2.363***	-2.342***
G_GDP	-2.257***	-2.050*
FDII_GDP	-3.355***	-3.209***
OR_GDP	-3.202***	-3.238***
	Critical values: *-1.92 (10%), **-2.03 (5%), ***-2.24 (1%)	Critical values: *-1.95 (10%), **-2.07 (5%), ***-2.29 (1%)

Variance Inflation Factors

Multicollinearity can lead to inefficient/unreliable coefficient estimates that cannot be interpreted due to artificially inflated significance, hence VIF's were calculated to identify multicollinearity amongst the independent variables. Both overall and within-entity multicollinearity was tested, this was an important consideration when using FE as entity-specific variation couldn't be ignored. VIF's less than 5 indicate low correlation of a predictor with others, values of 5-10 indicate moderate correlation and values greater than 10 a non-tolerable level of correlation (James et al., 2013). Table 5 shows the variables included in the models for each sample do not exhibit multicollinearity, so there are no issues with reliability or interpretation of the outputted coefficients.

Table 5 – Variance Inflation Factors of Variables

	Overall VIF		***Within-Entity VIF***	
	OPEC	*Non-OPEC*	*OPEC*	*Non-OPEC*
Ln_GlobalCOP	1.109	1.100	1.165	1.252
X_GDP	1.684	1.564	4.428	5.456
G_GDP	1.071	1.477	2.702	3.268
FDII_GDP	1.095	1.045	1.235	1.239
OR_GDP	1.655	1.455	3.259	3.159

Endogeneity
Endogeneity was tested for to ensure the independent variables and entity-FEs were uncorrelated with the regression's residuals, to satisfy the classical OLS assumption of exogeneity. Correlation matrices were constructed to understand the relationship of each variable with the residuals. All variables were uncorrelated with the residuals in both samples, meaning coefficients were both consistent and unbiased and the fixed effects have no systematic relationship with the error term. Interpretation of causal relationships can take place due to exogeneity holding in both models.

Robust Standard Errors
To confirm robust results, the Durbin Watson test for autocorrelation and Groupwise Distribution-Free Wald test for heteroskedasticity were undertaken for each model. The Durbin Watson test statistic (*OPEC - 0.445 & non-OPEC - 0.320*) was less than the lower critical value in both samples, hence the null hypothesis of no autocorrelation was rejected, positive autocorrelation was present. This violates the OLS classical assumption of zero correlation between model errors. The null hypothesis of the Wald test is that the error term is homoscedastic, however in both samples the test statistic (*OPEC - 93.125 & non-OPEC - 281.436*) was greater than the critical value, hence heteroskedasticity was present. This is a violation of the OLS assumption of constant variance in the error term. To account for autocorrelation/heteroskedasticity, Arellano robust standard errors were used, as they allow for valid hypothesis testing in the presence of the above results (Arellano, 1987).

5. Results

5.1 Final Model Summary

As outlined in the methodology section, an entity FE panel model is the best linear unbiased estimator which produces coefficients for each sample that are easily comparable to determine whether high dependence countries see larger fluctuations in GDP/capita. The results from the final model can be seen in Table 6, which indicates overall statistical significance of the models for both samples by reporting the respective F-statistics, where test statistics exceed their critical values. The models successfully explain a large amount of variation in the dependent variable, illustrated by the high R-squared values in each sample.

Table 6 – Final Panel Fixed Effects Model Outputs

Dependent Variable - Ln_RGDPC	***Panel Fixed Effects - Robust (HAC) Standard Errors***			
	OPEC Sample		***Non-OPEC Sample***	
	Coefficient	*Std. Error*	*Coefficient*	*Std. Error*
Constant	8.652***	0.311	8.845***	0.098
Ln_GlobalCOP	0.158**	0.054	0.107***	0.028
X_GDP	0.636**	0.185	0.742*	0.328
G_GDP	0.133	0.680	2.127***	0.528
FDII_GDP	-0.556	0.480	3.705***	0.774
OR_GDP	-0.381**	0.124	-0.630	0.697
Observations	320 (n=8, t=40)	-	280 (n=7, t=40)	-
LSDV R-Squared	0.963	-	0.968	-
F-Test on Regressors	5.156	Regression Significant	30.639	Regression Significant
Test for Differing Intercepts	131.060	Do not have common intercept	72.892	Do not have common intercept
Durbin Watson	0.455	Positive autocorrelation present	0.320	Positive autocorrelation present
Groupwise Heteroskedasticity	93.125	Heteroskedasticity present	281.436	Heteroskedasticity present
****p<0.01, **p<0.05, *p<0.1*				

Global Crude Oil Price

Table 6 reports a statistically significant positive effect of oil prices on GDP/capita in both samples of net oil-exporters, at the 5% & 1% level for the OPEC & non-OPEC sample respectively. Interpretation of this coefficient represents the elasticity of real GDP/capita with respect to global crude oil prices. For the OPEC sample, a 1% increase in the price of global crude oil leads to a 0.158% increase in real GDP/capita. Whereas in the non-OPEC sample, a 1% increase in the price of global crude oil increases real GDP/capita by 0.107%. These findings reinforce the hypotheses that countries with higher reliance on oil experience larger fluctuations in economic growth than countries with low reliance on oil. This is because developing countries typically have less diversified economies, so oil contributes more to GDP in the first place. The relative importance of the oil industry therefore drives the magnitude of the positive and significant relationship found, as highlighted by Gonzalez (2009) and Ahmadi & Manera (2021). Other factors that could be driving the difference are that developed countries typically have stronger fiscal/monetary institutions, they also manage oil wealth more effectively by investing profits into diversified portfolios (e.g. Norway's Sovereign Wealth Fund) which reduces vulnerability to oil price changes, hence a more stable GDP/capita than developing countries.

The results hold in line with Boheman (2015), who found a 1% increase in the change of oil price increases GDP growth rate of OPEC countries by 0.145%. The results of this paper add the element of relative dependence to the literature, showing that those who have higher oil rents see larger fluctuations in economic growth when oil prices increase. The positive relationship in both samples could also indicate the existence of the observed asymmetric relationship found in previous literature (Mork, 1989 & Jimenez-Rodriguez & Sanchez, 2005). These results are also economically rational. As oil is fundamental to almost all global industries and trade, it is a highly inelastic commodity, hence consumers won't respond to a price change by decreasing their demand nor will suppliers respond by increasing supply. The coefficients in this paper align with research by the Federal Reserve in the short-run, which finds the elasticities of demand/supply for oil are 0.1 (Caldara, 2016).

Tests were conducted to see if there was a lagged effect of oil prices on GDP/capita. In each sample, both one- and two-year lags of oil price were insignificant, their omission improved all information criteria. This suggests that the transmission of changes in oil price impact GDP in net oil-exporting countries within a year. Not including lags in the model contrasts much of the literature, however with this study using annual rather than quarterly data, it is intuitive that an annual lag would be insignificant.

Exports
Table 6 reports the coefficients on various control variables included, these figures need to be interpreted carefully as they are not logged but are percentage variables. For the OPEC sample, a 1 percentage point (pp) increase in exports as a percentage of GDP leads to a 0.636% increase in GDP/capita, whereas in the non-OPEC sample it leads to a 0.742% increase in GDP/capita. Both coefficients are significant, the larger magnitude of the coefficient in the non-OPEC sample suggests that firms in developed countries re-invest profits from the exporting of goods into more strategic areas that contribute more to and drive GDP/capita by creating jobs and driving up income.

Government Spending
The coefficient on the government spending variable is insignificant in the OPEC sample, but highly significant and of a much larger magnitude in the non-OPEC sample. In non-OPEC countries, a 1pp increase in government spending as a percentage of GDP increases GDP/capita by 2.127%, suggesting the government spending multiplier is much larger in developed countries than developing countries. This links back to the point of much stronger fiscal institutions, which direct spending to areas of the economy that are likely to drive economic growth to a higher degree than developing countries. This endorses Moshiri's (2015) findings that differences in institutional quality drive heterogenous responses to oil price shocks.

FDI Inflows
A 1pp increase in FDI inflows as a percentage of GDP statistically significantly increases GDP/capita in non-OPEC countries by 3.705%, whereas in OPEC countries it decreases GDP/capita by 0.556%, although this coefficient is insignificant. This suggests that FDI in developed countries is channelled into high growth areas, typically thanks to more advanced

technology and higher skilled workforces which drives up productivity further and therefore drives growth to the higher magnitude seen in Table 6.

Oil Rents

Table 6 suggests for both samples that an increase in oil rents as a percentage of GDP would have a negative impact on GDP/capita. The coefficient, however, is only significant in the OPEC sample and suggests that a 1pp increase in oil rents would cause a 0.381% fall in GDP/capita. This indicates a potential mismanagement of oil revenues within OPEC countries, it is possible that their higher oil rents are crowding out other sectors as government policy may be disproportionately aimed at the relatively larger oil sector. It also suggests a possible existence of a Dutch Disease effect, where sudden higher oil rents mean higher oil revenues which causes one's currency to appreciate, making other sectors less competitive internationally which can reduce employment opportunities and hence GDP/capita (Ebrahimzadeh, 2017). The fact this coefficient is insignificant in the non-OPEC sample illustrates their sound management of oil revenues, hence they are less impacted by oil price changes, reinforcing the initial hypotheses of this paper.

5.2 Robustness Checks

Robustness checks are used to examine how core regression coefficients react when the initial specification is modified, if coefficients remain plausible and robust, then it can be assumed they exhibit structural validity (Lu, 2014). Various robustness checks were completed in this paper, the addition of an inflation rate, interest rate, import and consumption variable were tested. Due to data availability, the samples had to be restricted when testing each variable, however all variables turned out to be statistically insignificant and induced multicollinearity problems into the models. Despite this, the behaviour of the oil price variable remained as hypothesised, being positive in both samples but higher for those countries with a higher dependence on oil.

A further check restricted the sample to only focus on 11 years (1998-2008) which all pertained to oil prices increases. The coefficients on the oil price variable remained stable (*OPEC - 0.177*** *& non-OPEC - 0.135****), maintaining the positive and significant relationship between oil prices and GDP/capita, but also that countries with higher dependence on oil see larger fluctuations in GDP. A final check was to remove the countries with the largest GDP/capita from the developing countries sample (Kuwait/Saudi Arabia) and developed countries sample (Canada/Norway) to minimise development differences between the samples. Again, the oil price coefficients were robust (*OPEC - 0.160*** *& non-OPEC - 0.132****), the trends remained and reinforced the hypotheses further.

6. Policy Implications

The results found in this paper are of real importance to policymakers who want to moderate the impact of oil price fluctuations on their economic growth. The results state that countries with a higher reliance on oil as a percentage of GDP will see larger fluctuations in economic growth because of changing oil prices. This group of net oil-exporting countries in particular should use periods of high oil prices to strengthen their overall fiscal position. They should use this to then invest in human capital, infrastructure, and diversification of their economies, to reduce overall reliance on oil. This would work to create employment elsewhere in the economy, increase productivity through higher human capital investment and promote longer-term sustainable economic growth. Alongside this, higher government savings in time of higher oil prices would help to strategically mitigate the adverse impacts of falling oil prices. Success of these policy suggestions depends on whether strong institutions can be implemented to help Governments strategically direct investment to diverse sectors that would efficiently aid economic growth. This is already done successfully in developed net oil-exporting countries with a lower reliance on oil as they see less impact on GDP when oil prices increase, suggesting their economies are heavily diversified with strong fiscal and monetary institutions to ensure that overall reliance on oil and its contribution to GDP is low, but they are still able to benefit from increases to its price. Norway's Sovereign Wealth Fund manages $1.6 trillion of assets and has holdings in 9,000 companies worldwide and is a good example of where diversification has taken place, Norway's economy effectively manages oil wealth by investing in diversified portfolios of asset which reduces vulnerability to oil price changes. Saudi Arabia's Public Investment Fund manages $926 billion of assets and is an example of where a Sovereign Wealth Fund has been set up to utilise oil revenues efficiently and moderate reliance of its economy on oil.

7. Further Research & Limitations

As with all pieces of research, it is important that the limitations are acknowledged. One limitation of this study is the timeframe used (1980-2019). Although the effect on oil prices of the Global Financial Crisis is encompassed, it fails to pick up the latest exogenous shocks. The 2020 COVID-19 pandemic caused a sharp fall in oil prices, then the 2022 Russian invasion of Ukraine caused a sharp rise. It isn't clear if the inclusion of this latest data would alter the relationship presented in this paper. Therefore, it would be of interest if a similar study could be conducted to see if the relationship held with larger fluctuations in the data.

Further research could investigate different groups of net oil-exporting countries. Azerbaijan/Kazakhstan/Oman/Qatar are all developing countries with high oil rents, whereas Vietnam/Indonesia are developing countries with low oil rents. These groups of countries could be studied further to focus solely on developing countries, to understand whether dependence on oil is what drives the difference in response of GDP/capita to oil price changes, eradicating development differences from the picture. Further research could also look to understand the impact of oil price fluctuations on the fiscal balance or current account rather than economic growth.

8. Conclusion

This paper used a fixed effects panel data model to understand the relationship between oil price fluctuations and economic growth in net oil-exporting countries. The nuance to this study is that it compares countries with respect to their relative dependence on oil to understand if that has a bearing on how much oil price changes impact economic growth. The results from this study align to the hypotheses set out in the introduction, finding that changes in oil prices have a statistically significant positive effect on economic growth in all net oil-exporting countries in the sample from 1980-2019, but that oil-exporting countries with a higher dependence on oil see larger fluctuations in economic growth.

The main finding shows a 1% increase in the price of global crude oil leads to a 0.158% increase in economic growth in high oil dependence countries, whereas in low oil dependence countries, a 1% increase in the price of global crude oil increases economic growth by 0.107%, confirming both hypotheses. The economic rationale behind the results is clear, countries with a higher dependence on oil have less diversified economies due to the inherent contribution of the oil industry to their GDP. Due to large fluctuations of oil prices, this impacts their economies more as they have fewer other stable industries to compensate, causing the larger fluctuations in economic growth seen in the results. The results also show that higher dependence on oil can impact economic growth negatively, indicating a diminishing relationship, suggesting past a certain level of oil dependence, the oil sector crowds out other strategic sectors, hindering growth.

This study holds in line with; Bolganbayev (2021), Berument (2010), Santillán–Salgado & Venegas-Martínez (2015) & Boheman (2015), who all found evidence of the statistically significant and positive relationship between oil prices and economic growth. The results of this paper add to the literature by proving that higher dependence on oil causes larger fluctuations in economic growth in response to oil prices. Differences in the diversification of economies, institutional quality and fiscal strategy, saving & management drive the differences in dependence on oil and hence the impacts on economic growth. The results warn macroeconomic policymakers in net oil-exporting countries of the importance of considering oil prices when making decisions on monetary/fiscal policy, periods of higher oil prices can help to facilitate expansionary policies to grow the economy.

Overall, this empirical paper concludes that the causal results are robust, providing strong evidence for the conclusions outlined. The analysis provides important policy implications, particularly for net oil-exporting countries with high dependence on oil, encouraging human capital investment to effectively diversify the workforce while also investing in other sectors of the economy to create employment opportunities. Those industries should be built while oil prices are high, this will help to moderate reliance on oil. This way all net oil-exporting countries can benefit from oil price increases whilst the impact of oil price decreases will be minimised, fuelling rather than stalling sustainable economic growth. Although the limitations and suggestions for further research have been acknowledged, it is hoped that this paper makes a credible addition to the existing literature.

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