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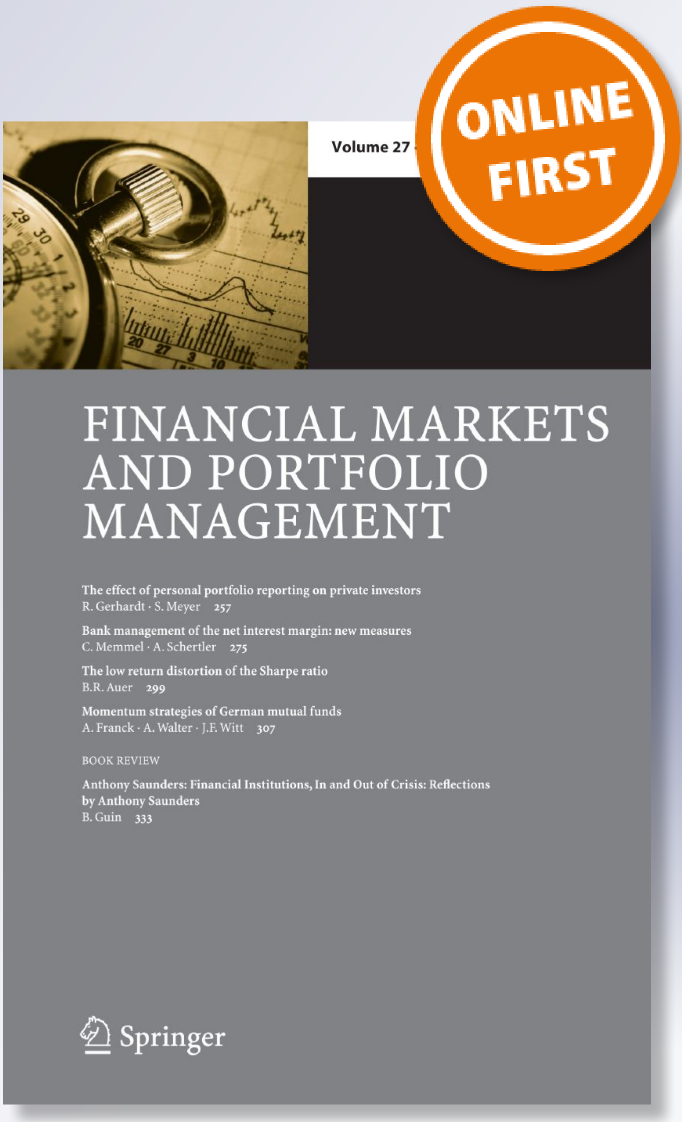

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Oil, the Baltic Dry index, market (il)liquidity and business cycles: evidence from net oil-exporting/oil-importing countries

Husaini Said[1] · **Evangelos Giouvris**[2]

Abstract

The recent financial crisis has made (il)liquidity research more significant than ever. Galariotis and Giouvris (Int Rev Financ Anal 38:44–69, 2015) find evidence that market liquidity may contain information for predicting the state of the economy. Similar to (il)liquidity, oil is an important indicator of the future state of the economy (GDP). We consider five predictive variables, namely national/global illiquidity, foreign exchange, Baltic Dry, and oil. Our findings show that (1) global illiquidity provides greater overall explanatory power compared to national illiquidity (even for developed oil exporters: Norway, Canada, and Denmark). (2) Oil is the most important predictive variable for oil exporters (especially for emerging oil exporters suggesting over-reliance), while Baltic Dry appears to be more important for oil importers. (3) FX has extra power over financial variables mainly for emerging oil exporters. Finally, there is a two-way causality between GDP and our predictive variables: (4) For oil exporters, the two-way causality between oil and GDP remains, while for net oil importers, we observe a one-way causality from GDP to oil.

Keywords Liquidity · Macroeconomic indicators · Oil prices · Baltic Dry · Oil-importing countries · Oil-exporting countries

JEL Classification F37 · F44 · G15 · Q43

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1 Introduction

Due to the recent financial crisis of 2007–2008, illiquidity research has gained importance,[1] as Crotty (2009) highlights that the crisis happens when investors run for liquidity and safety. Brunnermeier (2009) mentions that the crisis has led to the most severe financial predicament since the great depression. It had large repercussions on the real economy, indicating the significance of market liquidity on the economy. Liquid markets make new and existing investors more willing to invest in stocks which in turn make cost of capital cheaper for companies that seek capital in the financial markets. Cheaper cost of capital facilitates new investment which in turn helps increase GDP.

Nevertheless, along with liquidity, the price of oil is an important part of macroeconomic activity. Basher and Sadorsky (2006) highlight that countries' demand for oil increases significantly due to urbanization and modernization, indicating that oil is considered the lifeblood of modern economies. Furthermore, similar to illiquidity, oil is also linked to the financial crisis as Taylor (2009) mentions that oil price increases have prolonged the crisis. Tverberg (2012) also suggests that if world oil supply should remain the same (low), then there is the possibility of a continuing financial crisis similar to the 2008–2009 recession. Low supply implies a higher oil price which can bring about higher inflation and consequent stagnation. Higher oil prices could also increase the cost of existing or new investment projects, rendering those unprofitable achieving a direct hit on the real economy (see Cuñado and de Gracia 2003, 2005).

Current research acknowledges the relationship between the two variables. Ratti and Vespignani (2013) find evidence that the cumulative impact of China's liquidity (measured by money supply) on the real price of crude oil is large and statistically significant. Although both liquidity (Crotty 2009) and oil prices (Tverberg 2012) are related to present/past crises and economic growth, *there is no research available that investigates the combined effect of the two variables*.

Galariotis and Giouvris (2015) find evidence that market liquidity may contain some information for predicting the current and future state of the economy. We are looking into oil prices and illiquidity among other variables as antagonists using their framework. We include *national foreign exchange rate* (*NFX*) as part of our controlling variables because oil is usually priced in *United States dollar* (*USD*). Cunado and de Gracia (2005) highlight that the effect of oil on economic activity becomes more significant when oil is defined in local currencies. Authorities will also devalue the local currency in order to boost stagnating economies through increased exports (see Inman 2005 with reference to the devaluation of the Chinese Yuan). We also include *the Baltic Dry index* (*BD*), as it is commonly used as an indicator of economic activity reflecting on the global demand for raw materials (Bakshi et al. 2011). Higher global demand for raw materials implies an overall increase in productive activity and therefore GDP. Tett (2016) notes that price movements of the BD are almost as important as oil prices.

[1] See Said and Giouvris (2017a, b).

Although there are various studies on oil available, Wang et al. (2013) highlight that past studies seldom differentiate between oil-exporting countries and oil-importing countries. We undertake original research by covering ten countries grouped into five net oil-exporting countries (Norway, Canada, Denmark, Mexico, and Brazil) and five net oil-importing countries (Singapore, UK, Germany, Japan, and France). Our grouping is based on the latest data available on US Energy Information Administration and DataStream.

Overall, this paper contributes to the current literature of macroeconomics forecasting. Næs et al. (2011) mention that a larger cross section of stock markets should be investigated to test the predictive power of liquidity on the state of the economy. We expand this line of research by treating illiquidity and oil prices as antagonistic predictive variables along with other variables, focusing on ten countries. Four of those countries are new additions in comparison with Næs et al. (2011) and Galariotis and Giouvris (2015). We provide original results by analysing variables which have not been used before such as oil (OB), the Baltic Dry index (BD), and national foreign exchange (NFX), in addition to the illiquidity variables.[2] Moreover, by segregating our sample into net oil exporters and net oil importers, we will be able to investigate which predictive variables affect macroeconomic activity[3] of the two groups of countries. Finally, we also split our net oil-exporting countries into developed and emerging countries in order to further enhance our study.

The remainder of this paper is organized as follows. Section 2 presents the literature review, while Sect. 3 describes the data and variables. In Sect. 4, the methodology, empirical results, and analysis are discussed followed by our conclusion in Sect. 5.

2 Literature review

2.1 Predictive variables and the macroeconomy

Past literature such as Hamilton (1983)[4] appears to show that crude oil does impact the economy of countries (see also Hamilton 2011[5]; Mork 1989). Cuñado and de Gracia (2003) who study fifteen European countries find evidence of oil price shocks affecting inflation and industrial production indexes. Furthermore, Cunado and De Gracia (2005) undertake similar research on six Asian countries and highlight that oil prices have a significant effect on both economic activity and price indexes.

[2] The paper uses the *Amihud illiquidity measure* to construct two illiquidity variables, namely *national illiquidity* (*NAM*) and *global illiquidity* (*GAM*). National illiquidity (NAM) relates to the illiquidity of the companies of a specific country, while global illiquidity (GAM) excludes the companies of the specific country, hence consisting of international companies only. Further details of the illiquidity variables can be found in the *data and variables section*.

[3] The paper uses gross domestic product (GDP) as a proxy for macroeconomic activity.

[4] Hamilton (1983) underlines that there is a significant increase in the price of crude petroleum prior to seven of the eight post World War II recessions in the USA.

[5] Hamilton (2011) updates the count to ten out of eleven US recessions being preceded by significant rises in oil price.

Similarly, studies have emerged on the impact of liquidity on macroeconomic variables such as Næs et al. (2011) who mention that at least since World War II (WWII), market liquidity contains useful information for estimating the current and future state of the US and Norwegian economy. Galariotis and Giouvris (2015) expand this line of research by studying G7 countries, and they find evidence that market liquidity may contain some information for predicting the current and future state of the G7 economies.

In order to make this study broader, we have included the *Baltic Dry index* (*BD*)[6] due to its apparently close relationship with oil (Tett 2016). Moreover, Kilian (2009) introduces a new measure of monthly global real economic activity based on dry cargo bulk freight rate data that is used to disentangle demand and supply shocks in the global crude oil market.[7]

Lin and Sim (2013) highlight that BD has become one of the most important indicators of the cost of shipping and an important barometer of the volume of worldwide trade and manufacturing activity. Although the predictive ability of BD has recently waned, BD still shows some potential. Bakshi et al. (2011) find evidence of positive association between a BD increase and growth on stock/commodity returns as well as in global economic activity by studying the industrial production of 20 countries. Furthermore, using daily data spanning from 1985 to 2012, Apergis and Payne (2013) show the predictive capacity of the BD for both financial assets and industrial production, whereby the relationship is found to be positive.

As mentioned earlier, we have included *national foreign exchange* (*NFX*) rate because oil is usually priced in USD and there appears to be a relationship between oil and NFX.[8] Basher et al. (2012) highlight that lower USD coincides with higher oil prices and vice versa.[9] Nevertheless, Lizardo and Mollick (2010) make different observations for oil exporters and importers which motivate us to include NFX rate in our study as we are exploring net oil exporters and importers.

2.2 Causality

Past literature appears to show that the four predictive variables impact the economy of countries. Nevertheless, we believe that there may also be an inverse relationship whereby economic growth influences our predictive variables.

[6] The Baltic Dry index (BD) is a shipping and trade proxy created by the Baltic Exchange, and it reflects the rates that freight carriers charge to haul solid raw materials such as iron ore, coal, cement, and grain (Rothfeder 2016).

[7] Although the dry cargo bulk freight rate is not actually BD, its concept is the same as the dry cargos consist of grain, oil seeds, coal, iron ore, fertilizer and scrap metal. A similar technique is also applied by Wang et al. (2013) in order to estimate the scale of global economic activity as a proxy for global oil demand.

[8] Cunado and de Gracia (2005) also state that the effect of oil on economic activity becomes more significant when oil is defined in local currencies.

[9] The mechanism behind the relationship between NFX and the economy of countries appears simple. It is expected that as NFX rate changes, the prices of goods and services will affect exports and imports. This is a simple policy that is commonly reported in the mainstream media. For instance in 2015, China's central bank purposely devalued the Yuan relative to the USD because a cheaper Yuan will make Chinese exports less expensive, potentially boosting overseas sales (exports) that have been among the main drivers of economic growth for China's remarkable rise over the past 30 years (Inman 2015).

With reference to oil, as economies develop, it is expected that the energy consumption of those economies will increase resulting in a higher demand for oil causing oil price to increase. Al-Iriani (2006) finds a unidirectional causality running from GDP to energy consumption by studying six *Gulf Cooperation Council* (*GCC*)[10] countries. Similarly, Mehrara (2007) also shows a unidirectional strong causality running from economic growth to energy consumption for eleven oil-exporting countries.

Furthermore, Clements and Fry (2008) highlight that commodity-exporting countries through their exchange rate can have an impact on commodity prices. This situation can arise if a country is a large producer of a commodity or if a group of commodity-exporting countries have the combined market power to influence the world prices of commodities. This can relate to oil as well. In fact, Clements and Fry (2008) give examples of Saudi Arabia which has the ability to influence oil prices. Moreover, Saudi Arabia is part of *OPEC* (*Organization of Petroleum Exporting Countries*), a group of oil-exporting countries, which have the combined market power to influence oil prices. Kaufmann et al. (2004) actually find evidence that *OPEC*[11] Granger causes real oil prices, but there is no inverse relationship (or causality).

There are also studies that find bidirectional causality such as Oh and Lee (2004). They find a long-run bidirectional relationship between energy and GDP by studying Korea from 1970 to 1999. Even though Soytas and Sari (2003) obtain mixed results for their sample countries, they find bidirectional causality for Argentina. Thus, the overall literature appears to suggest the possibility of bidirectional relationship between oil and economic growth.

Similarly, past literature appears to show that there is a potential two-way relationship between illiquidity and macroeconomic variables. Fujimoto (2004) notes that macroeconomic fundamentals seem to be significant determinants of liquidity, while Næs et al. (2011) highlight an inverse relationship for the same country. Meanwhile, Pereira and Zhang (2010) do find a bidirectional relationship, but their study involves stock market and liquidity. Galariotis and Giouvris (2015) do find evidence that there is a two-way causality between macroeconomic indicators and liquidity variables for the six countries in their sample, but it is more consistent for global liquidity, whereas Lim and Giouvris (2016) obtain similar results for national liquidity.

The Baltic Dry index (BD) also appears to have the ability to predict economic growth (Bakshi et al. 2011). Nevertheless, there also seems to be an inverse relationship between macroeconomic variables and BD as well. Klovland (2002) shows that cycles in economic activity are major determinants of the short-run behavior of shipping freight rates in the years between 1850 and World War I. Moreover, since Apergis and Payne (2013) indicate that there is a relationship between commodities and BD, a change in demand for commodities should have an effect on BD as well.

[10] Gulf Cooperation Council (GCC) countries are: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates (UAE).

[11] The variables utilized include capacity utilization, OPEC production quotas, the degree to which OPEC exceeds these production quotas, and crude oil stocks in OECD nations.

For example, an increased demand for commodities will eventually affect BD. Bloch et al. (2012) mention that China's demand for coal is surging because of China's strong economic growth. Hence, there is potentially a two-way relationship between BD and economic growth. In fact, Bloch et al. (2012) find that there is bidirectional causality between coal consumption and GDP using demand-side analysis. Thus, since coal is part of BD, it should be expected that economic growth may also affect BD. Overall, there is potentially a two-way causality between the Baltic Dry index and the macroeconomy.

Finally, past literature appears to show that national foreign exchange (NFX) can influence economic activity. Cunado and De Gracia (2005) highlight that the impact of oil price shocks on economic activity becomes more significant when shocks are defined in national currencies. However, we believe that economic growth can also affect NFX rate. Inman (2015) highlights that the main reason that China devalued the Yuan is due to its flagging economy. This was also reported by Ryan and Farrer (2015), indicating that the state of the economy of a country can also impact NFX rate. Therefore, the possibility of a two-way relationship between the NFX rate and economic growth is present.

2.3 Net oil-exporting countries versus net oil-importing countries

We believe that the degree to which oil is important to a specific country's economy may result in this specific country to react differently to oil price movements. For instance, a country that is less dependent on oil is expected to react less to any movement in oil prices.

Earlier research tends to focus on the US economy, an oil importer, and the results show that there is a significant increase in the price of crude petroleum prior to recession periods (Hamilton 1983). However, an oil exporter is expected to benefit from an oil price increase, as shown by Saudi Arabia's willingness to cut oil production in order to improve revenue and their economy (Sheppard et al. 2016). Wang et al. (2013) mention that the influence of oil price shocks on the national economies of oil-exporting countries can be different from those of oil-importing countries. Oil price increases may bring positive effects on the national economies of oil-exporting countries.

Mork et al. (1994) obtain results which show that Norway, an oil-exporting country, benefits significantly from oil price increases. Moreover, Mork et al. (1994) highlight that Norway seems to be hurt by oil price declines but less significantly. Mork et al. (1994) mention that if the domestic oil sector is large enough relative to the size of the economy, a country's net oil-exporting position appears to influence the *oil price GDP correlation* substantially. Nevertheless, UK,[12] another oil-exporting country in their research, exhibits similar results to oil-importing countries such as USA, Germany, France, and Japan.

[12] In this paper, we classify UK as a net oil importer based on the latest available data as of 2012 that we obtained from US EIA website.

Cunado and De Gracia (2005) find that Malaysia's *oil price–economy relationship* seems to be less significant compared to other five Asian economies, as Malaysia is the only oil-exporting country in their sample. Cunado and De Gracia (2005) stress that more research is required to draw conclusions, but their results seem to suggest that there are different responses between oil exporters and oil importers.

Moreover, Wang et al. (2013) highlight the different reaction between oil-exporting and oil-importing countries, as positive aggregate and precautionary demand oil shocks are shown to result in a higher degree of co-movement among the stock markets in oil-exporting countries but not in oil-importing countries. Engemann et al. (2014) highlight that apparently the most energy-intensive US states are the ones that respond only to negative oil price shocks.

Overall, it seems that the classification of whether a country is an oil exporter or importer is important when undertaking research in this area. However, past studies seldom differentiate between oil-exporting countries and oil-importing countries, which is also highlighted by Wang et al. (2013). *If they do differentiate between oil-importing/exporting countries, their focus is on the relationship between oil price shocks and stock markets instead of macroeconomic activity. This indicates the importance of this study.*

3 Data and variables

3.1 Data

We have chosen ten (10) countries for our data sample expanding from January 1998 to December 2015. Using the most recent data obtained from the US *Energy Information Administration* (*EIA*) website, we have equally segregated our countries into five (5) net oil-exporting countries and five (5) net oil-importing countries. The net oil-exporting countries are Norway, Canada, Denmark, Mexico, and Brazil, while the net oil-importing countries are Singapore, UK, Germany, Japan, and France. The countries and periods are selected based on the availability of financial markets and economic data of the respective countries. Unfortunately, due to limited data availability, we are unable to include any members of the OPEC. Please refer to Table 1 for more information.

3.2 Macroeconomic, market, and illiquidity data

We use the constituents of stock indexes of our chosen ten (10) countries to calculate market data such as our illiquidity measure. The indexes that we chose are *Oslo All Share index* (*Norway*), *TSX Composite index* (*Canada*), *OMXC index* (*Denmark*), *IPC index* (*Mexico*), *Bovespa index* (*Brazil*), *STI index* (*Singapore*), *FTSE All Share index* (*UK*), *Prime All Share index* (*Germany*), *Nikkei 225* (*Japan*) and *SBF120 index* (*France*).

Gross domestic product (GDP) is used to determine economic growth. For financial variables (FV) and as control variables, we use the risk-free rate (RF), standard

Table 1 Details of the ten (10) countries in our sample

Countries	2012				2015					2016
	Crude oil Brent (thousand barrels per day)			Annual oil revenue (expenditure) to GDP ratio (%)	Goods and services (% of GDP)			Liner shipping connectivity index	GDP per capita (USD)	MSCI market classification
	Exports	Imports	Net exports (imports)		Exports (%)	Imports (%)	Net Exports (%)			
Net oil exporters										
Norway	1324	28	1296	10.42	37.4	32.0	5.4	4.8	74,481.8	Developed
Canada	2470	736	1734	3.90	31.6	34.0	− 2.4	42.9	43,315.7	Developed
Denmark	137	87	50	0.63	55.2	47.8	7.4	52.3	53,014.6	Developed
Mexico	1280	10	1270	4.39	35.4	37.5	− 2.1	43.0	9005.0	Emerging
Brazil	526	375	151	0.25	12.9	14.1	− 1.2	41.0	8677.8	Emerging
Net oil importers										
Singapore	0.1	1078	− 1077.9	− 15.28	176.5	149.6	26.9	117.1	52,888.7	Developed
UK	710	1222	− 512	− 0.79	27.6	29.2	− 1.6	95.2	43,929.7	Developed
Germany	3.8	1888	− 1884.2	− 2.18	46.8	39.2	7.6	97.8	41,178.5	Developed
Japan	0	3724	− 3724	− 2.56	17.6	18.0	− 0.4	68.8	34,523.7	Developed
France	1.3	1159	− 1157.7	− 1.77	30.0	31.4	− 1.4	77.1	36,352.5	Developed
World (average)					29.5	28.7	0.8	96.7	10,098.2	

This table reports the exports, imports, and net exports of crude oil as well as goods and services of the ten (10) countries in our sample. It is based on the most recently available data. Data for crude oil is from 2012, while the other data are from 2015 and 2016. The ten (10) countries are segregated into net oil-exporting countries and net oil-importing countries according to the countries latest net oil exports data. The table also reports the countries annual oil revenue (expenditure) to GDP ratios, which are calculated using the average crude oil Brent price in 2012 of USD 112.02 per barrel. We calculate the revenue (expenditure) of a country's net oil exports (imports) by the following formula:

Annual revenue (expenditure) of a country's net oil exports (imports) = Daily oil exports (imports) × number of days in a year (366 days) × the average crude oil Brent price (USD 112.02)

The calculation technique for oil revenue to GDP ratio is similar to Wang et al's (2013) framework. We have also reported the liner shipping connectivity index, GDP per capita (USD), and MSCI market classification of the countries in our sample. All data are obtained from DataStream, Bloomberg, World Bank, MSCI and US Energy Information Administration (EIA) website deviation or market volatility (SD), excess market returns (XS), and dividend yield (DY). Risk-free rate (RF) is the quarterly risk-free rate of the respective countries,[13] while standard deviation or market volatility (SD) is the standard deviation of daily average returns for all stocks over each quarter. Dividend yield (DY) is calculated as the cross-sectional quarterly average for all stocks of the respective countries. Excess market returns (XS) are the cross-sectional average returns for all stocks of the respective countries in excess of the risk-free rate of the respective countries also over each quarter. Unfortunately, due to the limited number of stocks available for certain countries, certain financial variables that are used by Galariotis and Giouvris (2015) are not available for us such as size premium (SMB) and value premium (HML).

Our five (5) predictive variables are national foreign exchange (NFX), national illiquidity (NAM), global illiquidity (GAM), crude oil Brent (OB), and the Baltic Dry index (BD). *National foreign exchange* (*NFX*) is the specific country's *currency foreign exchange*[14] *relative to USD,* and hence an increase in value will signify that USD has strengthened, while the respective country's currency has weakened. For instance, an increase in the GBP/USD value means that GBP has weakened, while USD has strengthened. The opposite scenario will be observed if the NFX value reduces. We include NFX because the crude oil Brent (OB) is normally priced in USD and Cunado and De Gracia's (2005) study of six (6) Asian countries suggests that the significant effect of oil price shocks on macroeconomic variables becomes more significant when oil prices are defined in local currencies.

Different illiquidity measures capture different aspects of liquidity (Goyenko et al. (2009)). There are various measures available such as *Bid-Ask spread* (Amihud and Mendelson 1986) and *High-Low Spread* (Corwin and Schultz 2012). Amihud et al. (2005) mention that there is hardly a single liquidity measure that can capture all aspects of estimating the effect of liquidity on asset prices. We have decided to choose the *Amihud illiquidity measure* (Amihud 2002). The reason we made this decision is because it is a recognizable measure which has been extensively used in the past literature and it is simple to calculate.

Our *Amihud illiquidity measure* is calculated *for each stock*, s, in all countries for every quarter as follows:

$$\text{Amihud}_{sq} = \frac{1}{q}\sum_{t}\frac{1{,}000{,}000 \times \left|\text{return}_t\right|}{\text{price}_t \times \text{volume}_t} \tag{1}$$

where t is each trading day.

[13] The risk-free rates that we have chosen for our ten (10) countries are 3-month *Norwegian Interbank Offered Rate* (*NIBOR*) (*Norway*), *28-day Mexican Federal Treasury Certificate* (*CETE*) *Rate* (*Mexico*), *3-month Canada Treasury Bills* (*Canada*), *Brazil Money Market Rate* (*Brazil*), *3-month Denmark Interbank Offered Rate* (*Denmark*), *3-month Singapore Interbank Offer Rate* (*SIBOR*) (*Singapore*), *3-month UK Treasury Bills* (*UK*), *3-months Frankfurt Interbank Offer Rate* (*FIBOR*)* (*Germany*), *3-months Japan Interbank Bank Rate* (*Japan*), and *3-month Paris Interbank Offer Rate* (*PIBOR*)* (*France*). *FIBOR and PIBOR are eventually merged into *Euro Interbank Offered Rate* (*Euribor*).

[14] The NFX consists of Norway (Norwegian Krone—NOK), Canada (Canadian Dollar—CAD), Denmark (Danish Krone—DKK), Mexico (Mexican Peso—MXN), Brazil (Brazilian Real—BRL), Singapore (Singapore Dollar—SGD), UK (UK Pound Sterling—GBP), Germany (Euro—EUR), Japan (Japanese Yen—JPY), and France (Euro—EUR).

We believe that using one illiquidity measure is sufficient because we will be considering two aspects of illiquidity, namely national and global illiquidity for all the countries in our sample. *National illiquidity* (*NAM*) is simply the cross-sectional average of *Amihud illiquidity measure* for all stocks of the respective countries in our sample. *Global illiquidity* (*GAM*) is created using the equally weighted average of the *Amihud illiquidity measure* across all stocks for the nine (9) countries, with the exception of the stocks belonging to a specific country nominated for the analysis. This is similar to Brockman et al.'s (2009) and Galariotis and Giouvris's (2015) technique. For instance, the global illiquidity (GAM) measure used in the UK regressions is the equally weighted average of all sample stocks of the nine (9) countries, with the exception of stocks that are part of the UK FTSE All Share index.

Oil is based on the *crude oil Brent prices* (*OB*), and we chose to use it because at the point of our data collection, crude oil Brent (OB) is considered as the most widely used oil reference (Kurt 2015). In comparison with other benchmarks such as the WTI (West Texas Intermediate), around two-thirds of global crude contracts use crude oil Brent (Kurt 2015).

Lastly, the *Baltic Dry index* (*BD*) is an index that tracks the cost of shipping commodities, such as coal, iron ore, steel, cement, and grain, around the world (Apergis and Payne 2013). Thus, it can be an indicator of global demand for raw materials as well as a predictor of growth in global economic activity (Bakshi et al. 2011). Moreover, BD appears to be closely related to oil. Tett (2016) remarks that the behavior of the BD is almost as dramatic as oil prices when viewing the global economy.

We use daily data to calculate our quarterly variables except for GDP which is available only quarterly. Before the calculation of the illiquidity measures and construction of the portfolios, the sample is initially scrutinized for any unsuitable data to avoid biased results. All the data used in this paper are obtained from DataStream, Bloomberg, the World Bank website, and the US *Energy Information Administration* (*EIA*) website.

3.3 Details of countries and variables

Table 1 provides more information of our chosen ten (10) countries, which is constructed using the most recently available data of the year 2012, obtained from the US EIA website. The table reports the "oil exports" and "oil imports" of the countries in our sample as well as the "net oil exports (imports)", which is merely the difference of oil exports and imports. Using the net oil exports, the ten (10) countries are then segregated into five (5) net oil-exporting countries and net oil-importing countries, respectively. The net oil exporters are Norway, Canada, Denmark, Mexico, and Brazil, while net oil importers consist of Singapore, UK, Germany, Japan, and France. The table also reports the "annual oil revenue (expenditure) to GDP ratios" of the countries, which are calculated using Wang et al.'s (2013) framework. The "annual revenue (expenditure)" of a country's net oil exports (imports) is calculated using the following formula:

$$\begin{aligned}&\text{Annual revenue (expenditure) of a country's net oil exports (imports)}\\&\quad=\text{Daily oil exports (imports)}\times\text{number of days in a year}\\&\qquad\times\text{the annual average oil price}\end{aligned} \tag{2}$$

where the annual average oil price of USD112.02 is the average price per barrel for crude oil Brent in the year 2012 obtained from DataStream and the number of days in the year 2012 is 366 days because it is a leap year.

Since we are investigating the Baltic Dry index, we have also included information for "*liner shipping connectivity index*" because it captures how well countries are connected to global shipping networks and it is computed by the *United Nations Conference on Trade and Development* (*UNCTAD*). Other information that we include in the table is the countries' "exports, imports and net exports for goods and services (as a percentage of GDP)" as well as "GDP per capita" and "MSCI market classification". With the exception of MSCI market classification, all the information is obtained from the World Bank website and it is more updated in comparison with our oil information, as we manage to obtain information as of 2015. The MSCI market classification categorizes the countries in our sample as either developed or emerging markets/countries as of 2016, and it is obtained directly from MSCI website.

Table 1 shows that Canada is a major net oil-exporting country, whereas Germany is the main net oil importer. The "annual oil revenue to GDP ratio" appears to be the highest for Norway, while Singapore's "annual oil expenditure to GDP ratio" is the highest in comparison with the other countries'. The table also shows that only Mexico and Brazil are classified as emerging markets/countries by MSCI, while Singapore is the highest net exporter of goods and services as a percentage of GDP. Interestingly, the *liner shipping connectivity index* for the five (5) net oil-importing countries is higher in comparison with the five (5) net oil exporters with Singapore having the highest index value.

In Table 2, panel A shows descriptive statistics (mean, median, standard deviation, maximum, and minimum) of the GDP for the ten (10) countries, while panel B exhibits descriptive statistics for crude oil Brent (OB) and the Baltic Dry index (BD). In panel C of Table 2, we present descriptive statistics of the *national foreign exchange* (*NFX*) rate of the ten (10) countries relative to the USD. The last two (2) panels (panel D and panel E, respectively) exhibit descriptive statistics of the two (2) liquidity measures, namely national (NAM) and global illiquidity (GAM).

4 Methodology, empirical results, and analysis

4.1 Predictive variables and business cycles

Figures 1, 2, 3, and 4 exhibit time series for the four out of the five (5) predictive variables in our research in relation to recession periods. Our five (5) predictive variables consist of national illiquidity (NAM), global illiquidity (GAM), national foreign exchange (NFX), oil (OB), and the Baltic Dry index (BD). We define a period

Table 2 Descriptive statistics of the chosen variables of the ten (10) countries in our sample

	Norway (%)	Canada (%)	Denmark (%)	Mexico (%)	Brazil (%)	Singapore (%)	UK (%)	Germany (%)	Japan (%)	France (%)	Oil	Baltic Dry
	Panel A: gross domestic product (GDP)										*Panel B: oil and Baltic Dry*	
Mean	0.417	0.579	0.258	0.587	0.598	1.341	0.489	0.322	0.151	0.363	60.753	2442.264
Median	0.300	0.625	0.300	0.655	0.895	1.363	0.600	0.400	0.300	0.400	57.685	1541.500
SD	1.106	0.637	0.887	0.912	1.264	2.226	0.643	0.851	1.099	0.499	34.825	2098.322
Maximum	3.500	1.550	2.900	2.140	2.490	9.250	1.800	2.100	2.700	1.300	122.060	10,228.000
Minimum	− 2.500	− 2.280	− 2.400	− 3.850	− 3.970	− 3.375	− 2.300	− 4.500	− 4.100	− 1.700	11.480	617.000

	Norway	Canada	Denmark	Mexico	Brazil	Singapore	UK	Germany	Japan	France
Panel C: National foreign exchange relative to United States dollars (USD)										
Mean	6.852	1.241	6.285	11.488	2.206	1.528	0.610	0.844	107.559	0.844
Median	6.566	1.207	5.944	11.004	2.093	1.545	0.622	0.798	109.218	0.798
SD	1.113	0.206	0.996	1.836	0.585	0.198	0.056	0.134	15.087	0.134
Maximum	9.258	1.594	8.580	16.762	3.848	1.834	0.704	1.151	139.879	1.151
Minimum	5.084	0.968	4.775	8.422	1.127	1.223	0.489	0.640	77.331	0.640

	Norway	Canada	Denmark	Mexico	Brazil	Singapore	UK	Germany	Japan	France
Panel D: National illiquidity (Amihud)										
Mean	769.285	250.049	1172.796	82.614	293.854	27.057	2.531	3135.614	0.021	20.579
Median	659.688	170.281	809.699	61.600	245.384	6.787	2.190	2930.160	0.012	14.030
SD	479.259	231.279	935.942	88.548	292.291	39.599	1.244	1810.116	0.017	15.991
Maximum	1882.618	858.993	3568.500	339.392	1341.593	194.620	6.073	8500.649	0.069	66.339
Minimum	123.574	3.317	163.083	0.152	0.390	0.696	0.764	88.869	0.004	1.749

Table 2 (continued)

	Norway	Canada	Denmark	Mexico	Brazil	Singapore	UK	Germany	Japan	France
Panel E: Global illiquidity (Amihud)										
Mean	498.570	550.494	458.219	567.237	546.113	572.793	575.246	261.937	575.497	573.441
Median	477.785	517.163	429.353	550.467	512.172	561.465	566.422	253.547	566.588	564.668
SD	228.986	257.903	219.861	257.269	260.301	257.563	258.915	115.769	258.992	258.537
Maximum	1048.510	1207.902	1158.321	1216.468	1177.493	1231.602	1236.298	504.251	1236.703	1230.518
Minimum	118.793	89.373	122.953	140.753	124.352	141.902	143.932	80.292	144.098	137.470
	Norway	Canada	Denmark	Mexico	Brazil	Singapore	UK	Germany	Japan	France
	NOK	CAD	DKK	MXN	BRL	SGD	GBP	EUR	JPY	EUR
Panel F: Market value (millions) in the respective national currencies										
Mean	11,096.240	5412.093	10,247.557	83,151.336	18,647.683	10,854.897	3060.525	3975.110	1114,927.875	11,446.907
Median	1283.815	1401.250	689.615	32,427.300	7272.040	6491.160	405.985	285.375	508,874.805	4541.700
SD	41,707.368	10,845.973	36,658.792	133,740.967	32,315.015	11,734.605	10,656.610	11,631.946	1995,805.407	18,549.008
Maximum	594,579.470	115,924.790	786,397.570	992,079.050	301,720.990	68,402.790	182,388.730	248,650.900	36,880,843.080	163,556.850
Minimum	3.200	0.040	0.870	149.940	15.740	3.310	0.960	0.310	12,064.360	21.760

Table 2 (continued)

	Norway USD	Canada USD	Denmark USD	Mexico USD	Brazil USD	Singapore USD	UK USD	Germany USD	Japan USD	France USD
Panel G: Market value (millions) in USD										
Mean	1753.672	4743.675	1720.015	6684.349	8971.786	7624.667	5057.328	4867.006	10,456.410	14,169.776
Median	193.982	1191.664	112.451	2858.528	3484.788	4435.872	674.505	348.738	4749.940	5502.411
SD	6812.642	9802.044	6176.118	10,510.816	16,207.038	8537.873	17,665.177	14,092.001	18,281.989	23,254.931
Maximum	116,958.937	106,092.550	116,798.596	80,083.811	165,281.560	50,922.592	279,202.036	245,145.322	344,766.485	213,992.328
Minimum	0.453	0.036	0.130	15.780	6.230	1.813	1.502	0.272	103.514	23.558

Panel A shows descriptive statistics (mean, median, standard deviation, maximum, and minimum) of the gross domestic products (GDP) for the ten (10) countries, while panel B exhibits descriptive statistics for crude oil Brent and the Baltic Dry index. Panel C shows descriptive statistics of the national foreign exchange (NFX) rate of the countries in our sample relative to USD. Panel D and panel E show descriptive statistics of national and global illiquidity (Amihud) measures for the relevant quarters, respectively. Panel F and panel G show descriptive statistics of the market value (millions) of the countries' chosen indexes in their respective currencies and in USD, respectively. The sample period is from January 1998 to December 2015, consisting of 72 quarterly observations. All data are obtained from DataStream, Bloomberg, World Bank, and the US Energy Information Administration (EIA) website

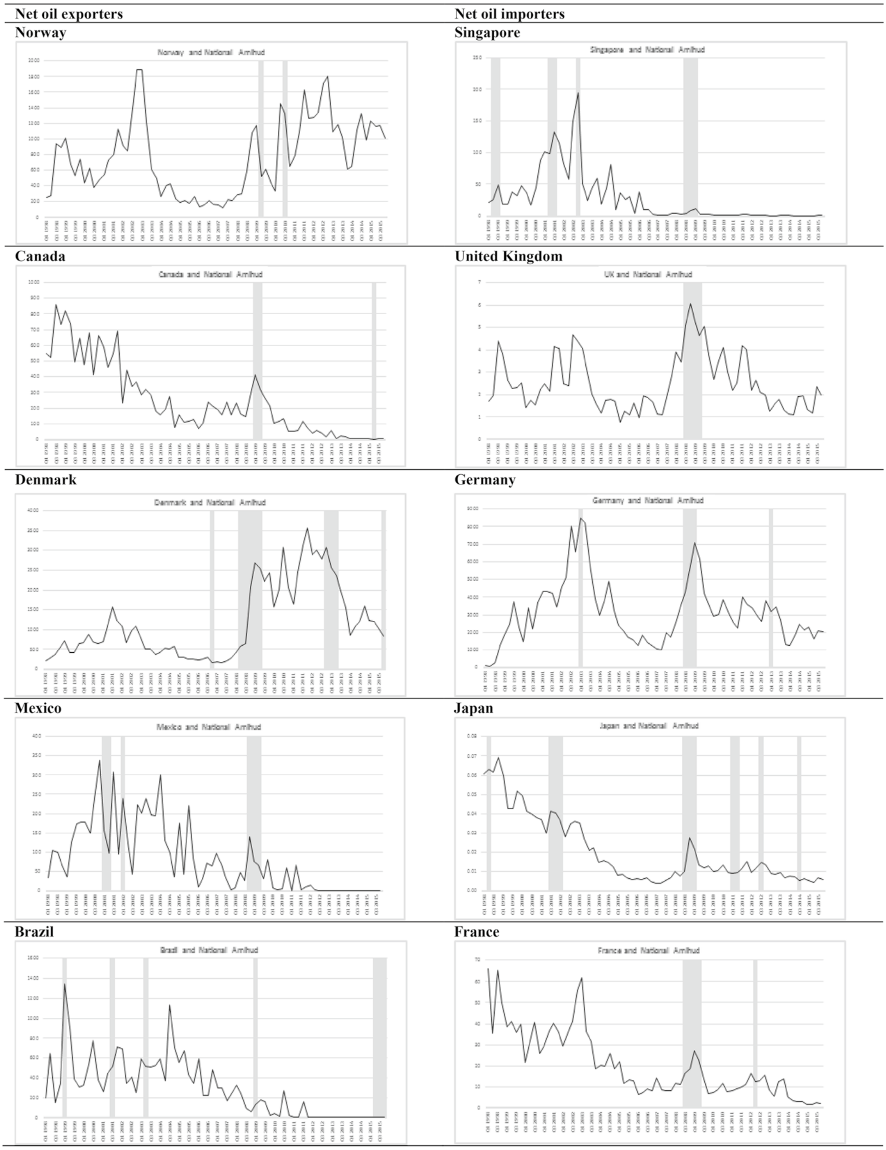

Fig. 1 Business cycles and national illiquidity based on the Amihud illiquidity measure. The figure shows time series plots of the *national illiquidity based on Amihud illiquidity measure* (*NAM*) for all the countries in our sample, which are represented by the black lines. Shaded grey columns are recession periods, and a recession period is identified as a period for which there is negative GDP growth for at least two consecutive terms. Sample range: Q1 1998 to Q4 2015, 72 quarterly observations. All data are obtained from DataStream, Bloomberg, World Bank, and the US Energy Information Administration (EIA) website

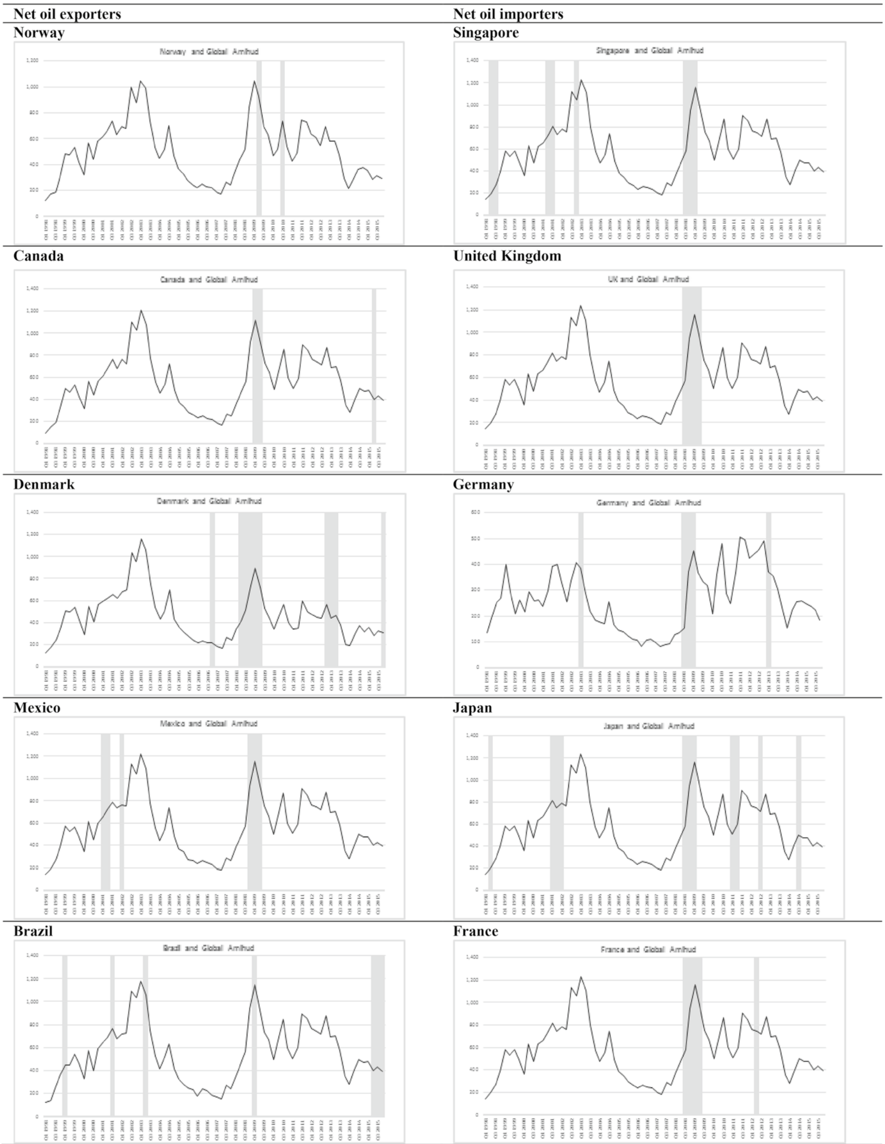

Fig. 2 Business cycles and global illiquidity based on the Amihud illiquidity measure. The figure shows time series plots of the *global illiquidity based on Amihud illiquidity measure* (*GAM*) for all the countries in our sample, which are represented by the black lines. Global illiquidity is constructed as in Brockman et al. (2009) and Galariotis and Giouvris (2015) whereby global illiquidity is created by combining all countries except the country nominated for the test. Shaded grey columns are recession periods, and a recession period is identified as a period for which there is negative GDP growth for at least two consecutive terms. Sample range: Q1 1998 to Q4 2015, 72 quarterly observations. All data are obtained from DataStream, Bloomberg, World Bank, and the US Energy Information Administration (EIA) website

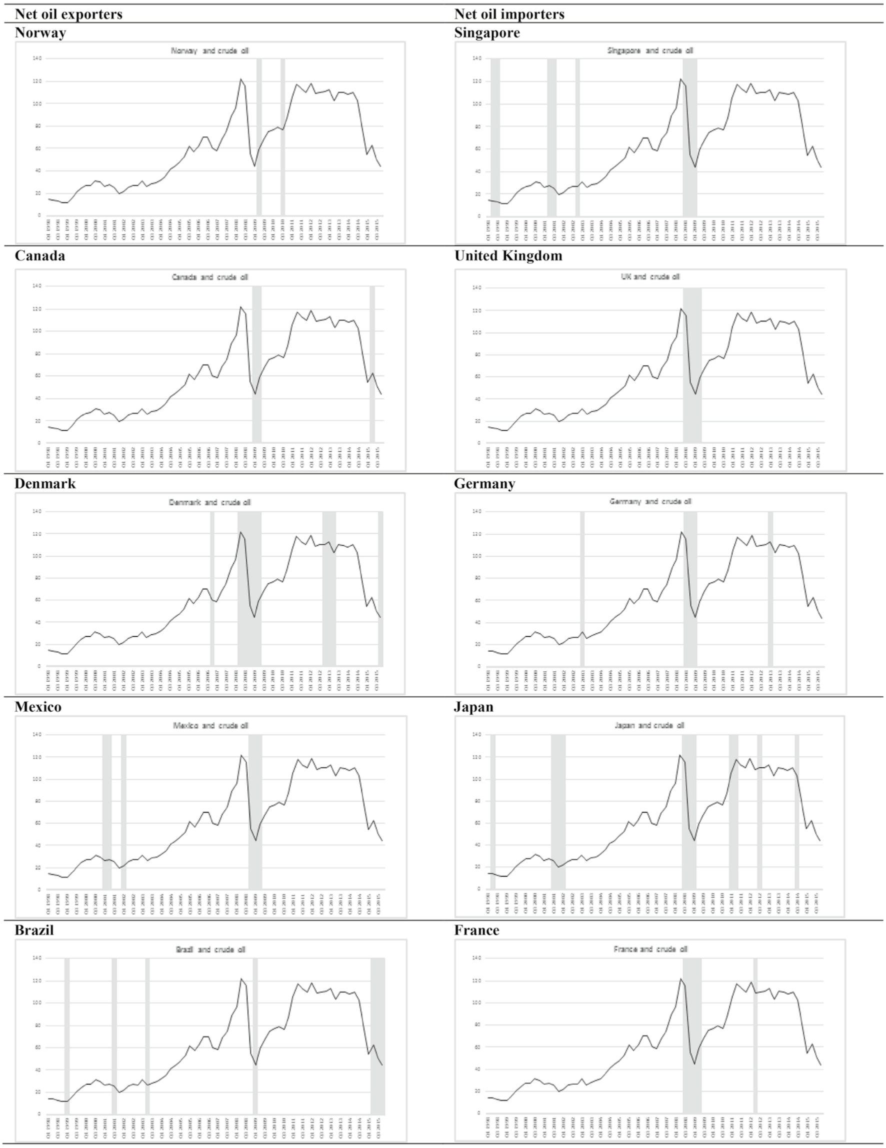

Fig. 3 Business cycles and crude oil Brent price. The figure shows time series plots of the crude oil Brent price, which are represented by the black lines. Shaded grey columns are recession periods, and a recession period is identified as a period for which there is negative GDP growth for at least two consecutive terms. Sample range: Q1 1998 to Q4 2015, 72 quarterly observations. All data are obtained from DataStream, Bloomberg, World Bank, and the US Energy Information Administration (EIA) website

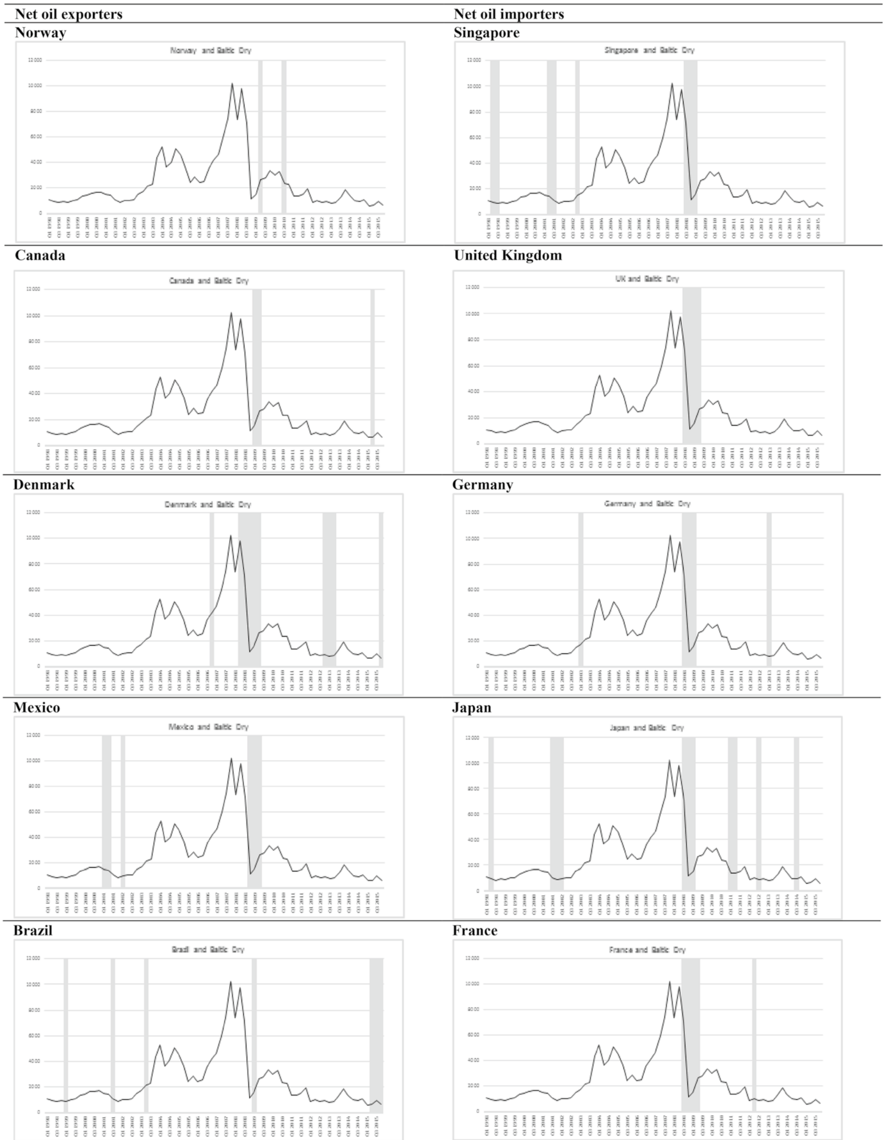

Fig. 4 Business cycles and Baltic Dry index. The figure shows time series plots of the Baltic Dry index, which are represented by the black lines. Shaded grey columns are recession periods, and a recession period is identified as a period for which there is negative GDP growth for at least two consecutive terms. Sample range: Q1 1998 to Q4 2015, 72 quarterly observations. All data are obtained from DataStream, Bloomberg, World Bank, and the US Energy Information Administration (EIA) website

as a recession period when there is negative GDP growth for at least two consecutive quarters. The grey columns capture negative growth for at least 2 terms. If the negative GDP growth is for one term only, then there will be NO grey columns in the graph even though there is a spike before.[15]

The figures reveal that the countries in our sample have different recession periods and those periods do not last the same. Figure 1 shows that national illiquidity (NAM) is able to predict recessions for all net oil exporters, as NAM increases before the recession. For some net oil exporters such as Norway, Canada, and Brazil this relationship is very clear. Among net oil importers, Singapore, UK, and Germany show the strongest relationship between illiquidity and subsequent recessions. At this point some of the readers might say that there are spikes which are not followed by recessions (grey columns). This is because those recessions last only for a term and are not captured by grey columns as it is the norm in the literature. If there is a grey column, then this is preceded by an increase in illiquidity. The correct way to read the graphs that follow is to identify the grey columns first and then check whether the grey columns are preceded by spikes in illiquidity and not the other way around. To identify the spikes first and then check whether a grey column follows is not the right way because negative growth could occur just for a single term which by definition is NOT captured by a grey column.

Figure 2 results are more consistent, as global illiquidity (GAM) increases prior to the recession period for the majority of the countries. At this stage we need to remind the readers how GAM is constructed. It is based on illiquidity of all countries in the sample except the country whose recession(s) we are trying to predict. As you understand maybe there is a liquidity crisis in all other countries but not in the one under investigation. By construction global illiquidity would be a weaker indicator since the liquidity of the country under consideration is excluded. Having said that, for all periods which are identified as recessions (2 + terms of consecutive negative GDP growth) by the grey columns, global illiquidity increases beforehand even though it is a weaker indicator by construction as we explained above. Japan presents contradictory results for 2011–2012 and France for 2012, but these are the only incidents.

With reference to oil (OB), Fig. 3 shows that all five (5) net oil-importing countries go into recession immediately after an increase in oil price (OB) during the big financial crisis (concentrate on the thickest grey column, which aligns perfectly for all graphs for all countries) which is consistent with past studies such as Hamilton (1983). Net oil exporters go into recession after an oil price decrease. The only exception is Denmark whose recession is concurrent with the oil price decrease. This

[15] If we choose to define a recession as a single term of negative growth in GDP (in contrast to the norm in the literature), then there will be more grey columns and those spikes would have captured the negative growth for a single term, but this is not how a recession is defined in all papers in the area. For example, in Galariotis and Giouvris (2015) in International Review of Financial Analysis, page 45, there are more spikes which are NOT followed by a recession (grey column) even though the same countries and illiquidity measures are used. In Naes et al. (2011) in the Journal of Finance, page 140, Figure 1, there are lots of spikes in 1960–1970 and 1980–1990 which are not followed by recessions (grey columns).

is actually expected for net oil exporters as a decrease in oil price is considered detrimental for such countries and is consistent to Mork et al. (1994) who finds that Norway, a net oil exporter, reacts differently to the oil-importing countries in their sample. Among net oil exporters, Denmark is the only country that reacts differently to oil (OB) during the crisis. Table 1 shows that Denmark exports the smallest amount of crude oil and has the second lowest "annual oil revenue to GDP ratio", indicating that probably the economy of Denmark may not be too dependent on oil. Following the big financial crisis, it takes a number of years before the price of oil bounces back to pre-crisis level and as you can see from the graphs there are periods (see Japan) which are identified as recession periods and the price increase does capture the recession. Japan suffers another recession before France and Germany. The graphs are stacked on top of each other, and the grey columns (which indicate recession) almost align perfectly. In the case of Japan the price index does capture the recession(s) that follow the big crisis, but in the other 2 countries there is no recession as it is defined in the literature. The needs of each country for oil are different so that it is not possible for the price index to predict recessions at the same point in time for all countries. Japan suffers more recessions than Germany and France because it may have more need for oil. In addition, governments take action to prevent a recession and some governments are better than other. So the fact that in some cases there are spikes even though there is no grey column (recession), could be because some governments are better than other at preventing recessions. Also keep in mind that the recession could be just for a single term which by default does not appear in the graphs. In addition, France and Germany are EU members and there is more coordination to tackle with recessions. Japan is not. We believe that the case of Japan, Germany, and France clearly illustrates this point. In Japan the index does capture a recession as indicated by the grey column, but in France and Germany there is no recession because maybe it was too small to be recorded and appear in the graph. We think that in this particular case the index is doing a very good job.[16]

Figure 4 shows that for net oil importers, a decrease in Baltic Dry is almost concurrent with the crisis. Baltic Dry starts from a high point and decreases during the crisis. See for example the thickest grey columns for Singapore, UK, Germany, Japan and France. The graphs for those countries are stacked on top of each other, and the biggest recession/thickest grey columns almost align perfectly. In all those occasions the BD reaches peak before and declines during the recession. The same happens in Denmark and Mexico even though they are oil exporters. This is the case for 7 countries out of 10 countries in the sample for the biggest worldwide recession. For shorter (less severe) recessions the index might not work so well, but at least for the big recession it is very consistent. For net oil exporters, Baltic Dry seems to predate the crisis for a very short period of time (see Brazil, Mexico, and Canada). In the case of Denmark, the decrease is concurrent with the crisis, while in the case

[16] In order to reinforce the points made here, even in Hamilton (1983) who looks into oil prices and US recessions since World War II, published in the Journal of Political Economy, page 229, Figure 1, there are price spikes which do not always predict or correspond to a recession. If there is a recession, this happens with considerable delay. Hamilton acknowledges this. In our graphs the response is pretty quick.

of Norway, Baltic Dry actually increases before the crisis. Bakshi et al. (2011) highlight that increases in the Baltic Dry index growth rate could predict increases in economic growth, concurring with strengthening commodity prices and rising stock markets. Rothfeder (2016) reports that BD predicted IndyMac's bankruptcy during the financial crisis of 2007–2008. Overall, the index is capable of capturing big recession(s) but may fail on shorter less severe recessions. In addition, the index may peak and then decline during a recession, but this is not captured in the graph by a grey column because it lasts for less than a term.

The main points from the analysis above are as follows:

1. In comparison with national illiquidity (NAM), global illiquidity (GAM) shows more consistent results since during the financial crisis, GAM is able to predict recessions for the majority of countries.
2. With reference to oil (OB), all five (5) net oil-importing countries go into recession immediately after an increase in oil price during the financial crisis, while it is observed that oil price actually decreases prior to recessions for net oil exporters (with the exception of Denmark), which is expected.
3. The Baltic Dry index (BD) is concurrent to the recession for net oil importers, while it decreases for net oil exporters (with the exception of Norway) prior to recessions, indicating that it may actually be a good proxy for oil.

Moreover, it appears that oil may have a stronger effect on economic growth relative to BD. Further analysis will follow to investigate this issue.

4.2 Correlations

Correlations in Table 3 use only raw data before any differencing and orthogonalization. The correlation analysis in Table 3 shows the relationship between our variables for all countries in our sample. Panel A to panel E show the correlation results for net oil exporters. The correlation results for net oil importers are presented in panel F to panel J. We will initially look at the relationship between *gross domestic product* (*GDP*) and *financial variables* (*FV*),[17] followed by the relationship between GDP and the predictive variables inclusive of *national foreign exchange* (*NFX*), *national illiquidity* (*NAM*), *global illiquidity* (*GAM*), *crude oil Brent* (*OB*) and the *Baltic Dry index* (*BD*).[18] Our correlation tables also present relationships between

[17] The effect of financial variables on GDP is well established in the literature for G7 (see Galariotis and Giouvris 2015) and for the USA (Naes et al. 2011), but this is a different sample which necessitates re-examining the relationship between financial variables and GDP.

[18] The effect of national (NAM) and global illiquidity (GAM) has been examined in the past; however, Galariotis and Giouvris (2015) show that there is no uniformity for G7 countries which necessitates the presentation of correlations in this study. In addition, the effect of all other predictive variables (foreign exchange, the Baltic Dry index, and Brent oil) on GDP is less known which means that additional correlations must be presented. In this study, we split our sample in oil importers/exporters; therefore, we will observe a negative/positive relationship, respectively, between an increase in the price of oil and GDP of which readers must be aware.

Table 3 Correlations of the chosen variables for all ten (10) countries

	GDP_NOR	RF_NOR	SD_NOR	XS_NOR	DY_NOR	NFX_NOR	NAM_NOR	GAM_NOR	OB	BD
Panel A: Norway										
GDP_NOR	1.0000									
	–									
RF_NOR	− 0.0407	1.0000								
	(0.7345)	–								
SD_NOR	− 0.1384	**0.2947**	1.0000							
	(0.2462)	**(0.0120)**	–							
XS_NOR	**0.2179**	**− 0.3779**	**− 0.3111**	1.0000						
	(0.0660)	**(0.0011)**	**(0.0078)**	–						
DY_NOR	− 0.0852	0.0742	**0.7360**	**− 0.2590**	1.0000					
	(0.4766)	(0.5357)	**(0.0000)**	**(0.0280)**	–					
NFX_NOR	0.0101	**0.5208**	**0.2080**	− 0.0914	0.1020	1.0000				
	(0.9331)	**(0.0000)**	**(0.0795)**	(0.4450)	(0.3937)	–				
NAM_NOR	**− 0.2283**	− 0.0607	**0.4822**	**− 0.2896**	**0.4061**	0.0126	1.0000			
	(0.0537)	(0.6126)	**(0.0000)**	**(0.0136)**	**(0.0004)**	(0.9164)	–			
GAM_NOR	− 0.1917	0.1723	**0.6295**	− 0.0524	**0.4536**	0.1065	**0.5625**	1.0000		
	(0.1067)	(0.1478)	**(0.0000)**	(0.6623)	**(0.0001)**	(0.3731)	**(0.0000)**	–		
OB	− 0.0484	**− 0.5226**	**− 0.2048**	− 0.0562	− 0.0180	**− 0.8101**	0.1936	− 0.0965	1.0000	
	(0.6866)	**(0.0000)**	**(0.0844)**	(0.6394)	(0.8807)	**(0.0000)**	(0.1032)	(0.4201)	–	
BD	0.0311	0.0667	**− 0.2804**	0.0605	**− 0.2216**	**− 0.4660**	**− 0.5510**	**− 0.2261**	**0.2163**	1.0000
	(0.7951)	(0.5777)	**(0.0171)**	(0.6136)	**(0.0614)**	**(0.0000)**	**(0.0000)**	**(0.0561)**	**(0.0680)**	–

Table 3 (continued)

	GDP_CAN	RF_CAN	SD_CAN	XS_CAN	DY_CAN	NFX_CAN	NAM_CAN	GAM_CAN	OB	BD
Panel B: Canada										
GDP_CAN	1.0000									
	–									
RF_CAN	**0.2927**	1.0000								
	(0.0126)	–								
SD_CAN	− 0.0948	**0.4652**	1.0000							
	(0.4285)	**(0.0000)**	–							
XS_CAN	0.1354	− 0.0449	− 0.1797	1.0000						
	(0.2569)	(0.7082)	(0.1309)	–						
DY_CAN	**− 0.6532**	**− 0.4663**	0.0113	− 0.0787	1.0000					
	(0.0000)	**(0.0000)**	(0.9248)	(0.5113)	–					
NFX_CAN	0.1717	**0.5956**	**0.6634**	0.1001	**− 0.4433**	1.0000				
	(0.1493)	**(0.0000)**	**(0.0000)**	(0.4028)	**(0.0001)**	–				
NAM_CAN	0.1553	**0.7138**	**0.7995**	− 0.0028	**− 0.3488**	**0.7716**	1.0000			
	(0.1928)	**(0.0000)**	**(0.0000)**	(0.9812)	**(0.0027)**	**(0.0000)**	–			
GAM_CAN	**− 0.3249**	**− 0.3946**	0.1571	0.0688	**0.3492**	0.1035	0.0024	1.0000		
	(0.0054)	**(0.0006)**	(0.1877)	(0.5655)	**(0.0026)**	(0.3870)	(0.9844)	–		
OB	− 0.1348	**− 0.6126**	**− 0.6211**	− 0.1637	**0.3234**	**− 0.9211**	**− 0.7522**	0.0178	1.0000	
	(0.2590)	**(0.0000)**	**(0.0000)**	(0.1695)	**(0.0056)**	**(0.0000)**	**(0.0000)**	(0.8822)	–	
BD	− 0.0250	0.1388	**− 0.2155**	− 0.0158	**0.3254**	**− 0.3556**	− 0.1844	**− 0.2866**	**0.2163**	1.0000
	(0.8347)	(0.2450)	**(0.0691)**	(0.8955)	**(0.0053)**	**(0.0022)**	(0.1209)	**(0.0146)**	**(0.0680)**	–

Table 3 (continued)

	GDP_DEN	RF_DEN	SD_DEN	XS_DEN	DY_DEN	NFX_DEN	NAM_DEN	GAM_DEN	OB	BD
Panel C: Denmark										
GDP_DEN	1.0000									
	–									
RF_DEN	− 0.0408	1.0000								
	(0.7338)	–								
SD_DEN	**− 0.4696**	− 0.0345	1.0000							
	(0.0000)	(0.7735)	–							
XS_DEN	0.1714	**− 0.3498**	**− 0.3675**	1.0000						
	(0.1501)	**(0.0026)**	**(0.0015)**	–						
DY_DEN	− 0.0815	**0.4136**	0.0007	− 0.0354	1.0000					
	(0.4961)	**(0.0003)**	(0.9957)	(0.7680)	–					
NFX_DEN	0.1520	**0.3920**	**− 0.2040**	0.0162	**0.4442**	1.0000				
	(0.2023)	**(0.0007)**	**(0.0857)**	(0.8929)	**(0.0001)**	–				
NAM_DEN	**− 0.2838**	**− 0.4952**	**0.6591**	− 0.1807	**− 0.3344**	**− 0.2872**	1.0000			
	(0.0157)	**(0.0000)**	**(0.0000)**	(0.1288)	**(0.0041)**	**(0.0144)**	–			
GAM_DEN	**− 0.3007**	0.1414	**0.2847**	− 0.1953	**0.4188**	**0.3377**	**0.2425**	1.0000		
	(0.0103)	(0.2361)	**(0.0154)**	(0.1001)	**(0.0003)**	**(0.0037)**	**(0.0402)**	–		
OB	− 0.1627	**− 0.4957**	**0.3399**	− 0.0842	**− 0.4746**	**− 0.7426**	**0.5527**	**− 0.2935**	1.0000	
	(0.1721)	**(0.0000)**	**(0.0035)**	(0.4819)	**(0.0000)**	**(0.0000)**	**(0.0000)**	**(0.0123)**	–	
BD	0.0094	**0.3553**	− 0.1796	− 0.0618	− 0.0904	**− 0.4673**	**− 0.3593**	**− 0.2027**	**0.2163**	1.0000
	(0.9379)	**(0.0022)**	(0.1311)	(0.6060)	(0.4500)	**(0.0000)**	**(0.0019)**	**(0.0877)**	**(0.0680)**	–

Table 3 (continued)

	GDP_MEX	RF_MEX	SD_MEX	XS_MEX	DY_MEX	NFX_MEX	NAM_MEX	GAM_MEX	OB	BD
Panel D: Mexico										
GDP_MEX	1.0000									
	–									
RF_MEX	− 0.0309	1.0000								
	(0.7967)	–								
SD_MEX	**− 0.3202**	**0.6481**	1.0000							
	(0.0061)	**(0.0000)**	–							
XS_MEX	0.1547	**− 0.2847**	**− 0.3996**	1.0000						
	(0.1946)	**(0.0154)**	**(0.0005)**	–						
DY_MEX	**− 0.3752**	**0.4866**	**0.3935**	− 0.0573	1.0000					
	(0.0012)	**(0.0000)**	**(0.0006)**	(0.6326)	–					
NFX_MEX	− 0.0614	**− 0.6409**	**− 0.3208**	0.1803	**− 0.3145**	1.0000				
	(0.6086)	**(0.0000)**	**(0.0060)**	(0.1297)	**(0.0071)**	–				
NAM_MEX	− 0.1215	**0.3278**	**0.2288**	− 0.0538	**0.3863**	**− 0.5757**	1.0000			
	(0.3093)	**(0.0049)**	**(0.0532)**	(0.6536)	**(0.0008)**	**(0.0000)**	–			
GAM_MEX	**− 0.3876**	**− 0.2163**	0.0633	0.0305	**0.3309**	0.1220	0.1781	1.0000		
	(0.0008)	**(0.0680)**	(0.5973)	(0.7995)	**(0.0045)**	(0.3075)	(0.1344)	–		
OB	0.1154	**− 0.6273**	**− 0.4285**	0.0940	**− 0.4167**	**0.5468**	**− 0.6438**	− 0.0276	1.0000	
	(0.3342)	**(0.0000)**	**(0.0002)**	(0.4321)	**(0.0003)**	**(0.0000)**	**(0.0000)**	(0.8177)	–	
BD	0.1167	− 0.1396	**− 0.1989**	0.1054	− 0.0558	− 0.1462	− 0.0431	**− 0.3024**	**0.2163**	1.0000
	(0.3288)	(0.2422)	**(0.0939)**	(0.3780)	(0.6417)	(0.2205)	(0.7193)	**(0.0098)**	**(0.0680)**	–

Table 3 (continued)

	GDP_BRA	RF_BRA	SD_BRA	XS_BRA	DY_BRA	NFX_BRA	NAM_BRA	GAM_BRA	OB	BD
Panel E: Brazil										
GDP_BRA	1.0000									
	–									
RF_BRA	**− 0.2435**	1.0000								
	(0.0393)	–								
SD_BRA	**− 0.2874**	**0.4819**	1.0000							
	(0.0144)	**(0.0000)**	–							
XS_BRA	**0.2062**	0.1006	**− 0.3056**	1.0000						
	(0.0822)	(0.4006)	**(0.0090)**	–						
DY_BRA	**− 0.3674**	**0.7321**	**0.4239**	0.0747	1.0000					
	(0.0015)	**(0.0000)**	**(0.0002)**	(0.5329)	–					
NFX_BRA	**− 0.2184**	0.0324	**− 0.2244**	0.0679	**0.3602**	1.0000				
	(0.0653)	(0.7868)	**(0.0580)**	(0.5708)	**(0.0019)**	–				
NAM_BRA	0.1510	**0.6634**	**0.2295**	**0.3305**	**0.5137**	0.1176	1.0000			
	(0.2056)	**(0.0000)**	**(0.0524)**	**(0.0046)**	**(0.0000)**	(0.3251)	–			
GAM_BRA	− 0.1463	− 0.1217	− 0.0747	− 0.0303	**0.2355**	**0.2775**	− 0.1008	1.0000		
	(0.2202)	(0.3086)	(0.5330)	(0.8007)	**(0.0464)**	**(0.0183)**	(0.3995)	–		
OB	0.1246	**− 0.7847**	**− 0.4069**	− 0.1116	**− 0.6572**	**− 0.2285**	**− 0.6583**	0.0247	1.0000	
	(0.2972)	**(0.0000)**	**(0.0004)**	(0.3506)	**(0.0000)**	**(0.0535)**	**(0.0000)**	(0.8368)	–	
BD	**0.4405**	− 0.1828	− 0.0139	0.0659	**− 0.4006**	− 0.0916	0.1057	**− 0.3123**	**0.2163**	1.0000
	(0.0001)	(0.1244)	(0.9080)	(0.5824)	**(0.0005)**	(0.4443)	(0.3771)	**(0.0076)**	**(0.0680)**	–

Table 3 (continued)

	GDP_SIN	RF_SIN	SD_SIN	XS_SIN	DY_SIN	NFX_SIN	NAM_SIN	GAM_SIN	OB	BD
Panel F: Singapore										
GDP_SIN	1.0000									
	–									
RF_SIN	− 0.1441	1.0000								
	(0.2271)	–								
SD_SIN	**− 0.2042**	**0.6062**	1.0000							
	(0.0854)	**(0.0000)**	–							
XS_SIN	**0.2836**	− 0.0698	0.0776	1.0000						
	(0.0158)	(0.5603)	(0.5171)	–						
DY_SIN	**− 0.3161**	0.1182	**0.3437**	− 0.0891	1.0000					
	(0.0068)	(0.3227)	**(0.0031)**	(0.4568)	–					
NFX_SIN	0.0322	**0.4854**	**0.5891**	0.1118	**− 0.2230**	1.0000				
	(0.7880)	**(0.0000)**	**(0.0000)**	(0.3499)	**(0.0597)**	–				
NAM_SIN	− 0.1825	0.1297	**0.3112**	− 0.0801	− 0.1887	**0.6999**	1.0000			
	(0.1249)	(0.2774)	**(0.0078)**	(0.5037)	(0.1124)	**(0.0000)**	–			
GAM_SIN	− 0.1667	**− 0.5770**	0.0241	− 0.0125	0.1275	0.0430	**0.3542**	1.0000		
	(0.1615)	**(0.0000)**	(0.8405)	(0.9168)	(0.2859)	(0.7198)	**(0.0023)**	–		
OB	− 0.0027	**− 0.4825**	**− 0.6441**	− 0.1534	0.0406	**− 0.9018**	**− 0.5909**	− 0.0407	1.0000	
	(0.9823)	**(0.0000)**	**(0.0000)**	(0.1984)	(0.7348)	**(0.0000)**	**(0.0000)**	(0.7345)	–	
BD	0.0964	0.1014	− 0.0650	− 0.0418	**− 0.2188**	0.0039	− 0.1902	**− 0.3007**	**0.2163**	1.0000
	(0.4207)	(0.3969)	(0.5876)	(0.7273)	**(0.0648)**	(0.9739)	(0.1095)	**(0.0103)**	**(0.0680)**	–

Table 3 (continued)

	GDP_UK	RF_UK	SD_UK	XS_UK	DY_UK	NFX_UK	NAM_UK	GAM_UK	OB	BD
Panel G: UK										
GDP_UK	1.0000									
	–									
RF_UK	0.1702	1.0000								
	(0.1528)	–								
SD_UK	**− 0.6366**	− 0.0023	1.0000							
	(0.0000)	(0.9845)	–							
XS_UK	**0.2038**	**− 0.2003**	**− 0.3479**	1.0000						
	(0.0860)	**(0.0916)**	**(0.0028)**	–						
DY_UK	**− 0.6374**	− 0.0999	**0.8611**	− 0.1071	1.0000					
	(0.0000)	(0.4040)	**(0.0000)**	(0.3704)	–					
NFX_UK	− 0.0080	**− 0.3669**	0.1863	0.0558	**0.3559**	1.0000				
	(0.9467)	**(0.0015)**	(0.1172)	(0.6418)	**(0.0022)**	–				
NAM_UK	**− 0.4964**	− 0.0899	**0.8093**	**− 0.2715**	**0.7738**	**0.2518**	1.0000			
	(0.0000)	(0.4526)	**(0.0000)**	**(0.0210)**	**(0.0000)**	**(0.0328)**	–			
GAM_UK	**− 0.2591**	**− 0.3516**	**0.4343**	− 0.0028	**0.6382**	**0.5580**	**0.6237**	1.0000		
	(0.0280)	**(0.0025)**	**(0.0001)**	(0.9815)	**(0.0000)**	**(0.0000)**	**(0.0000)**	–		
OB	**− 0.2585**	**− 0.6490**	− 0.0424	− 0.0373	− 0.1524	**− 0.2168**	− 0.0444	− 0.0495	1.0000	
	(0.0284)	**(0.0000)**	(0.7236)	(0.7559)	(0.2011)	**(0.0674)**	(0.7110)	(0.6799)	–	
BD	− 0.1606	**0.3322**	0.0462	− 0.1287	− 0.1263	**− 0.7778**	0.0063	**− 0.3020**	**0.2163**	1.0000
	(0.1778)	**(0.0044)**	(0.7001)	(0.2813)	(0.2905)	**(0.0000)**	(0.9582)	**(0.0099)**	**(0.0680)**	–

Table 3 (continued)

	GDP_GER	RF_GER	SD_GER	XS_GER	DY_GER	NFX_GER	NAM_GER	GAM_GER	OB	BD
Panel H: Germany										
GDP_GER	1.0000									
	–									
RF_GER	− 0.0656	1.0000								
	(0.5843)	–								
SD_GER	**− 0.2988**	**0.5179**	1.0000							
	(0.0108)	**(0.0000)**	–							
XS_GER	0.1853	**−0.3286**	**−0.2047**	1.0000						
	(0.1191)	**(0.0048)**	**(0.0845)**	–						
DY_GER	**−0.6891**	**−0.2052**	**0.3188**	−0.1633	1.0000					
	(0.0000)	**(0.0838)**	**(0.0063)**	(0.1705)	–					
NFX_GER	−0.0103	**0.4087**	**0.4604**	−0.1331	**−0.2179**	1.0000				
	(0.9318)	**(0.0004)**	**(0.0000)**	(0.2651)	**(0.0659)**	–				
NAM_GER	**−0.4378**	0.0514	**0.4703**	−0.1578	**0.5303**	0.1901	1.0000			
	(0.0001)	(0.6682)	**(0.0000)**	(0.1855)	**(0.0000)**	(0.1097)	–			
GAM_GER	**−0.3312**	**−0.3213**	**0.2603**	−0.1196	**0.4925**	0.1232	**0.4989**	1.0000		
	(0.0045)	**(0.0059)**	**(0.0272)**	(0.3169)	**(0.0000)**	(0.3026)	**(0.0000)**	–		
OB	0.0814	**−0.4723**	**−0.5036**	−0.0481	**0.2495**	**−0.7444**	−0.1543	0.1307	1.0000	
	(0.4969)	**(0.0000)**	**(0.0000)**	(0.6884)	**(0.0345)**	**(0.0000)**	(0.1955)	(0.2740)	–	
BD	0.0626	**0.4041**	−0.1430	−0.0600	−0.1335	**−0.4671**	−0.0852	**−0.5422**	**0.2163**	1.0000
	(0.6017)	**(0.0004)**	(0.2309)	(0.6166)	(0.2637)	**(0.0000)**	(0.4768)	**(0.0000)**	**(0.0680)**	–

Table 3 (continued)

	GDP_JAP	RF_JAP	SD_JAP	XS_JAP	DY_JAP	NFX_JAP	NAM_JAP	GAM_JAP	OB	BD
Panel I: Japan										
GDP_JAP	1.0000									
	–									
RF_JAP	**−0.2882**	1.0000								
	(0.0141)	–								
SD_JAP	**−0.3559**	**0.3929**	1.0000							
	(0.0022)	**(0.0006)**	–							
XS_JAP	**0.2092**	**−0.3053**	**−0.2611**	1.0000						
	(0.0777)	**(0.0091)**	**(0.0267)**	–						
DY_JAP	**−0.3041**	**0.2359**	0.1173	−0.1377	1.0000					
	(0.0094)	**(0.0461)**	(0.3264)	(0.2486)	–					
NFX_JAP	−0.0203	0.0529	0.1410	0.0200	**−0.6886**	1.0000				
	(0.8653)	(0.6591)	(0.2375)	(0.8674)	**(0.0000)**	–				
NAM_JAP	−0.1370	0.0685	**0.5411**	−0.0376	**−0.3452**	**0.4329**	1.0000			
	(0.2512)	(0.5677)	**(0.0000)**	(0.7537)	**(0.0030)**	**(0.0001)**	–			
GAM_JAP	−0.0763	**−0.2265**	**0.2662**	−0.0820	**0.3894**	**−0.3094**	0.1316	1.0000		
	(0.5240)	**(0.0557)**	**(0.0238)**	(0.4934)	**(0.0007)**	**(0.0082)**	(0.2706)	–		
OB	0.0099	0.1352	**−0.3455**	−0.0689	**0.6219**	**−0.7210**	**−0.7261**	−0.0495	1.0000	
	(0.9344)	(0.2576)	**(0.0030)**	(0.5653)	**(0.0000)**	**(0.0000)**	**(0.0000)**	(0.6799)	–	
BD	0.0929	**0.5434**	−0.1380	−0.1426	−0.1420	0.0140	**−0.3783**	**−0.3019**	**0.2163**	1.0000
	(0.4376)	**(0.0000)**	(0.2478)	(0.2320)	(0.2340)	(0.9071)	**(0.0011)**	**(0.0100)**	**(0.0680)**	–

Table 3 (continued)

	GDP_FRA	RF_FRA	SD_FRA	XS_FRA	DY_FRA	NFX_FRA	NAM_FRA	GAM_FRA	OB	BD
Panel J: France										
GDP_FRA	1.0000									
	–									
RF_FRA	0.0994	1.0000								
	(0.4059)	–								
SD_FRA	**−0.2889**	**0.4547**	1.0000							
	(0.0138)	**(0.0001)**	–							
XS_FRA	**0.2418**	**−0.2543**	**−0.3822**	1.0000						
	(0.0407)	**(0.0311)**	**(0.0009)**	–						
DY_FRA	**−0.7111**	**−0.2604**	**0.4804**	**−0.2140**	1.0000					
	(0.0000)	**(0.0271)**	**(0.0000)**	**(0.0710)**	–					
NFX_FRA	**0.2803**	**0.4090**	**0.3734**	−0.0217	−0.1638	1.0000				
	(0.0171)	**(0.0004)**	**(0.0012)**	(0.8565)	(0.1693)	–				
NAM_FRA	0.1498	**0.5085**	**0.5388**	−0.0081	0.0798	**0.6086**	1.0000			
	(0.2093)	**(0.0000)**	**(0.0000)**	(0.9464)	(0.5050)	**(0.0000)**	–			

Table 3 (continued)

	GDP_FRA	RF_FRA	SD_FRA	XS_FRA	DY_FRA	NFX_FRA	NAM_FRA	GAM_FRA	OB	BD
GAM_FRA	**−0.4532**	−0.1119	**0.5046**	**−0.1994**	**0.8024**	0.1845	**0.2821**	1.0000		
	(0.0001)	(0.3493)	**(0.0000)**	**(0.0931)**	**(0.0000)**	(0.1208)	**(0.0163)**	–		
OB	**−0.3360**	**−0.4728**	**−0.3684**	−0.0973	**0.2393**	**−0.7444**	**−0.7176**	−0.0451	1.0000	
	(0.0039)	**(0.0000)**	**(0.0015)**	(0.4159)	**(0.0429)**	**(0.0000)**	**(0.0000)**	(0.7066)	–	
BD	−0.0400	**0.4036**	**−0.2041**	−0.1291	**−0.2311**	**−0.4671**	**−0.2573**	**−0.3008**	**0.2163**	1.0000
	(0.7390)	**(0.0004)**	**(0.0856)**	(0.2798)	**(0.0508)**	**(0.0000)**	**(0.0291)**	**(0.0102)**	**(0.0680)**	–

The table shows correlation coefficients between all variables used in our analysis. The associated *p* values are reported in parentheses below each correlation coefficient. GDP is quarterly real gross domestic product growth. RF is the quarterly risk-free rate of the respective countries. SD is the standard deviation/market volatility and DY is the dividend yield, which are calculated as the cross-sectional average for all stocks of the respective countries in our sample. XS is excess market returns, which is the cross-sectional average returns for all stocks in excess of the RF of the respective countries. NFX is the national foreign exchange relative to USD. Amihud (AM) is our illiquidity measure, and the prefix "N" in front of it refers to national illiquidity based on Amihud (NAM), while the prefix "G" refers to global illiquidity based on Amihud (GAM). Global illiquidity is constructed as in Brockman et al. (2009) and Galariotis and Giouvris (2015) whereby global illiquidity is created by combining all countries except the country nominated for the test. OB is crude oil Brent price, while BD is the Baltic Dry index. Correlations presented below are for raw data. The sample period is from January 1998 to December 2015, consisting of 72 quarterly observations. All data are obtained from DataStream, Bloomberg, World Bank, and the US Energy Information Administration (EIA) website

Bold indicates significance

financial variables and predictive variables as well as correlations among predictive variables themselves.[19] If the reader wishes to avoid the discussion that follows, the reader can skip to the last paragraph where everything is summarized in just 4 points.

Similar to Galariotis and Giouvris (2015), it appears that *standard deviation* (*SD*) (*or market volatility*) *and dividend yield* (*DY*) are negative and significantly correlated to GDP for most countries, with the exception of Norway and Canada. Six (6) countries have *excess market returns* (*XS*) that are positively correlated to GDP, signifying that as excess market returns increase GDP also improves. The *risk-free rate* (*RF*) shows less consistent results, as only two (2) countries are found to be negatively correlated to GDP. The negative correlation between the risk-free rate and GDP is expected since as the interest rate falls, investment increases and this brings about an increase in GDP.

Correlations between GDP and the predictive variables show that out of the five (5) predictive variables, illiquidity variables appear to be more strongly correlated to GDP. Between national (NAM) and global illiquidity (GAM), the latter seems to be more important as six (6) countries out of 10 exhibit significant correlations to GDP, while for national illiquidity (NAM) only four (4) countries show correlations.

[19] Financial and predictive variables are used in the same regression; therefore, it is necessary to know their correlations in order to avoid introducing multicollinearity. However, we do not discuss correlations between financial variables and predictive variables as well as correlations among predictive variables themselves in the main body of this section in order to keep it sorter. A discussion follows below: correlations between financial variables, and the predictive variables show that the *risk-free rate* (*RF*), *standard deviation* (*SD*) and *dividend yield* (*DY*) are correlated with all the predictive variables in at least four (4) countries. Standard deviation is found to be positively correlated to *national illiquidity* (*NAM*) for all ten (10) countries, while DY correlates positively to *global illiquidity* (*GAM*) for nine (9) countries with the exception of Singapore. DY also correlates with NAM for eight countries, and hence, DY appears to have the closest relationship with both illiquidity variables. RF, SD, and DY appear to show a strong relationship with *national foreign exchange* (*NFX*), as all three (3) financial variables are significantly correlated in eight (8) countries. In relation to oil, both RF and SD are significantly correlated to *crude oil Brent* (*OB*) in nine countries with the exception of Japan and UK, respectively, which are both net oil-importing countries. For DY, the correlation with OB can be observed in seven (7) countries except for Norway, UK, and Singapore. The financial variables relationship with the *Baltic Dry index* (*BD*) is weaker. Both DY and RF correlate with BD in five (5) countries, while SD shows a relationship in four countries. Nevertheless, the weakest correlation is shown by *excess market returns* (*XS*) as it is not significantly correlated with NFX, OB, and BD. XS is correlated to the illiquidity variables in only three (3) countries for NAM and one (1) country for GAM, namely France.

Among the predictive variables, *national foreign exchange* (*NFX*) is significantly correlated with *crude oil Brent* (*OB*) for all countries and the relationship appears to be negative with the exception of Mexico. The negative relationship signifies that there may be a benefit for the economies of net oil exporters as an increase in oil prices will be boosted by the strengthening of their NFX. Mexico may not benefit from the positive relationship, as an increase in oil price will be offset by the weakening of Mexico's NFX relative to USD. Similarly, the negative relationship may not be beneficial for net oil-importing countries. As oil price decreases, their NFX weakens relative to USD and there will be no opportunity to purchase oil at a cheaper price. Oil (OB) is also found to be positively correlated to the *Baltic Dry index* (*BD*), and in a way, this somehow justifies some researchers' usage of the BD to estimate oil demand such as Wang et al. (2013). *Global illiquidity* (*GAM*) is also found to be significantly correlated to BD for all countries, but the correlation is negative. Surprisingly, *national illiquidity* (*NAM*) and GAM, which are used to measure illiquidity, are found to be positively correlated in only six (6) countries except for Canada, Mexico, Brazil, and Japan.

As expected, the two (2) illiquidity variables consistently show negative correlations to GDP, indicating that GDP increases with a decrease in illiquidity (or increase in market liquidity).

Correlations are less noticeable for the other three predictive variables. The Baltic Dry index (BD) and foreign exchange (NFX) show no significant correlations with GDP. (Only 2 countries out of 10 appear to show significant values.) In relation to crude oil Brent (OB), only the GDP of UK and France show significant negative correlations to oil as expected since they are oil importers.

Overall, the main message from this section is that

1. Financial variables have stronger correlations to GDP in comparison with predictive variables. *Standard deviation* (*SD*) appears to relate to GDP of most countries.
2. Among the predictive variables, *global illiquidity* (*GAM*) is found to have the strongest relationship with countries' GDP, while the *Baltic Dry index* (*BD*) and *crude oil Brent* (*OB*) are found to be less correlated to GDP.
3. Financial variables and predictive variables appear to show some significant correlations to each other.
4. Oil (OB) is found to be positively correlated to BD, and this somehow justifies some researchers' usage of the BD to estimate oil demand.

Finally (and this justifies why it is important to present correlations between all variables), significant correlations between financial and predictive variables used in the same regression(s), necessitate orthogonalization.

4.3 In sample prediction of economic growth

4.3.1 Stationarity and orthogonalization

In this section, we test the data for stationarity before conducting any further analysis, as non-stationary[20] data will result in potentially unreliable and biased outcomes. We conduct six (6) stationarity tests, namely the augmented Dickey–Fuller (ADF) test, GLS detrended Dickey–Fuller (DFGLS) test, Phillips–Perron (PP) test, Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test, Elliot, Rothenberg and stock point optimal (ERS) test and the Ng and Perron (NP) test on all the variables, and if the variable examined satisfies at least four (4) of the stationarity tests, we consider the variable as stationary.[21] The variables have been differenced to become stationary if the variable is deemed non-stationary. The variables that have been differenced have a D in brackets at the back of the name of the variable in the tables.[22]

[20] Results of stationarity tests are available upon request. They are not presented to keep the number of tables presented as small as possible.

[21] We have used EViews to run stationarity tests.

[22] Comparing our variables to the variables that have been used in Galariotis and Giouvris (2015), we find that we had to differentiate the same variables making our results easily comparable.

The correlation analysis also shows that most independent variables are correlated to each other, signifying the possibility of biased results due to multicollinearity. Thus, in order to avoid multicollinearity, we have also orthogonalized all the relevant variables using the same technique utilized by Brockman et al. (2009) and Galariotis and Giouvris (2015). For example, in order to orthogonalize the explanatory variables X_1, X_2, and X_3, we run the following regressions: $X_1 = c + X_2 + X_3 +$ residualsX_1 and $X_2 = c + X_3 +$ residualsX_2. From those 2 regressions we obtain: residualsX_1 and residualsX_2. By running those 2 regressions, we remove the effects of X_2 and X_3 from X_1 and the effect of X_3 from X_2. X_3 remains as it is. This means that residualsX_1, residuals X_2, and X_3 are independent from each other and their correlations are zero. Multicollinearity is not an issue. Then, we use residualsX_1, residualsX_2 and X_3 in order to explain Y. The regression we use to explain Y is as follows: Y = c + residualsX_1 + residualsX_2 + X_3 + error term.[23]

4.3.2 Predicting economic growth using individual variables

We estimate the following model to assess the predictive ability of our independent variables:

$$Y_{t+1} = \alpha + \beta' FV_t + \gamma' X_t + \varepsilon_{t+1} \tag{3}$$

where Y_{t+1} is the realized growth of our macroeconomic variable, GDP, one quarter ahead (t + 1); FV_t are the control variables at contemporaneous quarter t and contain the following financial variables (FV): the risk-free rate (RF), standard deviation, or market volatility (SD), excess market returns (XS), dividend yield (DY), at least one lag of the dependent variable (GDP), and more lags of the GDP if autocorrelation remains in the residuals. X_t contains the following predictive variables: national foreign exchange (NFX), national illiquidity (NAM), global illiquidity (GAM), crude oil Brent (OB), and Baltic Dry index (BD). β' and γ' are the vector of coefficient estimates for the financial variables (or control variables) and predictive variables, respectively, and ε is the error term.

In Table 4, we run six different regression models in order to identify the contribution of our predictive variables to economic growth. The first regression model includes one lag of the dependent variable and financial variables only. The following five regression models use the same variables as the first regression model, but we add one predictive variable at a time. This is repeated for all countries. Table 4 shows that only France requires an additional lag of the dependent variable (GDP), as initially there is an autocorrelation in the residuals. We have reported both regressions in panels J and K, respectively.

Our first regression model which includes only financial variables shows that excess market returns (XS) is the most relevant variable as it is positive and significant for six (6) countries, namely Norway, Denmark, Mexico, Brazil, Singapore, and France. Standard deviation (SD), dividend yield (DY), and the risk-free rate (RF) are less important.

23 The actual number of variables orthogonalized here is much higher. We do this for all explanatory variables.

Table 4 In sample prediction of economic growth using individual predictive variables for all ten (10) countries

	Cons	GDP	RF (D)	SD	XS	DY	X	Adj. R^2	Q Stat	LM Test
Panel A: Norway										
GDPt + 1 = FV	**0.0051**	**−0.2535**	**0.2311**	−0.1355	**0.2399**	−0.0038		0.1364	0.8170	0.6087
	(0.0000)	**(0.0044)**	**(0.0402)**	(0.1265)	**(0.0738)**	(0.9787)				
GDPt + 1 = FV + FX (D)	**0.0052**	**−0.2663**	**0.2278**	−0.1353	**0.2423**	−0.0036	−0.1317	0.1415	0.6880	0.3815
	(0.0001)	**(0.0157)**	**(0.0332)**	(0.1249)	**(0.0751)**	(0.9788)	(0.3373)			
GDPt + 1 = FV + NAM	**0.0053**	**−0.2833**	**0.2230**	−0.1354	**0.2448**	−0.0043	−0.1586	0.1494	0.7600	0.5067
	(0.0001)	**(0.0086)**	**(0.0402)**	(0.1614)	**(0.0651)**	(0.9776)	(0.1199)			
GDPt + 1 = FV + GAM	**0.0052**	**−0.2576**	**0.2303**	−0.1351	**0.2412**	−0.0031	−0.0168	0.1230	0.8260	0.6258
	(0.0000)	**(0.0038)**	**(0.0299)**	(0.1450)	**(0.0822)**	(0.9825)	(0.8515)			
GDPt + 1 = FV + OB (D)	**0.0051**	**−0.2514**	**0.2312**	−0.1361	**0.2387**	−0.0049	**0.1356**	0.1428	0.9840	0.9645
	(0.0002)	**(0.0240)**	**(0.0199)**	(0.1614)	**(0.0774)**	(0.9673)	**(0.0408)**			
GDPt + 1 = FV + BD	**0.0054**	**−0.2531**	**0.2314**	**−0.1353**	**0.2402**	−0.0034	−0.0220	0.1232	0.8300	0.6333
	Cons	GDP	RF (D)	SD	XS	DY (D)	X	Adj. R^2	Q Stat	LM Test
Panel B: Canada										
GDPt + 1 = FV	**0.0022**	**0.6044**	−0.0947	0.0542	0.1608	−0.1155		0.3102	0.6280	0.4036
	(0.0760)	**(0.0001)**	(0.2628)	(0.6433)	(0.1510)	(0.4877)				
GDPt + 1 = FV + FX (D)	**0.0022**	**0.6048**	−0.0948	0.0542	0.1608	−0.1156	0.0096	0.2993	0.6160	0.3872
	(0.0819)	**(0.0001)**	(0.2756)	(0.6448)	(0.1567)	(0.4853)	(0.9004)			
GDPt + 1 = FV + NAM (D)	**0.0021**	**0.6337**	−0.1032	0.0546	0.1602	−0.1211	**0.1502**	0.3231	0.7960	0.6476
	(0.0920)	**(0.0000)**	(0.1726)	(0.6239)	(0.1350)	(0.4960)	**(0.0181)**			
GDPt + 1 = FV + GAM	**0.0024**	**0.5761**	−0.0864	0.0535	0.1609	−0.1106	−0.0801	0.3055	0.6070	0.3568
	(0.0559)	**(0.0002)**	(0.3052)	(0.6362)	(0.1454)	(0.5404)	(0.3817)			

Table 4 (continued)

	Cons	GDP	RF (D)	SD	XS	DY (D)	X	Adj. R^2	Q Stat	LM Test
GDPt + 1 = FV + OB (D)	**0.0032**	**0.4330**	− 0.0447	0.0525	0.1666	**− 0.0810**	**0.4754**	0.5185	0.7020	0.5983
	(0.0000)	**(0.0000)**	(0.5386)	(0.5852)	(0.1034)	**(0.0929)**	**(0.0000)**			
GDPt + 1 = FV + BD	**0.0029**	**0.6024**	**− 0.0940**	0.0539	**0.1603**	**− 0.1157**	**− 0.0846**	0.3070	0.7340	0.5572
	(0.0000)	**(0.0000)**	**(0.0001)**	(0.2703)	**(0.0000)**	**(0.0628)**	**(0.0011)**			
	Cons	GDP	RF (D)	SD	XS	DY	X	Adj. R^2	Q Stat	LM Test
Panel C: Denmark										
GDPt + 1 = FV	**0.0024**	0.0701	0.1431	**− 0.2604**	**0.2997**	0.0504		0.1377	0.8120	0.5718
	(0.0326)	(0.6167)	(0.1145)	**(0.0200)**	**(0.0391)**	(0.7196)				
GDPt + 1 = FV + FX (D)	**0.0024**	0.0634	0.1437	**− 0.2625**	**0.2997**	0.0513	0.0710	0.1295	0.8910	0.7486
	(0.0411)	(0.6684)	(0.1039)	**(0.0179)**	**(0.0498)**	(0.7045)	(0.5748)			
GDPt + 1 = FV + NAM (D)	**0.0024**	0.0811	**0.1420**	**− 0.2571**	**0.2999**	0.0486	− 0.0981	0.1345	0.8740	0.6878
	(0.0511)	(0.5606)	**(0.0434)**	**(0.0261)**	**(0.0751)**	(0.6640)	(0.3900)			
GDPt + 1 = FV + GAM	**0.0026**	− 0.0066	**0.1485**	**− 0.2857**	**0.3021**	0.0583	**− 0.2519**	0.1879	0.9800	0.9558
	(0.0319)	(0.9643)	**(0.0253)**	**(0.0052)**	**(0.0716)**	(0.5825)	**(0.0068)**			
GDPt + 1 = FV + OB (D)	**0.0026**	− 0.0271	**0.1512**	**− 0.2910**	**0.3003**	0.0632	**0.2603**	0.1892	0.6760	0.3324
	(0.0101)	(0.8205)	**(0.0791)**	**(0.0033)**	**(0.0219)**	(0.6499)	**(0.0019)**			
GDPt + 1 = FV + BD	**0.0036**	0.0723	**0.1426**	**− 0.2601**	**0.3003**	0.0494	− 0.1183	0.1394	0.6820	0.3386
	(0.0077)	(0.6164)	**(0.0287)**	**(0.0148)**	**(0.0675)**	(0.6583)	(0.1394)			

Table 4 (continued)

	Cons	GDP	RF (D)	SD	XS	DY	X	Adj. R^2	Q Stat	LM Test
Panel D: Mexico										
GDPt + 1 = FV	**0.0034**	**0.4185**	0.1083	0.0579	**0.2978**	**−0.1548**		0.2994	0.9250	0.8659
	(0.0339)	**(0.0049)**	(0.2023)	(0.6174)	**(0.0003)**	**(0.0185)**				
GDPt + 1 = FV + FX (D)	**0.0034**	**0.4222**	0.1084	0.0583	**0.2975**	**−0.1539**	−0.1335	0.3077	0.8810	0.7889
	(0.0506)	**(0.0110)**	(0.3079)	(0.6428)	**(0.0022)**	**(0.0637)**	(0.1627)			
GDPt + 1 = FV + NAM (D)	**0.0034**	**0.4167**	0.1083	0.0577	**0.2980**	**−0.1552**	−0.0443	0.2904	0.8960	0.8150
	(0.0260)	**(0.0023)**	(0.1669)	(0.6058)	**(0.0005)**	**(0.0173)**	(0.6882)			
GDPt + 1 = FV + GAM	**0.0036**	**0.3806**	0.1077	0.0525	**0.3018**	**−0.1646**	−0.0993	0.2976	0.9950	0.9901
	(0.0139)	**(0.0030)**	(0.1297)	(0.5962)	**(0.0005)**	**(0.0136)**	(0.1667)			
GDPt + 1 = FV + OB (D)	**0.0045**	**0.2262**	0.1046	0.0378	**0.3172**	**−0.1959**	**0.5002**	0.5247	0.8080	0.7355
	(0.0000)	**(0.0022)**	(0.1555)	(0.6167)	**(0.0000)**	**(0.0087)**	**(0.0032)**			
GDPt + 1 = FV + BD	**0.0040**	**0.4265**	0.1085	0.0583	**0.2971**	**−0.1536**	−0.0641	0.2927	0.7970	0.6458
	(0.0049)	**(0.0009)**	(0.1094)	(0.5644)	**(0.0003)**	**(0.0181)**	(0.2314)			
	Cons	GDP	RF (D)	SD	XS	DY	X	Adj. R^2	Q Stat	LM Test
Panel E: Brazil										
GDPt + 1 = FV	**0.0039**	**0.3501**	−0.1723	−0.0232	**0.2434**	0.0240		0.1885	0.9470	0.8912
	(0.0203)	**(0.0059)**	(0.1316)	(0.8309)	**(0.0589)**	(0.7935)				
GDPt + 1 = FV + FX (D)	**0.0039**	**0.3372**	−0.1735	−0.0209	**0.2453**	0.0201	**−0.1953**	0.2172	0.6920	0.4386
	(0.0105)	**(0.0072)**	(0.1601)	(0.8308)	**(0.0472)**	(0.8135)	**(0.0115)**			
GDPt + 1 = FV + NAM (D)	**0.0039**	**0.3507**	−0.1721	−0.0232	**0.2434**	0.0241	0.0634	0.1800	0.9540	0.8986
	(0.0306)	**(0.0111)**	(0.2275)	(0.8194)	**(0.0522)**	(0.7836)	(0.3708)			
GDPt + 1 = FV + GAM	**0.0038**	**0.3563**	−0.1708	−0.0219	**0.2430**	0.0245	0.1132	0.1896	0.9690	0.9378
	(0.0195)	**(0.0059)**	(0.1801)	(0.8198)	**(0.0522)**	(0.7779)	(0.3161)			

Table 4 (continued)

	Cons	GDP	RF (D)	SD	XS	DY	*X*	Adj. R^2	*Q* Stat	LM Test
GDPt + 1 = FV + OB (D)	**0.0046**	0.2415	−0.1894	−0.0222	**0.2554**	0.0015	**0.2490**	0.2316	0.7530	0.5556
	(0.0580)	(0.1006)	(0.2921)	(0.8381)	**(0.0430)**	(0.9883)	**(0.0002)**			
GDPt + 1 = FV + BD	0.0025	**0.2931**	−0.1810	−0.0220	**0.2499**	0.0118	0.1228	0.1889	0.8130	0.6098
	(0.3010)	**(0.0291)**	(0.2469)	(0.8153)	**(0.0648)**	(0.8968)	(0.2774)			
	Cons	GDP	RF (D)	SD (D)	XS	DY	*X*	Adj. R^2	*Q* Stat	LM Test
Panel F: Singapore										
GDPt + 1 = FV	**0.0130**	0.0955	0.1346	**−0.2399**	**0.3113**	0.0302		0.1272	0.8060	0.5499
	(0.0001)	(0.3999)	(0.1422)	**(0.0514)**	**(0.0195)**	(0.7356)				
GDPt + 1 = FV + FX (D)	**0.0130**	0.0961	0.1346	**−0.2399**	**0.3112**	0.0303	0.0157	0.1136	0.8280	0.5902
	(0.0002)	(0.3971)	(0.1376)	**(0.0494)**	**(0.0211)**	(0.7358)	(0.8871)			
GDPt + 1 = FV + NAM (D)	**0.0130**	0.0945	0.1346	**−0.2398**	**0.3115**	0.0300	−0.0061	0.1134	0.7970	0.5303
	(0.0002)	(0.4109)	(0.1494)	**(0.0542)**	**(0.0180)**	(0.7388)	(0.9245)			
GDPt + 1 = FV + GAM	**0.0128**	0.1051	**0.1335**	**−0.2403**	**0.3092**	0.0318	0.0474	0.1157	0.7800	0.4963
	(0.0000)	(0.2860)	**(0.0906)**	**(0.0484)**	**(0.0232)**	(0.6953)	(0.5321)			
GDPt + 1 = FV + OB (OB)	**0.0138**	0.0321	0.1357	**−0.2333**	**0.3252**	0.0166	**0.2156**	0.1603	0.9140	0.8017
	(0.0000)	(0.7597)	(0.1031)	**(0.0206)**	**(0.0258)**	(0.8180)	**(0.0001)**			
GDPt + 1 = FV + BD	**0.0131**	0.0962	0.1346	**−0.2400**	**0.3112**	0.0303	−0.0069	0.1134	0.7980	0.5321
	(0.0001)	(0.3542)	(0.1152)	**(0.0533)**	**(0.0219)**	(0.7183)	(0.9459)			

Table 4 (continued)

	Cons	GDP	RF (D)	SD	XS	DY	*X*	Adj. R^2	*Q* Stat	LM Test
Panel G: UK										
GDPt + 1 = FV	0.0015	**0.6893**	0.0104	**−0.1587**	0.0110	0.0682		0.4330	0.7210	0.5995
	(0.2699)	**(0.0003)**	(0.9143)	**(0.0014)**	(0.8764)	(0.4233)				
GDPt + 1 = FV + FX (D)	0.0016	**0.6688**	0.0098	**−0.1584**	0.0116	0.0617	−0.0879	0.4320	0.7750	0.6749
	(0.2295)	**(0.0003)**	(0.9192)	**(0.0015)**	(0.8583)	(0.5068)	(0.3293)			
GDPt + 1 = FV + NAM	0.0017	**0.6496**	0.0094	**−0.1582**	0.0121	0.0556	**−0.1283**	0.4404	0.8520	0.7732
	(0.1945)	**(0.0003)**	(0.9112)	**(0.0031)**	(0.8724)	(0.5667)	**(0.0990)**			
GDPt + 1 = FV + GAM	0.0015	**0.6849**	0.0105	**−0.1588**	0.0112	0.0668	−0.0132	0.4241	0.7450	0.6187
	(0.2958)	**(0.0011)**	(0.8970)	**(0.0002)**	(0.8645)	(0.5348)	(0.8339)			
GDPt + 1 = FV + OB (D)	0.0015	**0.6875**	0.0104	**−0.1587**	0.0110	0.0676	0.0037	0.4240	0.7210	0.5998
	(0.3528)	**(0.0044)**	(0.9060)	**(0.0002)**	(0.8693)	(0.5149)	(0.9750)			
GDPt + 1 = FV + BD	**0.0039**	**0.6416**	0.0120	**−0.1601**	0.0131	0.0530	**−0.2738**	0.5038	0.3310	0.1594
	(0.0000)	**(0.0000)**	(0.8858)	**(0.0035)**	(0.8340)	(0.4660)	**(0.0421)**			

	Cons	GDP	RF (D)	SD	XS	DY	*X*	Adj. R^2	*Q* Stat	LM Test
Panel H: Germany										
GDPt + 1 = FV	0.0018	**0.4719**	−0.1809	−0.0849	0.0686	0.0367		0.1527	0.7170	0.4098
	(0.1851)	**(0.0081)**	(0.3791)	(0.5251)	(0.4285)	(0.7489)				
GDPt + 1 = FV + FX (D)	0.0018	**0.4722**	−0.1810	−0.0849	0.0686	0.0369	−0.0127	0.1394	0.7140	0.4023
	(0.1890)	**(0.0088)**	(0.3840)	(0.5290)	(0.4311)	(0.7506)	(0.9009)			
GDPt + 1 = FV + NAM	**0.0020**	**0.4079**	−0.1644	−0.0868	0.0710	0.0079	**−0.1150**	0.1505	0.8050	0.5122
	(0.0302)	**(0.0108)**	(0.4449)	(0.4959)	(0.4109)	(0.9367)	**(0.0980)**			
GDPt + 1 = FV + GAM (D)	0.0019	**0.4488**	−0.1734	−0.0864	0.0698	0.0287	**−0.2672**	0.2170	0.8220	0.6534
	(0.1531)	**(0.0076)**	(0.4090)	(0.5217)	(0.4451)	(0.8001)	**(0.0007)**			

Table 4 (continued)

	Cons	GDP	RF (D)	SD	XS	DY	*X*	Adj. R^2	*Q* Stat	LM Test
GDPt + 1 = FV + OB (D)	**0.0024**	**0.2480**	−0.1276	−0.0891	0.0759	−0.0711	**0.4886**	0.3614	0.7000	0.4805
	(0.0159)	**(0.0726)**	(0.2406)	(0.3715)	(0.3931)	(0.5172)	**(0.0077)**			
GDPt + 1 = FV + BD	0.0022	**0.4769**	−0.1817	−0.0850	0.0685	0.0396	−0.0482	0.1417	0.5940	0.2265
	(0.1333)	**(0.0239)**	(0.3455)	(0.5069)	(0.4657)	(0.7335)	(0.5764)			
	Cons	GDP	RF (D)	SD	XS	DY (D)	*X*	Adj. R^2	*Q* Stat	LM Test
Panel I: Japan										
GDPt + 1 = FV	**0.0017**	0.1068	0.1517	−0.2113	−0.0039	−0.1164		0.0473	0.7980	0.4034
	(0.0948)	(0.3019)	(0.1835)	(0.1328)	(0.9790)	(0.2570)				
GDPt + 1 = FV + FX (D)	0.0017	0.1035	0.1520	−0.2117	−0.0043	−0.1180	0.0410	0.0340	0.7220	0.2400
	(0.1492)	(0.3797)	(0.1978)	(0.1272)	(0.9748)	(0.3109)	(0.6331)			
GDPt + 1 = FV + NAM (D)	**0.0017**	0.0926	0.1528	−0.2148	−0.0035	−0.1222	−0.1121	0.0457	0.7960	0.4289
	(0.0829)	(0.3578)	(0.1717)	(0.1241)	(0.9811)	(0.2384)	(0.4345)			
GDPt + 1 = FV + GAM	0.0017	0.1096	0.1515	−0.2104	−0.0043	−0.1154	0.0208	0.0326	0.8030	0.4140
	(0.1017)	(0.2361)	(0.1794)	(0.1400)	(0.9776)	(0.2064)	(0.7928)			
GDPt + 1 = FV + OB (D)	**0.0019**	0.0131	**0.1602**	**−0.2299**	−0.0061	**−0.1572**	**0.3575**	0.1647	0.7510	0.4874
	(0.0123)	(0.8999)	**(0.0897)**	**(0.0582)**	(0.9637)	**(0.0779)**	**(0.0048)**			
GDPt + 1 = FV + BD	**0.0029**	0.1160	0.1506	−0.2104	−0.0027	−0.1119	−0.0980	0.0426	0.9870	0.9578
	(0.0335)	(0.2451)	(0.2027)	(0.1049)	(0.9861)	(0.2256)	(0.2356)			

Table 4 (continued)

	Cons	GDP	RF (D)	SD	XS	DY	*X*	Adj. R^2	*Q* Stat	LM Test
Panel J: France										
GDPt + 1 = FV	0.0012	**0.6375**	− 0.1943	− 0.0634	**0.1874**	− 0.0847		0.4436	0.1230	0.0249
	(0.1035)	**(0.0001)**	(0.2092)	(0.5332)	**(0.0410)**	(0.3783)				
GDPt + 1 = FV + FX (D)	0.0012	**0.6375**	− 0.1943	− 0.0634	**0.1874**	− 0.0847	0.0097	0.4349	0.1220	0.0247
	(0.1075)	**(0.0001)**	(0.2122)	(0.5369)	**(0.0431)**	(0.3844)	(0.9115)			
GDPt + 1 = FV + NAM (D)	**0.0013**	**0.6263**	− 0.1917	− 0.0627	**0.1874**	− 0.0906	**− 0.1702**	0.4664	0.1120	0.0252
	(0.0877)	**(0.0001)**	(0.2388)	(0.5228)	**(0.0295)**	(0.3317)	**(0.0126)**			
GDPt + 1 = FV + GAM	0.0014	**0.5961**	− 0.1844	− 0.0617	**0.1884**	− 0.1036	− 0.0653	0.4381	0.1900	0.0294
	(0.1261)	**(0.0037)**	(0.2829)	(0.5738)	**(0.0513)**	(0.3176)	(0.4805)			
GDPt + 1 = FV + OB (D)	**0.0017**	**0.5040**	− 0.1630	− 0.0565	**0.1885**	− 0.1503	**0.2396**	0.4838	0.3140	0.1311
	(0.0026)	**(0.0002)**	(0.2014)	(0.5491)	**(0.0532)**	(0.1714)	**(0.0073)**			
GDPt + 1 = FV + BD	**0.0022**	**0.6314**	− 0.1927	− 0.0636	**0.1883**	− 0.0857	**− 0.1540**	0.4607	0.0260	0.0014
	(0.0010)	**(0.0001)**	(0.1747)	(0.4795)	**(0.0362)**	(0.4096)	**(0.0268)**			

	Cons	GDP	GDP-1	RF (D)	SD	XS	DY	*X*	Adj. R^2	*Q* Stat	LM Test
Panel K: France (two lags for GDP)											
GDPt + 1 = FV	0.0009	**0.5287**	0.2140	− 0.2426	− 0.0858	**0.2007**	− 0.0536		0.4611	0.5690	0.1205
	(0.3362)	**(0.0006)**	(0.1050)	(0.1224)	(0.3713)	**(0.0229)**	(0.5903)				
GDPt + 1 = FV + FX (D)	0.0009	**0.5288**	0.2140	− 0.2426	− 0.0858	**0.2007**	− 0.0536	0.0098	0.4526	0.5700	0.1195
	(0.3400)	**(0.0007)**	(0.1079)	(0.1269)	(0.3765)	**(0.0248)**	(0.5948)	(0.9021)			
GDPt + 1 = FV + NAM (D)	0.0009	**0.5131**	**0.2220**	− 0.2417	− 0.0859	**0.2011**	− 0.0586	**− 0.1755**	0.4866	0.5190	0.1082
	(0.3127)	**(0.0010)**	**(0.0769)**	(0.1344)	(0.3510)	**(0.0153)**	(0.5397)	**(0.0215)**			
GDPt + 1 = FV + GAM	0.0008	**0.5323**	**0.2181**	− 0.2449	− 0.0865	**0.2008**	− 0.0504	0.0089	0.4525	0.5610	0.1048
	(0.3706)	**(0.0041)**	**(0.0234)**	(0.1765)	(0.3833)	**(0.0615)**	(0.6467)	(0.9373)			

Table 4 (continued)

	Cons	GDP	GDP-1	RF (D)	SD	XS	DY	*X*	Adj. R^2	*Q* Stat	LM Test
GDPt + 1 = FV + OB (D)	**0.0013**	**0.4079**	**0.1987**	− 0.2090	− 0.0776	**0.2007**	− 0.1190	**0.2307**	0.4985	0.8300	0.6109
	(0.0550)	**(0.0005)**	**(0.0479)**	(0.1168)	(0.3593)	**(0.0256)**	(0.2542)	**(0.0133)**			
GDPt + 1 = FV + BD	**0.0018**	**0.5156**	**0.2272**	**− 0.2439**	− 0.0875	**0.2024**	− 0.0528	**− 0.1636**	0.4821	0.1920	0.0010
	(0.0040)	**(0.0008)**	**(0.0154)**	**(0.0983)**	(0.2563)	**(0.0443)**	(0.6277)	**(0.0039)**			

	Adj. R^2						% Change of Adj. R^2 relative to FV only				
	FV only	FV + FX	FV + NAM	FV + GAM	FV + OB	FV + BD	FV + FX	FV + NAM	FV + GAM	FV + OB	FV + BD
Panel L: Summary of each countries Adj. R^2 after adding the individual control variables											
Norway	0.136	0.142	0.149	0.123	0.143	0.123	3.76%	9.49%	− 9.83%	4.70%	− 9.66%
Canada	0.310	0.299	0.323	0.305	0.519	0.307	− 3.50%	4.17%	− 1.51%	67.18%	− 1.00%
Denmark	0.138	0.130	0.134	0.188	0.189	0.139	− 5.96%	− 2.37%	36.43%	37.35%	1.19%
Mexico	0.299	0.308	0.290	0.298	0.525	0.293	2.80%	− 3.00%	− 0.60%	75.29%	− 2.23%
Brazil	0.189	0.217	0.180	0.190	0.232	0.189	15.25%	− 17.13%	5.32%	22.16%	− 18.46%
Singapore	0.127	0.114	0.113	0.116	0.160	0.113	− 10.68%	− 10.86%	− 9.03%	26.02%	− 10.85%

Table 4 (continued)

	Adj. R^2						% Change of Adj. R^2 relative to FV only				
	FV only	FV + FX	FV + NAM	FV + GAM	FV + OB	FV + BD	FV + FX	FV + NAM	FV + GAM	FV + OB	FV + BD
UK	0.433	0.432	0.440	0.424	0.424	0.504	− 0.22%	1.73%	− 2.04%	− 2.08%	16.37%
Germany	0.153	0.139	0.150	0.217	0.361	0.142	− 8.69%	− 1.42%	42.11%	136.73%	− 7.15%
Japan	0.047	0.034	0.046	0.033	0.165	0.043	− 28.12%	− 3.21%	− 31.01%	248.58%	− 9.90%
France (one lag)	0.444	0.435	0.466	0.438	0.484	0.461	− 1.97%	5.14%	− 1.24%	9.05%	3.86%
France (two lags)	0.461	0.453	0.487	0.452	0.498	0.482	− 1.86%	5.52%	− 1.87%	8.09%	4.55%

The table shows the results from predictive regressions where we regress the next quarter economic growth in the macroeconomic variable (GDP_{t+1}) using different individual predictive variables. The regression model estimated is

$$Y_{t+1} = \alpha + \beta' FV_t + \gamma' X_t + \varepsilon_{t+1} \qquad (3)$$

where Y_{t+1} is real GDP growth (GDP_{t+1}). We include one lag of the dependent variable (and we include more lags if there is autocorrelation in the residuals) and financial variables (FV_t). RF (risk free), SD (standard deviation), XS (excess market returns), DY (dividend yield) are used as control variables. Our predictive variables (X_t) consist of NFX (national foreign exchange), NAM (national illiquidity-Amihud), GAM (global illiquidity-Amihud), OB (crude oil Brent), and BD (the Baltic Dry index). NFX is the national foreign exchange relative to USD. Amihud (AM) is our illiquidity measure and the prefix "N" in front of each illiquidity variable refers to national illiquidity-Amihud (NAM), while the prefix "G" refers to global illiquidity-Amihud (GAM). Global illiquidity is constructed as in Brockman et al. (2009) and Galariotis and Giouvris (2015) whereby global illiquidity is created by combining all countries except the country nominated for the test. OB is crude oil Brent price, while BD is the Baltic Dry index. The coefficients reported are standardized. Adj. R^2 presents adjusted R^2 of the dependent variable (GDP) + financial variables (FV) + X (relevant additional predictive variable). Please note that panel L summarizes all results obtained from previous panels (countries) and are based on the methodology of Brockman et al. (2009), Galariotis & Giouvris (2015) and Lim & Giouvris (2016). Newey–West p values are reported in brackets whereby bold figures denote statistically significant coefficients at least at the 10% level. The bandwidth parameter for the Newey–West p value is calculated using the Newey–West automatic lag selection. The numbers in the last two columns are the probability values of the Ljung–Box test (Q Stat) and Breusch–Godfrey test (LM Test), for testing autocorrelation in the residuals. The null hypothesis is that there is no autocorrelation and a probability value above 0.05 indicates that there is no autocorrelation. Where there is autocorrelation, the regression is repeated, and the final results are presented where the residuals are free from autocorrelation. Both the old and new Ljung–Box test (Q Stat) and Breusch–Godfrey test (LM Test) probability values are presented, and the additional lagged variable is presented for as many lags as were necessary. The sample period is from January 1998 to December 2015, consisting of 72 quarterly observations. All data are obtained from DataStream, Bloomberg, World Bank, and the US Energy Information Administration (EIA) website

We will now investigate the effect of our predictive variables, adding one at a time. By adding national foreign exchange (NFX), only Brazil shows a significant result. Global illiquidity (GAM) is less important in comparison with national illiquidity (NAM), as only two (2) countries' GDP is predicted by GAM, while four (4) countries' economic growth can be predicted by NAM.

Interestingly, crude oil Brent (OB) appears to be the most significant variable as the economic growth of nine (9) countries is positively predicted by it. Only UK, a net oil importer is not affected by OB. All the countries that are affected exhibit a positive coefficient, signifying that as oil price increases, the GDP of those countries also increases. Moreover, Mexico displays the highest positive coefficient, which is not surprising, as Mexico is a net oil exporter. However, for net oil importers we expect the opposite results whereby an oil price decrease will increase GDP of those countries as they will be able to import oil cheaper for the development of their economy. Table 4 provides contradictory results for oil (OB), but Mork et al. (1994) do find evidence that USA and Canada are positively related to a decrease in oil price even though the two (2) countries are oil importer and potential[24] oil exporter, respectively. However, we will investigate this further in the next section when we include all variables.

The Baltic Dry index (BD) is found to be significant for three (3) countries, namely Canada, UK, and France. The negative coefficients indicate that as BD increases, the economy of the three (3) countries shrinks. We notice that the three (3) countries' "net exports of goods and services (% of GDP)" is negative and one way to explain this, is that as the BD increases (which indicates an increase in demand for raw materials as well as the price for those materials) this results in more expensive imports which could lead to a GDP decline through the balance of trade.

The last panel L shows the summary of each country's adjusted R^2 after the addition of the individual predictive variables (one at a time) to our initial regression model which consists of the dependent variable (one lag or two lags) and financial variables only. *National foreign exchange* (*NFX*) provides extra explanatory power over the financial variables for three (3) countries only. In relation to illiquidity, *national illiquidity* (*NAM*) provides greater explanatory power for four (4) countries over financial variables compared to *global illiquidity* (*GAM*) which provides greater explanatory power for three (3) countries only.[25] Surprisingly, GAM and not NAM provide extra explanatory power in the case of Germany even though both illiquidity variables are significant.

As expected, oil (OB) exhibits the greatest explanatory power over financial variables, as there is improvement in nine (9) countries with the exception of UK. In the case of Japan, the addition of oil brings the highest improvement in explanatory power over financial variables. This may be due to Japan being a net importing country with the second highest "Annual oil expenditure to GDP ratio" after Singapore. Moreover, Japan is the only country that does not export any oil. Similar to NFX, the inclusion of the Baltic Dry index (BD) provides extra explanatory power

[24] Mork et al. (1994) highlight that Canada switches from a position of net oil importer to net oil exporter over time, while we classify Canada as a net oil exporter based on the latest available data (2012) that we obtain from the US EIA website.

[25] It is important for the reader to note that these findings are based on adding one variable at a time. Results can be different when considering all variables.

for only three (3) countries. The highest improvement is observed in the case of the UK, which is consistent to our earlier regression findings.

The main message from the first set of regressions[26] is that:

1. Excess market returns (XS) is the best predictor among financial variables, while NFX is the least important predictive variable.[27]
2. Among predictive variables, oil (OB) appears to be the best predictor as it is significant in nine (9) countries.
3. Between illiquidity variables, national illiquidity (NAM) is found to be superior in comparison with global illiquidity (GAM).

4.3.3 Predicting economic growth using all variables

Instead of adding one predictive variable at a time, we will now use a regression model[28] which incorporates all variables and is shown in Table 5.

Table 5 shows that the effects of the risk-free rate (see Norway and Denmark), standard deviation (see Norway, and Germany) and dividend yield (see Japan) are reinforced since we obtain more significant coefficients. There are no changes for excess market returns (XS) since the same six (6) countries exhibit positive coefficients.

In relation to the predictive variables, national foreign exchange (NFX) remains negative and significant only for Brazil, confirming that Brazil benefits from their cheaper imports.

The effect of illiquidity appears to be more important than before (see NAM for Norway and GAM for Canada and Mexico). National liquidity (NAM) has more significant results compared to global illiquidity (GAM). The GDP of four (4) countries is correctly predicted by NAM and GAM, respectively. Thus, similar to Galariotis and Giouvris (2015), this shows that market illiquidity does contain some information for estimating the current and future state of the economy of certain countries in our sample.

The GDP of the nine (9) countries (except the UK) is still predicted by oil (OB) even after including all predictive variables. The coefficients are positive which is not expected for net oil importers.[29] Probable reasons for the positive coefficients are that (1) oil importers hedge their positions, (2) their need for oil is reduced, or (3)

[26] Again, we remind the reader that these findings are based on adding one variable at a time. Results can be different when considering all variables together, and actually results do change as far as the illiquidity variables are concerned.

[27] We obtain a significant result only for Brazil.

[28] The regression model estimate is similar to the previous Eq. (3), but we include all predictive variables.

[29] For net oil importers, we expect a negative coefficient whereby an oil price decrease will increase the GDP of those countries as they will be able to import oil cheaper. However, the positive coefficient for net oil exporters is expected, as the higher oil price means higher revenue for those countries, which translates to higher GDP, for instance, Sheppard et al. (2016) reports of Saudi Arabia's willingness to cut oil production in order to improve revenue and their economy.

Table 5 In sample prediction of the macroeconomic variable with all variables for the ten (10) countries

Panel A: all countries														
Cons	GDP	GDP-1	RF (D)	SD	XS	DY	NFX (D)	NAM	GAM	OB (D)	BD	Adj. R^2	Q Stat	LM Test
Norway														
0.0056	**−0.3003**		**0.2186**	**−0.1351**	**0.2480**	−0.0041	−0.1350	**−0.1617**	−0.0229	**0.1355**	−0.0192	0.1353	0.8100	0.6033
(0.0000)	**(0.0000)**		**(0.0578)**	**(0.0000)**	**(0.0000)**	(0.9309)	(0.1945)	**(0.0004)**	(0.6542)	**(0.0000)**	(0.5298)			
Cons	GDP	GDP−1	RF (D)	SD	XS	DY (D)	NFX (D)	NAM (D)	GAM	OB (D)	BD	Adj. R^2	Q Stat	LM Test
Canada														
0.0040	**0.4032**		−0.0360	0.0514	0.1660	−0.0766	0.0018	**0.1107**	**−0.1316**	**0.4837**	−0.0877	0.5284	0.4450	0.2755
(0.0000)	**(0.0000)**		(0.6010)	(0.5214)	(0.1142)	(0.2322)	(0.9769)	**(0.0295)**	**(0.0808)**	**(0.0001)**	(0.1007)			
Cons	GDP	GDP−1	RF (D)	SD	XS	DY	NFX (D)	NAM (D)	GAM	OB (D)	BD	Adj. R^2	Q Stat	LM Test
Denmark														
0.0041	−0.1203		**0.1575**	**−0.3222**	**0.3037**	0.0721	0.0851	−0.0802	**−0.2825**	**0.2885**	−0.1176	0.2506	0.7740	0.5207
(0.0050)	(0.3313)		**(0.0000)**	**(0.0001)**	**(0.0020)**	(0.4549)	(0.4733)	(0.3495)	**(0.0013)**	**(0.0001)**	(0.1893)			
Cons	GDP	GDP−1	RF (D)	SD	XS	DY	NFX (D)	NAM (D)	GAM	OB (D)	BD	Adj. R^2	Q Stat	LM Test
Mexico														
0.0053	**0.1553**		0.1033	0.0275	**0.3246**	**−0.2144**	−0.1266	−0.0537	**−0.1761**	**0.5241**	−0.0327	0.5472	0.9730	0.9603
(0.0001)	**(0.0581)**		(0.1999)	(0.7081)	**(0.0000)**	**(0.0061)**	(0.1019)	(0.5160)	**(0.0160)**	**(0.0003)**	(0.6460)			
Cons	GDP	GDP−1	RF (D)	SD	XS	DY	NFX (D)	NAM (D)	GAM	OB (D)	BD	Adj. R^2	Q Stat	LM Test
Brazil														
0.0024	0.1158		−0.2076	−0.0160	**0.2703**	−0.0274	**−0.2150**	0.0613	0.1087	**0.3024**	**0.2044**	0.2837	0.7920	0.5996
(0.2633)	(0.4896)		(0.1972)	(0.8273)	**(0.0265)**	(0.7763)	**(0.0045)**	(0.3742)	(0.3058)	**(0.0003)**	**(0.0227)**			

Table 5 (continued)

Cons	GDP	GDP−1	RF (D)	SD (D)	XS	DY	NFX (D)	NAM (D)	GAM	OB (D)	BD	Adj. R^2	Q Stat	LM Test
Singapore														
0.0137	0.0379		0.1349	**−0.2335**	**0.3238**	0.0176	0.0139	−0.0144	0.0366	**0.2143**	−0.0004	0.1054	0.8850	0.7269
(0.0003)	(0.7360)		(0.1041)	**(0.0208)**	**(0.0258)**	(0.8393)	(0.9015)	(0.8502)	(0.6434)	**(0.0005)**	(0.9976)			
Cons	GDP	GDP−1	RF (D)	SD	XS	DY	NFX (D)	NAM	GAM	OB (D)	BD	Adj. R^2	Q Stat	LM Test
UK														
0.0048	**0.4875**		0.0091	**−0.1590**	0.0179	0.0041	−0.1248	**−0.1723**	−0.0742	0.0890	**−0.2975**	0.5148	0.6880	0.4591
(0.0000)	**(0.0040)**		(0.9178)	**(0.0063)**	(0.7373)	(0.9660)	(0.1125)	**(0.0021)**	(0.2976)	(0.3297)	**(0.0071)**			
Cons	GDP	GDP−1	RF (D)	SD	XS	DY	NFX (D)	NAM	GAM (D)	OB (D)	BD	Adj. R^2	Q Stat	LM Test
Germany														
0.0033	0.0547		−0.0763	−0.0955	0.0832	−0.1562	−0.0063	**−0.2559**	**−0.2915**	**0.5495**	−0.0197	0.4662	0.4970	0.2350
(0.0014)	(0.5321)		(0.6265)	(0.2822)	(0.3219)	(0.1431)	(0.9276)	**(0.0007)**	**(0.0000)**	**(0.0015)**	(0.7869)			
Cons	GDP	GDP−1	RF (D)	SD	XS	DY (D)	NFX (D)	NAM (D)	GAM	OB (D)	BD	Adj. R^2	Q Stat	LM Test
Japan														
0.0030	0.0033		0.1608	**−0.2328**	−0.0051	**−0.1608**	0.0476	−0.1203	0.0110	**0.3590**	−0.0880	0.1369	0.8550	0.6744
(0.0433)	(0.9644)		(0.1013)	**(0.0388)**	(0.9694)	**(0.0409)**	(0.5745)	(0.2565)	(0.8790)	**(0.0003)**	(0.2854)			
Cons	GDP	GDP−1	RF (D)	SD	XS	DY	NFX (D)	NAM (D)	GAM	OB (D)	BD	Adj. R^2	Q Stat	LM Test
France														
0.0033	**0.3319**		−0.1222	−0.0492	**0.1921**	**−0.2293**	0.0083	**−0.1831**	**−0.1840**	**0.3060**	**−0.1629**	0.5390	0.3090	0.0683
(0.0000)	**(0.0352)**		(0.3784)	(0.4897)	**(0.0255)**	**(0.0722)**	(0.9108)	**(0.0229)**	**(0.0295)**	**(0.0047)**	**(0.0515)**			

Table 5 (continued)

Cons	GDP	GDP−1	RF (D)	SD	XS	DY	NFX (D)	NAM (D)	GAM	OB (D)	BD	Adj. R^2	Q Stat	LM Test
France														
0.0028	**0.3051**	**0.1621**	−0.1719	−0.0687	**0.2011**	−0.1798	0.0087	**−0.1846**	−0.1197	**0.2787**	**−0.1674**	0.5443	0.4470	0.0827
(0.0000)	**(0.0251)**	**(0.0893)**	(0.2815)	(0.2765)	**(0.0356)**	(0.1979)	(0.9037)	**(0.0248)**	(0.2238)	**(0.0069)**	**(0.0261)**			

	Adj. R^2		% Change of Adj. R^2 relative to FV only
	FV only	FV + ALL	FV + ALL
Panel B: Summary of each countries Adj. R^2			
Norway	0.136	0.1353	−0.84
Canada	0.310	0.5284	70.38
Denmark	0.138	0.2506	81.93
Mexico	0.299	0.5472	82.81
Brazil	0.189	0.2837	50.50
Singapore	0.127	0.1054	−17.15
UK	0.433	0.5148	18.89
Germany	0.153	0.4662	205.39
Japan	0.047	0.1369	189.58
France (one lag)	0.444	0.5390	21.51
France (two lags)	0.461	0.5443	18.03

The table shows the results from predictive regressions where we regress the next quarter economic growth in the macroeconomic (GDP_{t+1}) using all variables. Thus, the regression model estimated is similar to before, but it includes all variables as below

$$Y_{t+1} = \alpha + \beta' FV_t + \gamma' X_t + \varepsilon_{t+1}$$

where Y_{t+1} is real GDP growth (GDP_{t+1}). We include one lag of the dependent variable (and we include more lags if there is autocorrelation in the residuals) and financial variables (FV_t). RF (risk free), SD (standard deviation), XS (excess market returns), DY (dividend yield) are used as control variables. Predictive variables (X_t) consist of NFX (national foreign exchange), NAM (national illiquidity-Amihud), GAM (global illiquidity-Amihud), OB (crude oil Brent), and BD (Baltic Dry index). NFX is the national foreign exchange relative to (USD). Amihud (AM) is our illiquidity measure and the prefix "N" in front of each illiquidity variable refers to national

Table 5 (continued)

illiquidity-Amihud (NAM), while the prefix "G" refers to global illiquidity-Amihud (GAM). Global illiquidity is constructed as in Brockman et al. (2009) and Galariotis and Giouvris (2015) whereby global illiquidity is created by combining all countries except the country nominated for the test. OB is crude oil Brent price, while BD is the Baltic Dry index. The coefficients reported are standardized. Adj. R^2 presents adjusted R^2 of the dependent variable (GDP) + financial variables (FV) + ALL (All predictive variables). Please note that panel B summarizes all results obtained from panel A and are based on the methodology of Brockman et al. (2009), Galariotis & Giouvris (2015) and Lim & Giouvris (2016). Newey–West p value is reported in brackets whereby bold figures denote statistically significant coefficients at least at the 10% level. The bandwidth parameter for the Newey–West p value is calculated using the Newey–West automatic lag selection. The numbers in the last two columns are the probability values of the Ljung–Box test (Q Stat) and Breusch–Godfrey test (LM Test), for testing autocorrelation in the residuals. The null hypothesis is that there is no autocorrelation and a probability value above 0.05 indicates that there is no autocorrelation. Where there is autocorrelation, the regression is repeated, and the final results are presented where the residuals are free from autocorrelation. Both the old and new Ljung–Box test (Q Stat) and Breusch–Godfrey test (LM Test) probability values are presented and the additional lagged variable is presented for as many lags as are necessary. The sample period is from January 1998 to December 2015, consisting of 72 quarterly observations. All data are obtained from DataStream, Bloomberg, World Bank, and the US Energy Information Administration (EIA) website their net position could change from importer to exporter. In relation to switching positions (from importer to exporter or vice versa), Mork et al. (1994) do find evidence that countries with different characteristics, namely USA and Canada,[30] can have a similar reaction to oil (OB).

The Baltic Dry index (BD) still predicts the GDP of three (3) countries even after including all variables. However, the composition of the three (3) countries actually changes. Brazil's GDP is now significantly affected by BD, while the GDP of Canada is not affected by the BD.

Panel B presents a summary of explanatory power for all countries in the sample by looking at the adjusted R^2 of the combined predictive variables over financial variables. After including all predictive variables into the regression, surprisingly results for two (2) countries, namely Singapore and Norway, do not show any improvement.[31] Predictive variables for Germany show the greatest explanatory power over financial variables, as the adjusted R^2 increases by more than 200%.

Overall, the results show that when including all variables, oil (OB) is able to predict economic growth for most countries in our sample, while excess market returns (XS) is the best predictor among financial variables (FV). Regarding national and global illiquidity there are changes in the number of countries affected. National illiquidity (NAM) is significant for five (5) countries' GDP, and global illiquidity (GAM) is significant for four (4) countries' GDP. The Baltic Dry index (BD) has a positive effect on Brazil's GDP after the inclusion of all variables. With regard to explanatory power, Germany shows the highest improvement, while Norway and Singapore are the only two (2) countries that do not show any improvement after including all predictive variables. The main message one should keep in mind from all those regressions is that oil (OB) has greater explanatory power in comparison with other predictive variables such as BD and the illiquidity variables.

4.3.4 Summary of the average adjusted R^2

Table 6 presents the grand average of adjusted R^2. The first line shows the results when all countries are included. National foreign exchange (NFX) does not show any extra explanatory power over financial variables (FV). Global illiquidity (GAM) has extra explanatory power over national illiquidity (NAM) and the Baltic Dry index (BD). BD has more explanatory power in comparison with NAM. Nevertheless, the extra explanatory power of the three (3) variables dwarves by the extra

[30] Mork et al. (1994) highlight that Canada switches from a position of net oil importer to net oil exporter over time. Here, we classify Canada as a net oil exporter based on the latest available data (2012) that we obtain from the US EIA website.

[31] Table 1 shows that Singapore has the highest annual oil expenditure to GDP ratio and it is the only country with exports/imports of goods and services (as % of GDP) that exceeds 100%. Thus, Singapore may require different financial and predictive variables. Norway has the highest "annual oil revenue to GDP ratio" and the lowest "liner shipping connectivity index", but unlike Singapore, Norway is affected the most when all the variables are included, as two (2) variables, namely standard deviation (SD) and NAM, become significant.

Table 6 Summary of the average adjusted R^2 of the ten (10) countries as a group (all countries, net oil exporters and net oil importers)

Summary of each countries Adj. R^2

	Average Adj. R^2							% Change of Adj. R^2 relative to FV only					
	FV only	FV + FX	FV + NAM	FV + GAM	FV + OB	FV + BD	FV + ALL	FV + FX	FV + NAM	FV + GAM	FV + OB	FV + BD	FV + ALL
$X \rightarrow$ GDP (all countries)	0.229	0.227	0.231	0.235	0.322	0.233	0.351	−1.154	0.897	2.271	40.219	1.808	53.167
$X \rightarrow$ GDP (net oil exporters)	0.214	0.219	0.215	0.221	0.321	0.210	0.349	2.164	0.481	2.927	49.874	−1.956	62.776
$X \rightarrow$ GDP (net oil importers)	0.244	0.234	0.247	0.248	0.322	0.257	0.353	−4.068	1.263	1.694	31.743	5.112	44.731

The table shows the summary average adjusted R^2 results from the predictive regression of Table 4 and Table 5. FV only (financial variables) includes RF (risk free), SD (standard deviation), XS (excess market returns), DY (dividend yield), as well as one lag of the dependent variable (and we include more lags if there is autocorrelation in the residuals). The predictive variables are NFX (national foreign exchange), NAM (national illiquidity-Amihud), GAM (global illiquidity-Amihud), OB (crude oil Brent), and BD (the Baltic Dry index), whereas ALL involves regression using all the variables. Thus, the Adj. R^2 presents adjusted R^2 of the dependent variable (GDP) + financial variables (FV) + X (relevant additional variables), or ALL (all variables). Please note that summarizing by taking the average adjusted R^2 is based on the methodology of Brockman et al. (2009), Galariotis and Giouvris (2015) and Lim and Giouvris (2016). All countries include all ten countries in our sample. Net oil exporters are Norway, Canada, Denmark, Mexico, and Brazil, while net oil importers are Singapore, UK, Germany, Japan, and France. For France, we use Adj. R^2 of the regression with two lags of GDP, as it results in no autocorrelation in the residuals. NFX is the national foreign exchange relative to United States dollars (USD). Amihud (AM) is our illiquidity measure and the prefix "N" in front of each liquidity variable refers to national illiquidity-Amihud (NAM), while the prefix "G" refers to global illiquidity-Amihud (GAM). Global illiquidity is constructed as in Brockman et al. (2009) and Galariotis and Giouvris (2015) whereby global illiquidity is created by combining all countries except the country nominated for the test. OB is crude oil Brent price, while BD is the Baltic Dry index. The sample period is from January 1998 to December 2015, consisting of 72 quarterly observations. All data are obtained from DataStream, Bloomberg, World Bank, and the US Energy Information Administration (EIA) website explanatory power of oil (OB), signifying the importance of oil (OB) for predicting economic growth.

So far our study shows the importance of oil (OB) for the countries in our sample. In order to research this further, we have categorized the ten (10) countries into net oil exporters and net oil importers. To recap, net oil exporters are: Norway, Canada, Denmark, Mexico, and Brazil, while net oil importers are: Singapore, UK, Germany, Japan and France.

The adjusted R^2 for net oil exporters (line 2) shows that NFX now has extra explanatory power over financial variables, but BD does not have extra explanatory power. In terms of illiquidity variables, GAM remains superior in comparison with NAM. Nonetheless, oil (OB) outperforms all other predictive variables. For net oil importers (line 3), results are similar whereby oil (OB) provides superior explanatory power. By comparing the three groups, it appears that oil (OB) is more important for net oil exporters as the explanatory power is higher in comparison with the other two groups, consistent with Wang et al. (2013).

The Baltic Dry index (BD) is found to be more important for net oil importers probably since the countries are more focused on trading goods and services rather than oil (OB).

With reference to illiquidity, global illiquidity (GAM) seems to be more important for net oil exporters, while for net oil importers, national illiquidity (NAM) appears to be more important. National foreign exchange (NFX) also provides greater explanatory power for net oil exporters relative to net oil importers, implying that NFX may be important for them for trading oil. Being an emerging country may play a role as well. Brazil is the only country that displays significant results for NFX.

Here, we summarize all our findings from the analysis above and draw general conclusions condensed in four points:

1. Both illiquidity variables are able to provide greater explanatory power in comparison with financial variables, but the global illiquidity (GAM) variable is apparently superior.[32]
2. The Baltic Dry index (BD) also provides some explanatory power, while national foreign exchange (NFX)[33] is the only variable that does not provide any additional explanatory power when all countries are included.
3. It can be unanimously stated that oil (OB) is the most important predictive variable,[34] as it provides the greatest explanatory power, especially for net oil exporters, and
4. BD appears to be more important for net oil importers.

[32] When we introduce one variable at a time, national illiquidity (NAM) is superior to global illiquidity (GAM). When we consider all variables together, we observe a reversal as far as illiquidity is concerned.

[33] This is exactly the same to results obtained from introducing one variable at a time.

[34] The same as in the (previous) first stage.

The results obtained (in this stage) from adding all variables together in a single regression for each country are similar to the results obtained from adding one variable at a time in multiple regressions (previous stage). They confirm the suitability and importance of the chosen predictive variables.

4.4 Causality

So far our research has focused on the relationship and the effect of predictive variables on GDP. However, there is a possibility of an inverse relationship that is GDP may cause the predictive variables or even a two-way relationship. For instance, in relation to illiquidity, Fujimoto (2004) who studies the US market finds evidence that macroeconomic fundamentals are significant determinants of liquidity, while for oil (OB), Sheppard et al. (2016) report that due to big oil-producing countries going into recession, OPEC led by Saudi Arabia decided to cut oil production to help the oil market recover, signifying that there is a possibility for oil prices (OB) to be affected by GDP. With respect to national foreign exchange (NFX), Inman (2015) highlights that the main reason that China devalued its currency is due to its weakening economy, while for the Baltic Dry index (BD), Bloch et al. (2012) mention that due to China's strong economic growth, China's demand for coal is surging, and since coal is part of BD, it is expected that economic growth may also affect BD.

Furthermore, there is also evidence of a two-way or bidirectional relationship between the chosen predictive variables and macroeconomics. Galariotis and Giouvris (2015) find a two-way causality between global liquidity and macroeconomic variables in their study of G7 countries, while Bloch et al. (2012) find bidirectional causality between coal consumption and GDP, as coal is one of the raw materials captured by BD.

4.4.1 Causality results for all countries, net oil exporters and net oil importers

In Table 7, we use Galariotis and Giouvris (2015) methodology to investigate the possibility of an inverse or a two-way relationship between our predictive variables and GDP. Similarly, we use two causality tests, namely the "standard pairwise Granger causality panel data test" and the "Dumitrescu–Hurlin (D–H) panel data test". However, unlike them, we have two further panels of countries, namely net oil exporters (panel B) and net oil importers (panel C), in addition to the panel data involving all countries (panel A). We report the *F* test, and probability/*p* value (in parenthesis) for the *standard pairwise Granger causality panel data test* and the *W*-stat, *Z* bar and probability/*p* value (in parenthesis) for the *Dumitrescu–Hurlin* (*D–H*) *panel data test*. The null hypotheses for the *standard pairwise Granger causality panel data test* are that our predictive variables do not Granger cause GDP and GDP does not Granger cause our respective predictive variables. For the *Dumitrescu–Hurlin* (*D–H*) *panel data test*, the null hypothesis is that our predictive variables do not homogeneously cause GDP and then we test the null hypothesis that GDP does not homogeneously cause our predictive variables.

Panel A in Table 7 reports causality results between our predictive variables and macroeconomic variable for all ten (10) countries in our sample. The panel shows that there are no interactions between national foreign exchange (NFX) and the macroeconomic variable (GDP). Both illiquidity variables appear to cause GDP based on D–H panel data test for national illiquidity (NAM) and standard Granger causality panel data test for global illiquidity (GAM). However, GDP also Granger causes GAM signifying a two-way causality for GAM, which is close to the findings of Galariotis and Giouvris (2015).

A two-way relationship can also be observed for the Baltic Dry index (Table 7, panel A, lines 9–10) according to both standard Granger and D–H tests which is close to the bidirectional evidence that Bloch et al. (2012) find between coal consumption and GDP. Oil (OB) also shows a two-way causality. Oil (OB) causes GDP (D–H test), while GDP Granger causes oil (standard Granger test). The main message from causality tests considering all countries is that there is a two-way causality for all variables except foreign exchange and GDP.

Next we will look into causality results for net oil-exporting countries in panel B of Table 7. Panel B shows that GDP Granger causes NFX. There are no interactions between national illiquidity (NAM) and GDP as previously observed when using all countries. Moreover, for net oil exporters, GDP does not homogenously cause global illiquidity (GAM) based on D–H test, but the two-way relationship between GAM and GDP remains according to the *standard Granger test*. In comparison with all countries, oil (OB) and the Baltic Dry index (BD) relationship with GDP remains the same, as there is still a two-way causality. The main message from causality tests considering oil-exporting countries only is that the two-way causality observed previously for all countries remains the same with minor changes. In addition, GDP Granger causes NFX.

Panel C in Table 7 shows causality tests for net oil-importing countries which consist of Singapore, UK, Germany, Japan, and France. Similar to net oil exporters, GDP of net oil importers also causes NFX according to *D–H test*. Surprisingly, there is no interaction between national illiquidity (NAM) and GDP for net oil importers. Global illiquidity (GAM) still appears to have a two-way relationship with GDP, but it is slightly weaker compared to all countries and net oil exporters. Furthermore, there is no more a two-way causality for both oil (OB) and the Baltic Dry index (BD). GDP still Granger causes oil (OB), while BD Granger causes GDP (both tests) but not the other way around.

Table 7 Granger causality tests (panel data of all countries, net oil exporters and net oil importers)

		Standard pairwise Granger causality tests		Dumitrescu–Hurlin (D–H)	
		Std (2 lags)	Std (4 lags)	D–H (2 lags)	D–H (4 lags)
Panel A: All countries					
Line 1	H0: NFX does not → GDP	0.139	0.496	1.961	3.160
		(0.871)	(0.739)	− 0.154	− 1.007
				(0.878)	(0.314)
Line 2	H0: GDP does not → NFX	0.511	0.724	1.006	4.346
		(0.600)	(0.576)	− 1.570	0.208
				(0.116)	(0.835)
Line 3	H0: NAM does not → GDP	1.017	0.788	**0.664**	3.259
		(0.362)	(0.533)	**− 2.077**	− 0.905
				(0.038)	(0.366)
Line 4	H0: GDP does not → NAM	0.543	1.115	2.148	4.146
		(0.581)	(0.348)	0.124	0.003
				(0.901)	(0.998)
Line 5	H0: GAM does not → GDP	**7.822**	**4.977**	2.877	4.147
		(0.000)	**(0.001)**	1.205	0.005
				(0.228)	(0.996)
Line 6	H0: GDP does not → GAM	**4.851**	**5.912**	2.298	**5.915**
		(0.008)	**(0.000)**	0.346	**1.815**
				(0.730)	**(0.070)**
Line 7	H0: OB does not → GDP	0.097	0.798	1.348	**2.304**
		(0.907)	(0.527)	− 1.062	**− 1.883**
				(0.288)	**(0.060)**
Line 8	H0: GDP does not → OB	**4.622**	**4.335**	2.174	4.551
		(0.010)	**(0.002)**	0.163	0.418
				(0.871)	(0.676)
Line 9	H0: BD does not → GDP	**26.420**	**19.185**	**16.756**	**22.729**
		(0.000)	**(0.000)**	**21.813**	**19.065**
				(0.000)	**(0.000)**
Line 10	H0: GDP does not → BD	1.401	**4.152**	0.981	**6.593**
		(0.247)	**(0.003)**	− 1.608	**2.516**
				(0.108)	**(0.012)**

		Standard pairwise Granger causality tests		Dumitrescu–Hurlin (D–H)	
		Std (2 lags)	Std (4 lags)	D–H (2 lags)	D–H (4 lags)
Panel B: Net oil-exporting countries					
Line 1	H0: NFX does not → GDP	1.255	1.017	1.672	2.862
		(0.286)	(0.399)	− 0.411	− 0.928
				(0.681)	(0.354)

Table 7 (continued)

		Standard pairwise Granger causality tests		Dumitrescu–Hurlin (D–H)	
		Std (2 lags)	Std (4 lags)	D–H (2 lags)	D–H (4 lags)
Line 2	H0: GDP does not → NFX	**3.196**	**3.442**	1.698	5.644
		(0.042)	**(0.009)**	− 0.385	1.087
				(0.701)	(0.277)
Line 3	H0: NAM does not → GDP	0.416	0.462	0.709	1.940
		(0.660)	(0.764)	− 1.422	− 1.595
				(0.155)	(0.111)
Line 4	H0: GDP does not → NAM	0.149	0.385	2.450	3.985
		(0.862)	(0.819)	0.404	− 0.114
				(0.686)	(0.909)
Line 5	H0: GAM does not → GDP	**4.364**	**2.632**	2.642	4.375
		(0.014)	**(0.034)**	0.605	0.168
				(0.545)	(0.866)
Line 6	H0: GDP does not → GAM	**3.849**	**4.924**	2.630	**7.295**
		(0.022)	**(0.001)**	0.593	**2.283**
				(0.553)	**(0.022)**
Line 7	H0: OB does not → GDP	0.249	0.265	0.773	**1.561**
		(0.780)	(0.900)	− 1.355	**− 1.869**
				(0.175)	**(0.062)**
Line 8	H0: GDP does not → OB	**3.502**	**2.475**	2.382	4.588
		(0.031)	**(0.044)**	0.332	0.322
				(0.740)	(0.747)
Line 9	H0: BD does not → GDP	**10.200**	**9.349**	**12.183**	**15.306**
		(0.000)	**(0.000)**	**10.623**	**8.098**
				(0.000)	**(0.000)**
Line 10	H0: GDP does not → BD	0.384	**3.233**	0.897	**7.172**
		(0.682)	**(0.013)**	− 1.225	**2.199**
				(0.221)	**(0.028)**

		Standard pairwise Granger causality tests		Dumitrescu–Hurlin (D–H)	
		Std (2 lags)	Std (4 lags)	D–H (2 lags)	D–H (4 lags)
Panel C: Net oil-importing countries					
Line 1	H0: NFX does not → GDP	0.056	0.301	2.249	3.458
		(0.946)	(0.878)	0.194	− 0.496
				(0.846)	(0.620)
Line 2	H0: GDP does not → NFX	0.333	0.666	**0.314**	3.049
		(0.717)	(0.616)	**− 1.836**	− 0.792
				(0.066)	(0.428)

Table 7 (continued)

		Standard pairwise Granger causality tests		Dumitrescu–Hurlin (D–H)	
		Std (2 lags)	Std (4 lags)	D–H (2 lags)	D–H (4 lags)
Line 3	H0: NAM does not → GDP	0.803	0.877	0.619	4.578
		(0.449)	(0.478)	– 1.516	0.315
				(0.130)	(0.753)
Line 4	H0: GDP does not → NAM	0.396	0.955	1.846	4.306
		(0.673)	(0.432)	– 0.229	0.118
				(0.819)	(0.906)
Line 5	H0: GAM does not → GDP	**3.919**	**2.503**	3.112	3.919
		(0.021)	**(0.042)**	1.098	– 0.162
				(0.272)	(0.871)
Line 6	H0: GDP does not → GAM	1.719	**2.040**	1.965	4.535
		(0.181)	**(0.089)**	– 0.104	0.284
				(0.917)	(0.777)
Line 7	H0: OB does not → GDP	0.120	0.788	1.924	3.047
		(0.887)	(0.533)	– 0.147	– 0.793
				(0.883)	(0.428)
Line 8	H0: GDP does not → OB	1.789	**2.385**	1.967	4.515
		(0.169)	**(0.051)**	– 0.102	0.269
				(0.919)	(0.788)
Line 9	H0: BD does not → GDP	**16.472**	**11.120**	**21.330**	**30.152**
		(0.000)	**(0.000)**	**20.225**	**18.865**
				(0.000)	**(0.000)**
Line 10	H0: GDP does not → BD	1.427	1.604	1.064	6.014
		(0.241)	(0.173)	– 1.049	1.359
				(0.294)	(0.174)

The table shows panel Granger causality tests between the quarterly macroeconomic variable (GDP) and all relevant variables. The predictive variables are consisting of NFX (national foreign exchange), NAM (national illiquidity-Amihud), GAM (global illiquidity-Amihud), OB (crude oil Brent), and BD (Baltic Dry index). NFX is the national foreign exchange relative to United States dollars (USD). Amihud (AM) is our illiquidity measure and the prefix "N" in front of each illiquidity variable refers to national illiquidity-Amihud (NAM), while the prefix "G" refers to global illiquidity-Amihud (GAM). Global illiquidity is constructed as in Brockman et al. (2009) and Galariotis and Giouvris (2015), whereby global illiquidity is created by combining all countries except the country nominated for the test. OB is crude oil Brent price, while BD is the Baltic Dry index. All variables are orthogonalized. Besides the standard pairwise Granger causality panel data test, we also use the Dumitrescu–Hurlin (D–H) panel data test. We first test the null hypothesis that our variables do not Granger cause the macroeconomic variable in question and then we test the null hypothesis that our macroeconomic variable does not Granger cause the respective variables in question. The null for the D–H test is that our variables do not homogeneously cause the macroeconomic variable in question and then we test the null hypothesis that our macroeconomic variable does not homogeneously cause the particular variables in question. We do this for all macroeconomic and predictive variables. We report the F test and p value (in parenthesis) for the standard panel Granger causality test and the W-stat, Z bar, and probability (in parenthesis) for the D–H test. We use 2 and 4 lags for our tests. If in bold, figures denote statistically significant results at least at the 10% level. Panels A, B, and C present results for all countries, net oil exporters and net oil importers, respectively. The sample period is from January 1998 to December 2015, consisting of 72 quarterly observations. All data are obtained from DataStream, Bloomberg, World Bank, and the US Energy Information Administration (EIA) website

Our findings are summarized in four points:

1. GDP is found to cause national foreign exchange (NFX) regardless of segregation into net oil exporters and importers.[35]
2. With regard to illiquidity there is a two-way relationship between global illiquidity (GAM) and GDP, similar to Galariotis and Giouvris (2015).
3. The Baltic Dry index (BD)[36] and oil (OB)[37] show a two-way relationship with GDP, but it appears to be stronger for the former.
4. Oil (OB) is apparently more important for net oil exporters as the two-way causality remains, while for net oil importers, we observe a one-way causality from GDP to oil (OB).

4.5 Net oil exporters: developed versus emerging countries

Lim and Giouvris (2016) find that causality between macroeconomic variables and liquidity is different for developed and developing markets. Since our data consist of two (2) countries that are categorized as emerging markets/countries by MSCI, we decide to investigate this briefly by further regrouping our net oil-exporting countries into developed and emerging countries. Therefore, developed countries are consisting of Norway, Canada, and Denmark, while Mexico and Brazil will form part of emerging countries.

4.5.1 Summary of the average adjusted R^2 for net oil exporters: developed versus emerging countries

As before, Table 8 presents a summary of the grand average of adjusted R^2 of the relevant variables. According to Table 8, national foreign exchange (NFX) has extra explanatory power over financial variables for emerging countries, which could probably be due to Brazil, as Brazil is the only country that shows significant results in the earlier sections. Both illiquidity variables provide extra explanatory power for developed countries which is probably due to the more established financial markets of developed countries. Nevertheless, global illiquidity (GAM) remains superior compared to national illiquidity (NAM) for developed countries. As expected, oil (OB) is more important for emerging countries, as oil (OB) provides superior explanatory power over financial variables, potentially due to emerging countries over-reliance on oil. Surprisingly, the Baltic Dry index (BD) does not provide any extra explanatory power over financial variables for both developed and emerging markets. However, then again in Table 1, our net oil-exporting countries are in the bottom five "liner shipping connectivity index" of our sample.

[35] GDP may be the reason that countries try to manipulate their currencies as reported by Inman (2015) for China.

[36] Evidence for the BD is similar to Bloch et al. (2012).

[37] As expected, oil (OB) does impact GDP. This is also highlighted by Mork et al. (1994). Inverse causality signifies that a group of countries can affect oil prices as suggested by Kaufmann et al. (2004) in relation to OPEC countries, but interestingly, our data do not include any OPEC countries.

Table 8 Summary of the average adjusted R^2 of the five (5) net oil-exporting countries as a group of developed and emerging countries (net oil exporters-developed countries and net oil exporters-emerging countries)

Summary of developed versus emerging countries Adj. R^2

	Average Adj. R^2							% Change of Adj. R^2 relative to FV only					
	FV only	FV + FX	FV + NAM	FV + GAM	FV + OB	FV + BD	FV + ALL	FV + FX	FV + NAM	FV + GAM	FV + OB	FV + BD	FV + ALL
$X \rightarrow$ GDP (net oil exporters—developed countries)	0.195	0.190	0.202	0.205	0.284	0.190	0.305	−2.383%	3.870%	5.488%	45.561%	−2.507%	56.474%
$X \rightarrow$ GDP (net oil exporters—emerging countries)	0.244	0.262	0.235	0.244	0.378	0.241	0.415	7.610%	−3.578%	−0.140%	55.041%	−1.296%	70.325%

The table shows the summary average adjusted R^2 results from the predictive regression of Table 4 and Table 5. FV only (financial variables) includes RF (risk free), SD (standard deviation), XS (excess market returns), DY (dividend yield) as well as one lag of the dependent variable (and we include more lags if there is autocorrelation in the residuals). The predictive variables consist of NFX (national foreign exchange), NAM (national Amihud), GAM (global Amihud), OB (crude oil Brent), and BD (Baltic Dry), whereas ALL involves using all the variables. Thus, the Adj. R^2 presents adjusted R^2 of the dependent variable (GDP) + financial variables (FV) + X (relevant additional variables) or ALL (all variables). Please note that summarizing by taking the average adjusted R^2 is based on the methodology of Brockman et al. (2009), Galariotis & Giouvris (2015), and Lim & Giouvris (2016). net oil exporters—developed countries are Norway, Canada, and Denmark, while Net oil exporters—emerging countries are Mexico and Brazil. NFX is the national foreign exchange relative to USD. Amihud (AM) is our liquidity measure and the prefix "N" in front of each illiquidity variable refers to national illiquidity-Amihud (NAM), while the prefix "G" refers to global illiquidity-Amihud (GAM). Global illiquidity is constructed as in Brockman et al. (2009) and Galariotis and Giouvris (2015), whereby global illiquidity is created by combining all countries except the country nominated for the test. OB is crude oil Brent price, while BD is the Baltic Dry index. The sample period is from January 1998 to December 2015, consisting of 72 quarterly observations. All data are obtained from DataStream, Bloomberg, World Bank, and the US Energy Information Administration (EIA) website

The main point to be taken onboard from Table 8 is that oil (OB) appears to be more significant for emerging countries, while illiquidity variables provide superior explanatory power for developed countries.

4.5.2 Causality results for net oil exporters: developed versus emerging countries

We have also conducted causality tests on net oil exporters (developed countries) and net oil exporters (emerging countries) to investigate whether there is a two-way causality between GDP and the chosen predictive variables for the two groups of countries (or markets).

Panel A in Table 9 reports causality results between GDP and our predictive variables for net oil exporters (developed countries). The panel shows that national foreign exchange (NFX) Granger causes GDP, but there is no interaction between national illiquidity (NAM) and GDP. Global illiquidity (GAM) Granger causes GDP, and surprisingly, there is two-way relationship between the Baltic Dry index (BD) and GDP although in our last section BD apparently does not provide any extra explanatory power. More surprisingly, there is no interaction between oil (OB) and GDP, probably due to insufficient amount of data after segregation of net oil-exporting countries to developed and emerging countries.

Panel B of Table 9 shows causalities for emerging countries among net oil exporters. Unlike developed countries, emerging countries do not show any interaction between GDP and NFX, which is unexpected as our earlier results appear to show that Brazil may be the reason that there is a relationship between GDP and NFX. GDP appears to cause both national illiquidity (NAM) and global illiquidity (GAM). Also, there is no two-way causality between GDP and the Baltic Dry index (BD), but BD does cause GDP. Similar to developed countries, there are no interactions found between GDP and oil (OB) also for emerging countries, again probably due to insufficient data.

The findings of this section are summarized as follows:

1. There is a two-way causality between Baltic Dry (BD) and GDP for developed countries.
2. There is no causality between national illiquidity (NAM) and GDP for developed countries, while for emerging countries there is a one-way causality from GDP to NAM.[38]
3. Surprisingly, one-way causality for national foreign exchange (NFX) is found only in developed countries and not in emerging countries.

[38] This is contradictory to Lim and Giouvris (2016) who find that there is a two-way causality between macroeconomic variables and national liquidity. Nevertheless, our contradictory evidence is probably due to the high liquidity of developed markets. Dey (2005) highlights that liquidity is not a concern for investors, resulting in insignificant results for developed markets. Both markets (groups of countries) obtain significant results for global illiquidity (GAM), but for developed countries, GAM caused GDP, while the opposite is observed for emerging countries, which is similar to Lim and Giouvris (2016). However, Lim and Giouvris (2016) find no causality for developed markets.

4. In addition, there is no causality between oil (BD) and GDP for both developed and emerging countries, probably due to insufficient amount of data after segregation of net oil-exporting countries to developed and emerging countries.

5 Conclusion

This study looks into the relationship between macroeconomic growth (captured by GDP) and predictive variables, namely national foreign exchange (NFX), national illiquidity (NAM), global illiquidity (GAM), oil (OB), and the Baltic Dry index (BD). By investigating net oil-exporting countries (Norway, Canada, Denmark, Mexico, and Brazil) and net oil-importing countries (Singapore, UK, Germany, Japan and France), this study offers original results on the two groups of countries which have not been commonly segregated in the past as highlighted by Wang et al. (2013).

This paper shows (based on the first stage of our analysis) that excess market returns (XS) is the most relevant financial variable, while among predictive variables, oil (OB) appears to be the most significant as the GDP of nine (9) countries is predicted by it. Both global (GAM) and national illiquidity (NAM) variables mainly show a negative relationship with GDP. National foreign exchange (NFX) is the least important predictive variable, as it is significant only in the case of Brazil. The Baltic Dry index (BD) is found to be negatively related to economic growth, which is contradictory to past research.

Both illiquidity variables provide greater explanatory power in comparison with financial variables, but global illiquidity (GAM) is apparently superior (based on R^2). BD also provides some explanatory power, while NFX does not have any extra explanatory power when all countries are included. Overall, oil (OB) is the most important predictive variable, as it provides the greatest explanatory power. Our results show that oil (OB) has higher explanatory power for net oil exporters, while the BD seems to be more important for net oil-importing countries. Moreover, NFX is also found to provide some explanatory power for the group of net oil exporters only.

With regard to causality, we obtain almost similar findings to Galariotis and Giouvris (2015), as there is two-way causality between global illiquidity (GAM) and GDP. GDP is found to cause NFX when our sample countries are segregated into net oil exporters and importers. The Baltic Dry index (BD) and oil (OB) show a two-way causality, but it appears to be stronger for the former. Evidence for the BD is similar to Bloch et al.'s (2012) study. As expected, oil (OB) impacts GDP as noted by Mork et al. (1994). There is also an inverse causality, signifying that a group of countries can affect the price of oil (OB) as suggested by Kaufmann et al. (2004) although none of our countries are part of OPEC. In relation to net oil exporters and importers, oil (OB) is apparently more important for net oil exporters as the two-way causality remains. For net oil importers, there is only a single direction causality from GDP to oil (OB). GDP is found to cause NFX when the countries are segregated into net oil exporters and importers, signifying that macroeconomic inactivity (captured by GDP) may be the reason

Table 9 Granger causality tests (panel data of net oil exporters–developed countries and net oil exporters–emerging countries)

		Standard pairwise Granger causality tests		Dumitrescu–Hurlin (D–H)	
		Std (2 lags)	Std (4 lags)	D–H (2 lags)	D–H (4 lags)
Panel A: Net oil exporters (developed countries)					
Line 1	H0: NFX does not → GDP	0.665	0.902	2.042	3.367
		(0.515)	(0.464)	− 0.018	− 0.435
				(0.986)	(0.664)
Line 2	H0: GDP does not → NFX	**2.483**	**2.303**	1.513	4.599
		(0.086)	**(0.060)**	− 0.448	0.256
				(0.654)	(0.798)
Line 3	H0: NAM does not → GDP	0.106	0.205	0.474	2.084
		(0.900)	(0.935)	− 1.292	− 1.155
				(0.196)	(0.248)
Line 4	H0: GDP does not → NAM	0.964	0.499	0.856	3.046
		(0.383)	(0.736)	− 0.981	− 0.615
				(0.326)	(0.538)
Line 5	H0: GAM does not → GDP	**2.717**	1.510	1.641	3.221
		(0.069)	(0.201)	− 0.344	− 0.517
				(0.731)	(0.605)
Line 6	H0: GDP does not → GAM	0.559	1.216	0.891	4.588
		(0.573)	(0.305)	− 0.954	0.250
				(0.340)	(0.803)
Line 7	H0: OB does not → GDP	0.257	0.174	0.792	1.873
		(0.773)	(0.952)	− 1.033	− 1.273
				(0.301)	(0.203)
Line 8	H0: GDP does not → OB	1.625	1.457	2.438	4.520
		(0.200)	(0.217)	0.303	0.212
				(0.762)	(0.833)
Line 9	H0: BD does not → GDP	**9.047**	**6.964**	**13.155**	**15.399**
		(0.000)	**(0.000)**	**9.019**	**6.324**
				(0.000)	**(0.000)**
Line 10	H0: GDP does not → BD	0.475	**2.513**	1.348	**8.634**
		(0.622)	**(0.043)**	− 0.582	**2.524**
				(0.561)	**(0.012)**
		Standard pairwise Granger causality tests		Dumitrescu–Hurlin (D–H)	
		Std (2 lags)	Std (4 lags)	D–H (2 lags)	D–H (4 lags)
Panel B: Net oil exporters (emerging countries)					
Line 1	H0: NFX does not → GDP	0.610	0.324	1.117	2.104
		(0.545)	(0.862)	− 0.628	− 0.934
				(0.530)	(0.350)
Line 2	H0: GDP does not → NFX	1.031	1.715	1.975	7.211
		(0.360)	(0.151)	− 0.059	1.405
				(0.953)	(0.160)

Table 9 (continued)

		Standard pairwise Granger causality tests		Dumitrescu–Hurlin (D–H)	
		Std (2 lags)	Std (4 lags)	D–H (2 lags)	D–H (4 lags)
Line 3	H0: NAM does not → GDP	0.558	0.549	1.061	1.725
		(0.574)	(0.700)	− 0.665	− 1.107
				(0.506)	(0.268)
Line 4	H0: GDP does not → NAM	**3.018**	1.632	**4.841**	5.394
		(0.052)	(0.170)	**1.841**	0.573
				(0.066)	(0.567)
Line 5	H0: GAM does not → GDP	2.078	1.391	4.143	6.107
		(0.129)	(0.241)	1.378	0.899
				(0.168)	(0.369)
Line 6	H0: GDP does not → GAM	**4.185**	**4.856**	**5.239**	**11.356**
		(0.017)	**(0.001)**	**2.106**	**3.304**
				(0.035)	**(0.001)**
Line 7	H0: OB does not → GDP	0.657	0.468	0.743	1.093
		(0.520)	(0.759)	− 0.877	− 1.397
				(0.381)	(0.163)
Line 8	H0: GDP does not → OB	2.019	1.261	2.297	4.689
		(0.137)	(0.289)	0.154	0.250
				(0.877)	(0.803)
Line 9	H0: BD does not → GDP	**8.113**	**6.663**	**10.725**	**15.167**
		(0.001)	**(0.000)**	**5.751**	**5.058**
				(0.000)	**(0.000)**
Line 10	H0: GDP does not → BD	0.037	1.863	0.221	4.981
		(0.964)	(0.121)	− 1.223	0.386
				(0.221)	(0.700)

The table shows panel Granger causality tests between the quarterly macroeconomic variable (GDP) and all relevant variables. The predictive variables are NFX (national foreign exchange), NAM (national illiquidity-Amihud), GAM (global illiquidity-Amihud), OB (crude oil Brent), and BD (Baltic Dry). NFX is the national foreign exchange rate relative to United States dollars (USD). Amihud (AM) is our liquidity measure and the prefix "N" in front of each illiquidity variable refers to national illiquidity-Amihud (NAM), while the prefix "G" refers to global illiquidity-Amihud (GAM). Global illiquidity is constructed as in Brockman et al. (2009) and Galariotis and Giouvris (2015), whereby global illiquidity is created by combining all countries except the country nominated for the test. OB is crude oil Brent price, while BD is the Baltic Dry index. All variables are orthogonalized. Besides the standard pairwise Granger causality panel data test, we also use the Dumitrescu–Hurlin (D–H) panel data test. We first test the null hypothesis that our variables do not Granger cause the macroeconomic variable in question and then we test the null hypothesis that our macroeconomic variable does not Granger cause the respective variables in question. The null for the D–H test is that our variables do not homogeneously cause the macroeconomic variable in question and then we test the null hypothesis that our macroeconomic variable does not homogeneously cause the particular variables in question. We do this for all macroeconomic and liquidity variables. We report the *F* test and *p* value (in parenthesis) for the standard panel Granger causality test and the *W*-stat, *Z* bar, and probability (in parenthesis) for the D–H test. We use 2 and 4 lags for our tests. If in bold, figures denote statistically significant results at least at the 10% level. Panels A and B present results for net oil exporters (developed countries) and net oil exporters (emerging countries), respectively. The sample period is from January 1998 to December 2015, consisting of 72 quarterly observations. All data are obtained from DataStream, Bloomberg, World Bank, and the US Energy Information Administration (EIA) website that countries try to manipulate their currencies as reported by Inman (2015) for China.

By further segregating net oil-exporting countries into developed (Norway, Canada, and Denmark) and emerging markets/countries (Mexico and Brazil), our results show that NFX has extra explanatory power over financial variables for emerging countries, while both illiquidity variables provide extra explanatory power for developed countries only. Nevertheless, global illiquidity (GAM) remains superior compared to national illiquidity (NAM) for developed countries. Oil (OB) appears to be more important for emerging countries, potentially due to emerging countries over-reliance on oil, while the Baltic Dry index (BD) does not provide any extra explanatory power for both developed and emerging countries. We find a two-way causality between BD and GDP for developed countries. Our findings on emerging countries are similar to Lim and Giouvris (2016), but they find no causality for developed markets. Surprisingly, a one-way causality for NFX is found only for developed countries and not for emerging countries.

Our findings are very important for policy makers and corporate managers. Oil is an important predictor of the future state of the economy, especially for oil-producing countries; therefore, policy makers in those countries need to consider carefully the movement of oil prices. This is particularly important for emerging oil-producing countries which over rely on the price of oil for their development. There have been many (un)successful attempts to manipulate the price of oil over the years. This had a temporary positive effect for the economies of oil producers and negative effects for oil importers. Prices in one way or another reverted to pre-manipulation levels. The price of oil can give a boost to oil producers, but this cannot last forever. The exchange rate is also quite important for emerging oil producers. Our results indicate that the FX rate has extra explanatory power over financial variables. Liquidity is also important; therefore, it is essential that policy makers try to keep financial markets as liquid as possible since liquid markets make new and existing investors more willing to invest in stocks which in turn makes cost of capital cheaper for companies that seek capital in the financial markets. Cheaper cost of capital facilitates new investment which in turn helps increase GDP. This is also true for developed oil exporters (Norway, Canada and Denmark). Some policy makers in developed oil-exporting countries may wrongfully believe that close monitoring of oil prices is all they need to do to keep their GDP on an increasing path. Finally, the Baltic Dry index appears to be mostly relevant to oil importers; therefore, close monitoring of the index could provide info for the future state of the economy of those countries.

Overall, in relation to illiquidity variables, our results are close to Galariotis and Giouvris (2015) and Lim and Giouvris (2016). However, in a limited number of cases our results diverge and this is probably due to different data and periods used. Nevertheless, we believe that further research is necessary in order to include OPEC countries especially when studying oil. One other issue that has arisen is the classification of the chosen countries based on the latest available data of 2012. For instance, Mork et al. (1994) classify UK as an oil-exporting country, while we consider it as a net oil-importing country. Moreover, Mork et al. (1994) highlight that the UK and Norway switch from a position of net importer to net exporter of oil in the 1970s, while Canada also has moved back and forth between net exporter and net importer over time. Therefore, for future studies the classification of countries should probably be based on the average or total oil exports or imports over the sample periods.

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