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Does oil production promote economic growth in OPEC countries?

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Dissertação para a obtenção de grau de mestre em **Economia**
(2º ciclo de estudos)

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Covilhã, Junho de 2013

Acknowledgements

This dissertation could not have been possible without the support of many people to whom I have to express my gratitude.

First of all, I must thank my mother and my sister, not only for their affection and understanding, but also for the support they gave me in this adventure.

Then, I express my gratitude to my supervisor, Professor José Alberto Serras Ferreira Rodrigues Fuinhas, who provided an immensurable assistance, so that an interesting study could be accomplished. I am also grateful for his friendship and support. Also Professor António Manuel Cardoso Marques played an important part in this research. I thank him for his valuable assistance and suggestions, which improved this work.

Finally, I show a special gratitude to all the friends I made in the University of Beira Interior, who, besides their friendship, gave me a precious support to achieve this point.

Resumo

O *nexus* consumo de petróleo-crescimento económico é estudado num painel composto por países da OPEP e com um horizonte temporal longo (1960-2011), controlando o contexto específico da produção de petróleo. A pertença destes países ao cartel da OPEP coloca-os sob uma orientação comum, que origina no painel fenómenos de dependência de dados seccionais/correlação contemporânea. Estimadores recentes de dados em painel, assim como, análises de cointegração são utilizados e discutidos, analisando-se, nomeadamente, a heterogeneidade dos painéis e os efeitos específicos dos países. O estimador Driscoll-Kraay revela ser adequado para lidar com as propriedades dos painéis. A compreensão do *nexus* requere que se proceda à sua decomposição em efeitos de curto e de longo prazo. A "hipótese de crescimento" foi verificada apenas no curto prazo. Os resultados apoiam o fenómeno de "maldição dos recursos" e provam que o objectivo de longo prazo do cartel não está a ser alcançado. Tanto a produção de petróleo como os preços estão a constranger o crescimento económico dos países da OPEP.

Palavras-chave

Macro painéis; *nexus* petróleo-crescimento económico; e OPEP

Resumo alargado

A análise do nexus energia-crescimento económico é vasta na literatura. No entanto, esta não se tem focado em países produtores de energia primária nem em grupos de países, cuja decisão de produção de energia obedece a uma entidade supranacional. O interesse deste estudo é relevante, sobretudo por se focar numa realidade em que a decisão de exploração de petróleo não depende apenas do interesse nacional e individual, mas respeita um acordo de colusão. Assim, procura-se estudar a complexidade da relação entre consumo de petróleo e crescimento económico no cartel da Organização dos Países Exportadores de Petróleo (OPEP), tendo em conta que existe um centro de controlo institucional sobre a produção de petróleo. Por outras palavras, procura-se verificar se a abundância de recursos poderá influenciar o consumo de

energia e o crescimento económico, uma vez que é um pilar da actividade económica desses países.

Este estudo inova por quatro razões principais. Primeiro, o foco é num grupo de países, que para além de serem exportadores de petróleo, têm uma ligação institucional entre eles, ou seja, o cartel da OPEP. A pertença a este cartel levanta questões sobre a presença de fenómenos de dependência seccional/correlação contemporânea, que, depois de confirmados, levarão a que estes países sejam estudados em painel, recorrendo a técnicas de dados em painel para os acomodar e corrigir. Segundo, o período é longo (1960-2011), providenciando um número considerável de observações. Neste sentido, as técnicas econométricas podem ser usadas com confiança reforçada. Terceiro, a relação entre consumo de energia e crescimento económico é examinada, sobretudo no que se refere ao consumo de petróleo e, está enquadrada num contexto de países que são produtores de energia primária. Quarto, são usadas técnicas recentes de dados em painel e os resultados de vários estimadores são sujeitos não só a uma bateria extensiva de testes de diagnóstico, mas também avaliados, o que permite uma escolha fundamentada do estimador de painel mais apropriado.

O nexus energia-crescimento económico tem-se debruçado sobre quatro tipos principais de causalidade à Granger entre consumo de energia e crescimento económico, conhecidas como hipóteses de crescimento, conservação, *feedback* e neutralidade. As três primeiras hipóteses têm subjacente a ideia de uma relação de causalidade positiva de uma variável na outra. No entanto, mais recentemente, um novo tipo de relação causal, que implica um sinal negativo, tem sido mencionado na literatura (e.g. Sari e Soytas, 2009; Menyah e Wolde-Rufael, 2010; e Fuinhas e Marques, 2012a).

O cartel da OPEP tem dois grandes objectivos, ou seja, a estabilização do preço do petróleo nos mercados internacionais, por forma, a garantir retornos adequados aos seus membros, e o desenvolvimento económico dos mesmos. Contudo, tem apenas um instrumento disponível, que consiste em estabelecer as quotas de produção dos seus membros. Alguns autores têm questionado a validade dos objectivos (Noguera e Pecchecnino, 2007) e o papel do cartel quando a sua quota no mercado internacional não é suficiente para garantir um poder de mercado conjunto, que lhe permita ser *pricemaker* (Radetzki, 2012). A nacionalização das companhias depois dos anos setenta causou obsolescência técnica e limitou a competitividade entre os players desses países.

O estudo foca onze países da OPEP (Arábia Saudita, Argélia, Emirados Árabes Unidos, Equador, Irão, Iraque, Kuwait, Líbia, Nigéria, Qatar, e Venezuela) e usa dados

de 1960 a 2011. Devido à falta de informação completa para o período em análise, Angola foi excluida. As variáveis usadas são Produto Interno Bruto (PIB), produção de petróleo, consumo de petróleo, exportações e preços internacionais de petróleo. Tanto o PIB como as exportações foram deflacionadas, usando o índice de preços no consumidor dos Estados Unidos. A fonte das variáveis é a OPEC Annual Statistical Bulletin 2012, à excepção da variável preço de petróleo, que foi recolhida na BP Statistical Review of World Energy, June 2012.

Na análise preliminar dos dados verificou-se que existe dependência seccional e que não se suspeita de colinearidade. Os testes de raízes unitárias de primeira e segunda geração realizados permitiram concluir que, em logartitmos, as variáveis são I(1). A cointegração foi testada recorrendo-se aos testes de Kao e de Westerlund, sendo este último robusto à dependência seccional. Os dois testes comprovaram que as variáveis são cointegradas. Devido ao número limitado de *crosses*, o uso de estimadores de painéis heterogéneos está comprometido. Neste sentido, realizou-se uma bateria de testes de especificação, que permitisse escolher um estimador mais apropriado. Deste modo, estimaram-se o *modified Wald test for groupwise heteroskedasticity of the fixed effects regression,* o *Pesaran's test of cross section independence*, o *Breusch-Pagan Langragian multiplier test of independence* e o teste Wooldridge para autocorrelação. Uma vez que foram detectadas heterocedaticidade, autocorrelação de primeira ordem e dependência de dados seccionais e que o horizonte temporal é longo, optou-se pelo que o estimador Driscoll e Kraay. No entanto, outros estimadores, nomeadamente, o estimador dos mínimos quadrados (OLS), o de efeitos fixos (FE) e o de efeitos fixos com erros padrão robustos, são apresentados como termo de comparação e de avaliação da robustez dos resultados. Como a cointegração foi anteriormente detectada, as elasticidades de longo prazo foram calculadas para verificar a relevância das variáveis, usando o estimador DOLS (Dynamic Ordinary Least Squares).

Em geral, os modelos são consistentes. A adequação geral do DOLS e os termos negativos e estatisticamente significantes dos mecanismos de correcção de erro corroboram a cointegração detectada anteriormente. O consumo de petróleo é significante apenas no curto prazo. No entanto, e de acordo com o DOLS, o consumo faz parte da cointegração. A "hipótese de crescimento" é confirmada no curto prazo. O efeito da produção de petróleo no crescimento é negativo. De facto, parece haver uma força que perpetua a estrutura produtiva da economia, impedindo a sua diversificação para actividades "não petrolíferas". O efeito observado para a produção de petróleo está

em linha com o que se verifica nos preços, apresentando ambos o mesmo sinal. Além disso, os preços não têm impacto no curto prazo, o que se explica pelo facto de a "maldição dos recursos" ser principalmente um fenómeno de longo prazo. As exportações têm uma elasticidade superior a um, o que é consistente com a influência que a exportação de bens e serviços com elevado valor acrescentado tem no PIB. Este valor acrescentado pode ter duas fontes, ou seja, pode resultar da componente tecnológica e da diversificação, que permitem margens mais elevadas, ou pode resultar do baixo custo de produção, relativamente ao preço de mercado. O PIB é elástico, reagindo rapidamente, por forma a incorporar pequenas variações nas exportações. Nos países da OPEP, onde a exportações totais são basicamente coincidentes com as exportações de petróleo, é expectável que se verifique a mesma consequência. Todavia, a questão central nestes países não é o valor acrescentado da tecnologia, mas o das exportações no petróleo, que têm custo baixo de produção e, por isso, um valor acrescentado elevado. O mecanismo de correção dos erros tem um valor baixo, inferior a 20%, como é revelado pelo parâmetro ECM. Este resultado é consistente com a "maldição", visto que se espera que uma economia, que é muito dependente de um só sector, demore mais tempo a ajustar-se aos choques.

Em conclusão, tanto a produção de petróleo como os preços internacionais do petróleo constrangem o crescimento económico. Consequentemente, a liderança do cartel da OPEP deveria repensar os seus próprios objectivos e/ou os instrumentos disponíveis para os alcançarem. De facto, assumindo que a produção de petróleo não diverge das quotas estabelecidas, ou seja, que o fenómeno de cheating não é relevante, os resultados verificados para a produção de petróleo provam a incapacidade do cartel em cumprir os objectivos que foram propostos aquando da fundação da OPEP. Esta discussão interna sobre os objectivos do cartel é ainda mais urgente quando a dependência geopolítica induzida pelo cartel pode, em breve, ser ameaçada por novas descobertas de petróleo e gás, nomeadamente, no Brasil e Moçambique. Além disso, desenvolvimentos tecnológicos recentes na exploração de gás e petróleo de xisto posicionarão os Estados Unidos da América como líder mundial na produção destas fontes de energia primária.

Abstract

The oil-growth nexus is studied in a panel of OPEC countries, for a long time span (1960-2011), controlling for the specific context of oil production. Their membership to the cartel put them under a common guidance, which originates phenomena of cross section dependence/contemporaneous correlation in the panel. Recent panel data estimators and cointegration analyses are both pursued and discussed, namely confronting the heterogeneity of panels and the countries specific effects. The Driscoll-Kraay estimator reveals to be appropriate to handle the panel properties. The full comprehension of the oil-growth nexus requires the decomposition in short and long run effects to be done. The growth hypothesis was found only in the short run. The results support the resource curse and prove that the cartel's long run growth goal is not being accomplished. Actually, both oil production and prices are constraining economic growth in OPEC countries.

Keywords

Macro panels; oil-growth nexus; and OPEC

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OPEC – Organisation of the Petroleum Exporting Countries

1. Introduction

The literature on the relationship between energy consumption and economic growth is vast. Even so, the interest on this energy-growth nexus is perennial. Several factors contribute to explain that interest, namely: (i) the lack of consensus on the obtained results; (ii) the need to understand the drivers of economic growth within a complex context of both the high cost of energy linked to the energy paradigm shift, and the stagnation of economic growth in developed world; and (iii) the role that the exploration of endogenous energy resources could play on the nexus. The first factor can be easily explained by both the econometric approaches and the time spans under analysis. The last two factors make both timely and essential, performing this research.

The analysis of the energy-growth nexus has been carried out to a wide range of countries, both individually and in group. A summary of this literature can be seen, for example, in Payne (2010). In general, the literature has not been focused on analysing this nexus within a context of specific countries that are producers of primary energy, or of groups of countries whose energy production decision obeys to a supra-national entity. The scarce literature focused on oil exporting countries (e.g. Mehrara, 2008; and Damette and Seghir, 2013) studied this nexus, but decontextualized from whether energy can be a growth driver in two different ways. On the one hand, energy can be an input of production and therefore it can be a driver of economic growth through its use (customary literature's insight). On the other hand, when the energy resource exploitation contributes decisively to the country's productive structure, it can be driving economic growth. The interest of this study is increased when the study is over a reality in which the oil exploitation decision is not only internal and individual, but also from an organization of countries.

From the above, the main aim of this paper is to analyse the fullness of the relationship between energy and economic growth in the Organization of the Petroleum Exporting Countries (OPEC) cartel. In those countries, energy is an abundant resource, particularly oil. May the abundance of oil be influencing both sides of the nexus? In other words, may that abundance influence both the consumption and the economic growth, since it is a pillar of the economic activity within those countries? This is the central question to which an answer is sought. The excitement of this study is increased

when focused on a set of countries that have a centre of institutional control over their energy production.

Four relevant contributions are brought by this paper to the literature. First, the focus is on a group of countries that, besides being oil exporters, have an institutional connector between them, i.e., the OPEC cartel. The cartel's membership awakens qualms of the presence of cross section dependence/contemporaneous correlation phenomena. Once confirmed these phenomena, these countries should be studied on a panel, by recurring to appropriate panel data techniques, both to accommodate and correct those phenomena. Second, the long time span of 52 years provides a large number of observations. Accordingly, the use of appropriate econometric techniques can be performed with reinforced confidence. Third, the well-known literature issue of the relationship between energy consumption and economic growth is examined but, more than that, that relationship is particular for the oil consumption case and is framed on a context of countries that are primary energy producers. The question to answer is whether the exploitation of abundant hydrocarbon resources impacts on economic growth, either in form or in time. Fourth, recent panel data techniques are used, and the results of several estimators are not only subject to extensive battery of diagnostic tests, but also fully evaluated. This methodology allows treading the way to choose the most appropriate panel estimator. By doing so, one ensures that the seal of robustness attests the research achievements.

The results show that the analysis of the oil-growth nexus shall presume the decomposition in short and long run. In the same way, that analysis must be controlled for production and for a proxy of external rents. The context, in which this nexus is studied, is not trivial. Thus, it shall be taken into account that this study is done over a context of oil exporters. Furthermore, cointegration was found and the results support the existence of the phenomenon referred in literature as "resource curse".

The paper evolves as follows. Next section provides a literature review on the energy-growth nexus, particularly highlighting the context of the OPEC countries. Section three presents both data and methodology. In this section a preliminary analysis of data is also provided. Section four discloses results as well as the discussion. Section five concludes.

2. Literature Review

The energy-growth nexus has deserved particular interest in literature along the last decades, looking for explaining the role of energy consumption on economic growth (Apergis and Payne, 2009a) both in developed and developing countries. The nexus is not a stable relationship along the time and it might be affected by energy, economic crises and structural adjustments (Eggoh et al., 2011). The importance of the energy consumption on economic growth lies on the type of causality verified between the variables in cause, since it has consequences on the development of energy policies (Chu and Chang, 2012).

Causality main question is to check if it is growth that leads energy consumption, or if it is the latter that causes economic growth (Pradhan, 2010). The literature has been focused on four main types of causality between energy consumption and economic growth, which are known as growth, conservation, feedback and neutrality hypotheses. The conservation hypothesis implies a unidirectional causality running from growth to energy consumption, meaning that an increase in economic growth leads to an increase in energy consumption. Also the growth hypothesis is a unidirectional causality, but running from energy to growth, which means that an economy is dependent on the energy consumption to grow. The third type of causality, known as feedback hypothesis, implies a bidirectional relation between economic growth and energy. The last hypothesis is the neutrality one and in this there is no relationship between the variables, i.e., the variables are independent from one another. The first three mentioned types imply a positive impact from one variable on the other.

The studies' achievements are far from consensual, namely on what concerns the causality direction (e.g. Payne, 2010), when it exists, and on the short and long run impact of the policies (e.g. Ozturk, 2010 and Padhan, 2010), which should take into account the features of each country (Altinay and Karagol, 2004). In fact, the results depend if the study is upon just a country or a set of countries (Fuinhas and Marques, 2012b), on the econometric methodologies (Alam et al., 2012), on time span (Chen et al., 2012), on studied variables (Ozturk, 2010) and even on the heterogeneity of climacteric conditions of the countries, on different energy consumption standards and on the structure and development levels of the countries (Apergis and Payne, 2009a). In Gambia, Ghana and Senegal, it was verified the feedback hypothesis, in Sudan and

Zimbabwe the conservation hypothesis, in Congo the growth hypothesis and in Cameroon, Côte D'Ivoire, Nigeria, Kenya and Togo the neutrality hypothesis (Akinlo, 2008), as well as, in Turkey (Altinay and Karagol, 2004). In the Commonwealth of Independent States the causality is bidirectional (Apergis and Payne, 2009b and 2010b), but when those countries are inserted in a panel with Russia, the results are modified and a negative effect is discovered, i.e., the energy consumption has a negative impact on growth (Apergis and Payne 2010b). Bidirectional causality was also found in some African importer countries, as well as, exporters ones (Eggoh et al., 2011), in Russia (Zhang, 2011), in the PIGST countries (Fuinhas and Marques, 2012a) and in Taiwan (Yang, 2000). The growth hypothesis is a feature of Bangladesh (Alam et al., 2012), Central and South America countries (Apergis and Payne, 2009a and 2010a). When studying OPEC countries, some countries, as Iran, Iraq, Qatar, United Arab Emirates and Saudi Arabia, show a unidirectional causality running from energy to economic growth in the short term, while in the long term there is no evidence of causality (Hossein et al., 2012). In Nigeria, the conservation hypothesis was found (Sa'ad, 2010).

More recently a new kind of relationship sign has been assigned in the literature, shedding light on a negative effect from energy consumption on energy growth. In general, the empirical evidence of that negative relationship was found in resource abundant countries, for instance, in Saudi Arabia by Sari and Soytas (2009), in South Africa by Menyah and Wolde-Rufael (2010), in Nigeria, Zambia, Tunisia and Gabon by Wolde-Rufael (2005 and 2006), in Algeria, Iraq and Libya by Squalli (2007) and in Algeria by Fuinhas and Marques (2012b). This fact that often appears linked to the resource curse. Some likely reasons for this effect are appointed in the literature. The existence of resource abundance may create environments conducive to turn the country dependent of its rents, discouraging the goal of competitiveness. The abundance of natural resources might impact negatively on other tradable sectors of the economy, reducing the viability of no-energy sectors (Apergis and Payne, 2010). Such as Fuinhas and Marques (2012a) sustain the abundance of resources hampers the diversification of the productive structure of the economy.

The resource curse theory states that the abundance of natural resources, mainly minerals (Alexeev and Conrad, 2009) and oil, in a country constrains its economic growth, which happens due to rent seeking (Rosser, 2006a) that increases corruption, voracity and civil conflicts (Esfahani et al., 2012), aggravating development in no developed countries (Kropf, 2010). Other mentioned reasons are the fraction of the

government (which when is high, may induce revenues to be lost (Bjorvatn et al., 2012)), Dutch Disease, excessive loans, inequality and volatility (Mehrara, 2009), political mechanisms (Rosser, 2006b), institutional and market failures (Boyce and Emery, 2011) and institutions related to the extraction of resources (Idemudia, 2012). Nevertheless, the negative impact of resource abundance seems to be found only under some conditions. Thus, a positive relation between economic growth and oil revenues was verified until a certain threshold in oil exporter countries, which makes a modest oil boom a blessing but an excessive one a curse (Mehrara, 2009, Mehrara et al., 2010). Institutions (Stevens and Dietsche, 2008), as well as, the diversification of the economies (Wiig and Kolstad, 2012; Murshed and Serino, 2011) are factors that may reduce the risk of resource curse in resource abundant countries, since they may moderate the impact of oil booms and busts (Mehrara, 2009). Hence, some appoint resources dependence as the main cause of Resource Curse (Boyce and Emery, 2011; Murshed and Serino, 2011; Kropf, 2010), being it avoidable, since some resource abundant countries have done well (Stevens and Dietsche, 2008). Positive effects of oil exports on economic growth were, indeed, found, at least in the short term (Cavalcanti et al., 2011) in the six major oil exporters (Esfahani et al., 2012), in Iran (Mehrara et al., 2010) and in oil dependent countries (Mehrara, 2008). However, also negative effects were found, for instance in Iran in the long term (Mehrara, 2010) and in U.S. states (Boyce and Emery, 2011).

A specific kind of energy-growth nexus is the relationship between oil consumption and economic growth. Oil remains as one of the leader primary energy sources around the world, and consequently, restrictive or expansionary energy policies focused on oil can bring diverse consequences to economic growth. This type of nexus is also characterized by the lack of consensual results. Thus, unidirectional causality was found in Bangladesh (Pradhan, 2010) and in China (Zou and Chau, 2006), running from oil consumption to economic growth, and in India, Nepal and Sri Lanka (Pradhan, 2010) and in Taiwan (Yang, 2000), running from economic growth to oil consumption, while bicausality was discovered in Pakistan (Pradhan, 2010), in Portugal (Fuinhas and Marques, 2012c), in China (Zhao et al., 2008) and also in MENA countries (Al-mulali, 2011). The neutrality hypothesis was found in Canada, France, Germany and United Kingdom (Chu and Chang, 2012).

The study of that oil-growth nexus is particularly exhilarating within countries which are abundant in the natural resource oil. Indeed, in these countries, the economic

activities directly linked to the production of oil constitute a relevant share of the economy, as a whole. In consequence, the analysis of the complexities of the relationship between oil and growth shall be accomplished by controlling not only for the domestic production of oil, but also for a variable of external adjustment, such as, the oil price in the international markets, given that, in general, countries abundant in oil are oil net exporters. Being oil exporters, most of them are contributing for the price formation mechanism. The literature focused on oil exporting countries is not abundant. An exception is the study of Damette and Seghir (2013). These authors are focused on the time span 1990-2010, which is borderline or even unsatisfactory to apply with confidence recent panel data estimators capable of dealing with the complexity of relations among the crosses.

All this together leads to study the complexity of the oil-growth nexus for countries that: (i) are oil producers; (ii) are oil exporters; and (iii) have market power to make the international prices of oil. The natural candidates to be the target of this study are, then, the members of the Organization of the Petroleum Exporting Countries.

Organization of the Petroleum Exporting Countries

The OPEC cartel was created in 1960 by Iran, Iraq, Kuwait, Saudi Arabia and Venezuela, having other countries joined the organization later. Thus, nowadays, it is composed by twelve countries, i.e., Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates and Venezuela. This organization has two major objectives. On one hand, the cartel pursues the stabilization of oil price in the international markets, in order to guarantee adequate returns to the members. On the other hand, it aims at the economic development of its member countries. However, it has only one available instrument, which is the setting of production quotas of its members. Beyond this constraint, it is still subject to strategies of cheating in meeting these quotas. The industrial organization literature has been studying the internal interaction within the OPEC Cartel (e.g. Wirl, 2010).

The context of this cartel has changed significantly since the 60s. During this period the oil market was very stable and the cartel strategy apparently worked. With the volatility observed after the 70s, Noguera and Pecchecnino (2007) argue that the objective of long run growth and development may not be accomplished only acting

through the profit oriented pricing policy. In the current context of high volatility of oil prices and since OPEC is looking for high current profits, the constant streams of revenue hampers the deployment of other sectors and alternative investments. In this way, the desired development is not achieved. The role of the OPEC cartel as a price maker is even questioned by Radetzki (2012), who argues that the whole share of the OPEC cartel in the global supply of oil is far from enough. Such as noted by Cunado (2011), the OPEC members oil reserves round about two thirds of global world oil reserves, and the production quota, in 2008, was only 35.6%. Radetzki (2012) believes that it is a weak cartel, and the climbing oil price is mainly a consequence of governments' political decisions, jointly with the phenomena of resource curse. The nationalization of companies after the 1970s has caused technical obsolescence and prevented a competitive environment with private players in those producing countries.

Despite the growing doubts in the literature about the full exercise of the OPEC cartel, it remains, being the member countries under the influence, more or less effective, of a supra-national body. This common guidance recommends the countries to be studied together, on a panel, with techniques that properly handle phenomena as contemporaneous correlation and cross section dependence. However, these panel estimators require long time spans, given their strong sensibility to asymptotic properties. This is true not only for the estimators but also for cointegration tests, such as Westerlund (2007) cointegration test. The period under analysis satisfies this requirement and the next section is focused on the presentation of the data, its characteristics and modelling.

3. Data and Methodology

The analysis of the richness of the relationship between oil consumption and economic growth for cartelized oil producer countries, controlling for oil production, is the main aim of this paper. The choice of the countries to be included in the research was, at first, motivated by the fact of belonging to OPEC and, then, by the possibility of working over a long time span. Thus, due to the availability of data, Angola was excluded. In this way, this study is focused on a set of eleven countries, specifically, Algeria, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates and Venezuela. The data are annual and cover a time span of 52 years, starting in 1960 and ending in 2011. The econometric analysis was carried on, using Stata/SE 12.0 and Eviews7 software. The source of the variables was OPEC Annual Statistical Bulletin 2012, except for the variable oil price, which was BP Statistical Review of World Energy, June 2012. The five used variables used are as follows.

- Gross Domestic Product (*Y*), measured in million US dollars, deflated using the consumer price index in the United States. The source of this index was the U.S. Department of Labor: Bureau of Labor Statistics and the base year is 1982-84=100;
- Oil production (*OP*), measured in thousand barrels, per day;
- Oil consumption (*OC*) - oil domestic consumption, measured in thousand barrels, per day;
- Exports (*X*) - total exports, measured in million US dollars, deflated using consumer price index in the United States;
- Oil prices (*P*), refer to crude oil prices, measured in 2011 US dollars per barrel. Thus, this variable is common to all crosses.

Since the time span is long, it is expected these variables to have dynamic relationships. In consequence, the study of both short and long run adjustments is required. In accordance, the analysis of the functional relationship among variables is modelled based on autoregressive distributed lag (ARDL), which allows the decomposition of the effects into short and long run. As it is well known, this approach has consistent and efficient estimates, as long as, the variables are I(0), I(1), or fractional integrated, and it has the advantage of supporting the inference of parameters based on standard tests. The variables are both in natural logarithms and in first

differences. Thus, their coefficients are, in the first case, elasticities and, in the second semi-elasticities. Thereafter, the prefixes "L" and "D" denote natural logarithm and first differences, respectively. The ARDL model specification is:

$$LY_{it} = \alpha_i + b_{i1}LY_{it-1} + b_{i2}LOP_{it} + b_{i3}LOP_{it-1} + b_{i4}LOC_{it} + b_{i5}LOC_{it-1} + b_{i6}LX_{it} + b_{i7}LX_{it-1} + b_{i8}LP_t + b_{i9}LP_{t-1} + \epsilon_{it}. \quad (1)$$

Eq. (1) is re-parameterized to capture the dynamic relationship among variables, as follows:

$$DLY_{it} = \alpha_i + \beta_{i1}DLOP_{it} + \beta_{i2}DLOC_{it} + \beta_{i3}DLX_{it} + \beta_{i4}DLP_t + \gamma_{i1}LY_{it-1} + \gamma_{i2}LOP_{it-1} + \gamma_{i3}LOC_{it-1} + \gamma_{i4}LX_{it-1} + \gamma_{i5}LP_{t-1} + \epsilon_{it}, \quad (2)$$

where α denotes the intercepts, β_i and γ_i the estimated parameters; and ϵ_i the error term.

Preliminary data analysis

A preliminary data analysis is crucial to understand the characteristics of both series and crosses, in order to conclude about the appropriateness of the estimators. Hence, an analysis of the statistics and integration order shall be done. It is worth noting that this paper studies a set of countries that have some common guidance, as it was previously stated. Indeed, this fact may lead to cross section dependence This phenomenon implies an interdependence among the crosses that exists due to common shocks (Eberhardt, 2011) and that can be of two types. The first type, referred as long-range or global interdependence by Moscone and Tosetti (2010), occurs when the crosses react similarly to external events, answering in a very alike way to them and causing a correlation among countries in spite of the existing geographic space among them, while the second type is based on a spatial matter that takes into account the distance among crosses. Cross section dependence, which usually occurs in macro panels, may lead to inefficiencies and biases in the estimates if it is not appropriately accommodated. Therefore, Table 1 discloses the descriptive statistics of the variables, as well as, the cross section dependence test.

Table 1
Variables statistics and dependence

	Descriptive statistics					Cross section dependence (CD)		
Variables	Obs	Mean	Std. Dev.	Min	Max	CD-test	Corr	abs(corr)
LY	572	9.9665	1.2887	4.0506	12.4561	42.81***	0.805	0.805
LOP	569	7.1084	1.2714	1.3083	9.2003	21.44***	0.403	0.470
LOC	572	4.8092	1.6220	-0.3575	7.9061	50.67***	0.952	0.952
LX	572	8.9480	1.3375	1.9105	11.9836	44.01***	0.827	0.827
LP	572	3.4838	0.7039	2.3439	4.7118	53.21***	1.000	1.000
DLY	561	0.0637	0.2130	-1.2948	1.0117	19.54***	0.371	0.371
DLOP	558	0.0454	0.2954	-2.0121	3.0497	9.79***	0.186	0.203
DLOC	561	0.0693	0.1282	-0.8583	1.2928	10.27***	0.195	0.211
DLX	561	0.0784	0.3429	-2.111	2.1414	27.09***	0.514	0.514
DLP	561	0.0401	0.2733	-0.6655	1.1546	52.69***	1.000	1.000

Notes: Libya in 1960 and the United Arab Emirates in 1960 and 1961 had no oil production. Consequently, LOP registers fewer observations. This happened before these countries joined OPEC. CD test has N(0,1) distribution, under the H_0: cross-section independence. *** denotes statistically significant at 1% level. The stata command *xtcd* was used to achieve the results for cross section dependence.

The presence of cross section dependence is strongly proved for all variables. When working with variables in long periods, it also advisable to check the presence of collinearity, i.e., the extent to which different variables share the same information, when explaining the same dependent variable. The problem lies on the fact that the variance of the regression coefficients can be inflated and, thus creating a misidentification of the predictors' significance (Dormann et al., 2013). Nevertheless, both correlations coefficients and the variance inflation factor (VIF), which was carried out to check multicollinearity among variables, show that collinearity is far from a concern (see Table 2).

Table 2
Matrices of correlations and VIF statistics

	LY	LOP	LOC	LX	LP		DLY	DLOP	DLOC	DLX	DLP
LY	1.0000					DLY	1.0000				
LOP	0.6549	1.0000				DLOP	0.3869	1.0000			
LOC	0.8585	0.6217	1.0000			DLOC	0.2971	0.1648	1.0000		
LX	0.9142	0.7786	0.7756	1.0000		DLX	0.7073	0.5834	0.2323	1.0000	
LP	0.5999	0.2453	0.4872	0.6527	1.0000	DLP	0.4718	-0.0138	0.0325	0.6124	1.0000
VIF		3.87	2.45	8.00	2.75			2.34	1.08	3.98	2.56
Mean VIF				4.27					2.49		

The usual first generation panel unit roots tests, namely Levin Lin Chu (2002), Breitung (2000), Im Pesaran Shin (2003), ADF-Fisher (Maddala and Wu, 1999) and ADF-Choi (Choi, 2001), were carried out (see Table 3) to verify the order of integration of the variables. The Breitung test, as well as, the ADF ones are consensual and they do point to I(1) variables in levels. Nevertheless, the consensus is not general and some questions might arise from the other two unit root tests. To mitigate the effect of cross

section dependence, the tests were performed using the options "robust" and "demean", whenever they were applicable. This last procedure decreases the effect of cross section dependence. Usually, the literature uses Hadri (2000) unit root test as a confirmation test, since its H_0 is in favour of the stationarity, opposing to all the other tests, which point to the existence of unit roots in their null hypotheses. Nevertheless, this test has the disadvantage of size distortion and consequently the over rejection of H_0, when the autocorrelation of the variables is high, which was later verified. The second generation unit roots test CIPS by Pesaran (2007) was also performed. When comparing with those of first generation, this CIPS test has the advantage of being robust to heterogeneity and tests the null of non-stationarity under a nonstandard distribution.

Table 3
Unit root tests

	1st generation					2nd generation	
	LLC	Breitung	IPS	ADF-Fisher	ADF-Choi	CIPS (Zt-bar)	
			no constant			no trend	with trend
LY	-1.3505*	-0.2697	-1.4366*	2.2068	4.6350	-0.833	-0.953
LOP	-1.1134	-0.4235	-4.2818***	6.8133	2.6692	-1.849**	0.355
LOC	-2.8156***	0.6189	-0.2550	1.5516	5.7212	-0.865	-2.159**
LX	0.4563	-0.8381	-2.2868**	2.2272	4.8702	-0.973	-0.142
LP	n.a.	n.a.	n.a.	3.2865	3.6015	15.791	15.547
DLY	-1.8011**	-3.0544***	-7.7746***	95.8829***	-7.3058***	-6.253***	-5.939***
DLOP	-1.2497	-4.8707***	-9.2054***	142.5479***	-9.6933***	-6.707***	-5.844***
DLOC	-1.4260*	-2.0759**	-7.6149***	68.6327***	-5.3067***	-6.875***	-6.040***
DLX	-6.0685***	-1.9110**	-10.2369***	156.7072***	-10.2473***	-6.970***	-5.962***
DLP	n.a.	n.a.	n.a.	136.3525***	-9.5282***	15.757	15.514

Notes: ***, **, * denote significant at 1%, 5% and 10% level, respectively ; the null hypotheses are as follows. Levin-Lin-Chu and Breitung: panels contain unit roots; Im-Pesaran-Shin: all panels contain unit roots, these unit-root tests have cross-section means removed and 3 lags; ADF-Fisher and ADF-Choi: Unit root (individual unit root process); first generation tests follow the option "no constant", which was decided after a visual inspection of the series; Pesaran (2007) Panel Unit Root test (CIPS): series are I(1); the presented results include 3 lags; n.a. denotes not available; and the stata commands *xtunitroot and multipurt were* used.

The CIPS test, which was performed till lag 3, led to the acceptance of the null hypothesis, i.e., the series are I(1). As stated earlier, the oil prices variable is common to all crosses and consequently does not cope with all tests, even with the second generation ones. Together the results appoint the series to be I(1), when in logarithms, and stationary, when in differences. Thus, cointegration can be tested. Moreover, it is worth noting that the dynamic estimators are consistent, as long as, the series are not I(2).

When working upon a panel data structure, the good econometric practices recommend testing the presence of individual effects. In accordance, fixed effects (FE) were tested against random effects (RE), using a Hausman test, which has as null hypothesis that the best model is random effects. In Eq. (2), the error term assumes the form $\epsilon_{it} = \mu_i + \omega_{it}$, where μ_i denotes the N-1 country specific effects and ω_{it} are the independent and identically distributed error. The Hausman's statistically significant p-

value ($\chi_9^2 = 41.66$) led to the rejection of H_0, being the first, FE, the preferred model. In other words, there is evidence of correlation between countries individual effects and the explanatory variables, i.e., the countries individual effects are relevant and must be considered in the estimations.

4. Results and discussion

After concluding that all variables in logs are I(1), their cointegration was tested. One of the most used first generation cointegration tests is the one provided by Pedroni (1999, 2004), which is based on four statistics that run under the null of no-cointegration and takes into account heterogeneity and the independence across countries (Pedroni 1999), not being, therefore, suitable for this study. In this way, Kao's (1999) cointegration test was computed as a first generation cointegration test. This test, which is based on the assumption of coefficients' homogeneity, states the no-cointegration as null hypothesis that was clearly rejected ($t = -6.0043$), leading to the assumption of coefficient homogeneity. Thus, it seems reasonable to use a second generation cointegration test to double check the results, i.e., the Westerlund (2007) cointegration test, which deals with dynamic structures instead of residuals. Also, this test runs under the null hypothesis of no-cointegration and is based on four statistical tests that are consistent and have normal distribution. Two of those statistics (Pt and Pa) test the cointegration of the model as a whole, while the other two (Gt and Ga) test the hypothesis of at least one cross having all the variables cointegrated. They check if the term of error correction in a conditional model is zero and they are able to incorporate short run dynamics for each country, as well as, serial correlated error terms, non-strictly exogenous regressors, interceptions, tendencies and slop parameters for each country (Ciarlone, 2011), being, therefore, flexible and suitable for heterogeneous specification. Note that only Westerlund (2007) cointegration test results (see Table 4) were presented, attending that the variables reveal cross section dependence. Following good econometric practices, which suggest that resampling needs to be done at least 100 times, 800 reps were used. Bootstrapping method provides proper coefficients, standard errors and confidence intervals, disclosing robust critical p-values. As shown in Table 4, it is concluded that cointegration exists considering the panel as a whole, as well as, taking each country individually.

Table 4
Westerlund (2007) cointegration tests

Statistic	Value	Z-value	P-value	Robust P-value
Gt	-2.694	-2.307	0.011	0.006
Ga	-12.084	-1.028	0.152	0.024
Pt	-8.922	-2.810	0.003	0.004
Pa	-11.036	-2.233	0.013	0.015

Notes: Bootstrapping regression with 800 reps; H_0: no cointegration; Gt and Ga test the cointegration for each country individually, and Pt and Pa test the cointegration of the panel as whole; and the stata command *xtwest* was used.

Since there is a large number of observations, macro panels may be treated together, as a panel, or a time series. As OPEC is an organization that works as a cartel, making its members to act in accordance to certain objectives the study of these countries as a whole is justifiable and, thus, a panel data is logical. Besides that, this methodology has several advantages that might improve this type of study. In this way, as pointed out by Klevmarken (1989) and Hsiao (2003), panel data allow the heterogeneity of each cross, which certainly exists when several units are studied, to be controlled. It gives more information, variability, degrees of freedom and efficiency and, thus, less collinearity that is usually present in time series, but more ability to detect and measure phenomena, as well as, to build more complex models that are not checkable or possible with other methodologies. Other advantage is the macro panel data with a bigger time span, which afford panel unit root tests to have a standard asymptotic distribution (Baltagi, 2005).

If heterogeneity is indeed found, Mean Group (MG) and Pooled Mean Group (PMG) estimators should be applied. MG is the most flexible model. It separates the regressions for each cross and then calculates a coefficient average for each cross. Its estimates of the long run average coefficients are consistent, but inefficient when there is a slop of homogeneity (Pesaran et al., 1999). Besides that this model is not suitable for small countries samples, since an outlier can significantly change the coefficients averages (Ciarlone, 2011). Also PMG allows for a bigger flexibility than the traditional models when studying a panel, but not as flexible as MG. It performs restrictions among crosses in the long run parameters, pooling them, but not in the short run ones neither in the adjustment speed. Thus, the short run dynamics are allowed to be heterogeneous, while the long run ones must be homogeneous. It can be based on an ARDL approach, allowing the correction of serial correlation among residuals and the problem of endogenous regressors, as long as, an optimal number of lags is chosen. It is an

intermediate method in which the intersection, the short run coefficients and the error variances can be different among countries, while it implies homogeneity in the long run. If homogeneity is verified, PMG estimators are more consistent and efficient than MG. However, these estimators require both large number of crosses (N) and of time observations (T), such as noted by Blackburne III and Frank (2007). Despite the number of crosses under analysis being short, these estimators were applied and analysed. Indeed, when recurring to times series, i.e., the estimations by crosses are, in general, poor, with few statistically significant parameters and not similar. Consequently, heterogeneity is far from evident, which is in line with the specificities that each country experienced during the studied time span.

Since heterogeneity among crosses was not proved, the MG and PMG estimators were tested against fixed effects, which is the less flexible model. In fact, it is the complete opposite of the previous models, imposing homogeneity for all coefficients and allowing only the interception to be different among crosses. The homogeneity is valid if the parameters have a common convergence. The decision to use one of these models instead of other is done by computing a Hausman test, which states in the null hypothesis that the difference in coefficients is not systematic. Table 5 presents the estimations for each of these three models, as well as, the Hausman tests. The results lead to the rejection of the most flexible models, presenting FE as the most suitable estimator. The negative $\chi 2$ of the Hausman tests, though not usual (see e.g. Dincecco, 2010), emphasize the rejection of the first tested estimator, as stated by Hausman (1984). Note that the long run parameters are computed elasticities.

Table 5
Heterogeneous estimators and Hausman tests

Variable	MG	PMG	FE
Constant	0.6416***	0.1032***	0.3049***
DLOP	0.0410	0.0288	0.0357
DLOC	0.2884***	0.3478***	0.1554***
DLX	0.4009***	0.3779***	0.4369***
DLP	0.0652	0.0586	0.0235
ECM	-0.3311***	-0.1774***	-0.1865***
LOP (-1)	0.2352	0.4081***	-0.1845***
LOC (-1)	0.1642*	0.0997**	-0.0316
LX (-1)	0.5470**	0.5716***	1.1768***
LP (-1)	0.2448	0.2460**	-0.1884**
Hausman tests	MG vs PMG	PMG vs FE	MG vs FE
Chi2(9)	-16.01	0.51	-5.59
Prob>chi2	n.a.	1.0000.	n.a.

Notes: ***, **, * denote significant at 1%, 5% and 10% level, respectively; Hausman results for H_0: difference in coefficients not systematic, n.a. denotes not available; ECM denotes error correction mechanism; the stata command *xtpmg* was used.

Since heterogeneity was not detected, but fixed effects were confirmed, a battery of specification tests was computed to give additional information, so that an appropriate estimator could be chosen. First, a modified Wald test for groupwise heteroskedasticity of the fixed effects regression was performed. This test, which has a χ^2 distribution, tests the null of homoskedascity, i.e., $\sigma_i^2=\sigma^2$ for i=1, …., N, being σ^2 the variance of i country. Then, the existence of contemporaneous correlation among crosses was tested by computing Pesaran's test of cross section independence. The null hypothesis of this test states that the residuals are not correlated and it follows a normal distribution. Breusch-Pagan Langragian multiplier test of independence was also performed in order to check if the variances across individuals are not correlated. This test follows a $\chi 2$ distribution. Finally, Wooldridge test for autocorrelation was performed to attest the existence of serial correlation. The null hypothesis of this test is no serial correlation and follows a F distribution. The results shown in Table 6 reject the null for the modified Wald test, concluding for the presence of heteroskedasticity, as well as, the null for the Wooldridge test, which means that the data has first order autocorrelation, while it accepts the inexistence of contemporaneous correlation, since the null of the Pesaran's test was accepted, as well as, the null for Breusch-Pagan LM test, accepting that the residuals are not correlated.

Table 6
Specification tests

	Statistics
Modified Wald test	48,71***
Pesaran's test	0.589
Breusch-Pagan LM test	62.272
Wooldridge test	67.274***

Note: Results for H_0 of Modified Wald test: sigma(i)^2 = sigma^2 for all I; Results for H_0 of Pesaran's and Breusch_Pagan LM test: residuals are not correlated; Results for H_0 of Wooldridge test: no first-order autocorrelation.

As heteroskedascity, first order autocorrelation, cross section dependence and a large time span are present, Driscoll and Kraay (1998) estimator (e.g. Hoechle, 2007) was used (Table 7). This estimator is a matrix estimator that produces standard error robust to several phenomena, namely the ones found in the sample errors. Additionally, as benchmark, the ordinary least squares (OLS) estimator, which is consistent whenever the regressors are said to be exogenous and no perfect multicollinearity is found and which is improved if there is homoscedasticity and no serial correlation of the errors,

was presented, as well as, the FE estimator and the FE estimator with robust standard errors (Table 7), so that heteroskedascity, which was previously verified, was controlled.

Table 7
Estimation results

Models	OLS (I)	FE (II)	FE robust (III)	FE D.-K. (IV)
Constant	0.1752**	0.3049***	0.3049***	0.3049***
DLOP	0.0305	0.0357	0.0357	0.0357
DLOC	0.1959***	0.1554***	0.1554***	0.1554***
DLX	0.3926***	0.4369***	0.4369***	0.4369***
DLP	0.0565	0.0235	0.0235	0.0235
LY(-1)	-0.0965***	-0.1865***	-0.1865***	-0.1865***
LOP(-1)	-0.0183*	-0.0344***	-0.0344**	-0.0344***
LOC(-1)	0.0055*	-0.0059	-0.0059	-0.0059
LX(-1)	0.1118***	0.2195 ***	0.2195***	0.2195***
LP(-1)	-0.0276*	- 0.0352**	-0.0351	-0.0351**
Statistics				
N	558	558		
R^2	0.5632	0.5236		
R^2_a	0.5560			
F	78.50***	85,15***		

Notes: ***, **, * denote statistically significant at 1%, 5% and 10% level, respectively; in the estimation of DOLS 1 lead and 1 lag were used; and the stata commands *xtreg*, *xtdolshm* and *xtscc* were used.

Table 8 displays the short and the long run elasticities for each model. Note that the long run ones are not directly provided by the estimates, being, therefore, computed. These elasticities were achieved by dividing the coefficient of the variables by the coefficient of LY, both lagged once and multiplying the ratio by -1.

As cointegration was previously detected, as a first approach, de long run elasticities were computed in order to check the relevance of the variables. Thus, the dynamic OLS (DOLS) is present. The following DOLS specification,

$$LY_{it} = \alpha + \beta_1 LOP_{it} + \beta_2 LOC_{it} + \beta_3 LX_{it} + \beta_4 LP_t + \sum_{j=-1}^{1} c_j\, DLOP_{it} + \sum_{j=-1}^{1} d_j\, DLOC_{it} + \sum_{j=-1}^{1} e_j\, DLX_{it} + \sum_{j=-1}^{1} f_j\, DLP_t + \epsilon_{it}, \quad (3)$$

is used to get an unbiased estimation of long run elasticities.

Table 8
Elasticities and speed of adjustment

Models	OLS (I)	FE (II)	FE robust (III)	FE D.-K. (IV)	DOLS (V)
Short run elasticities					
DLOP	0.0305	0.0357	0.0357	0.0357	
DLOC	0.1959***	0.1554***	0.1554***	0.1554***	
DLX	0.3926***	0.4369***	0.4369***	0.4369***	
DLP	0.0565	0.0235	0.0235	0.0235	
Computed long run elasticities					
LOP	-0.1901*	-0.1845***	-0.1845***	-0.1845***	-0.2929***
LOC	0.0574	-0.0316	-0.0316	-0.0316	0.2658***
LX	1.1592***	1.1768***	1.1768***	1.1768***	1.0233***
LP	-0.2856*	-0.1884**	-0.1884	-0.1884**	-0.2531***
Speed of adjustment					
ECM	-0.0965***	-0.1865***	-0.1865***	-0.1865***	

Notes: ***, **, * denote statistically significant at 1%, 5% and 10% level, respectively, in the estimation of DOLS 1 lead and 1 lag were used; ECM denotes the coefficient of the variable LY lagged once.

The results of the elasticities in Table 8 display, in general, consistency throughout all the models. There are similar significance levels in all models and no changes of signs, which confirm the suitability of the dynamic estimate option. Globally, the models corroborate the cointegration detected previously (Table 4), since the error correction mechanisms (ECM) are negative and statistically significant. It is worth noting that model II is a model that does not distinguish short from long run. Indeed it only provides information about the long run elasticities.

The results from the different estimates show the curious particularity of oil consumption being highly statistically significant only in the short run. However, as DOLS model proves that oil consumption is part of the cointegration. Attending to the traditional hypotheses of the nexus defined earlier, the growth hypothesis is confirmed, i.e., there is a unidirectional causality running from oil consumption to growth, though this effect is only verified in the short run. If the paper was merely centred on the nexus it would be completed, but this consumption shall be considered in countries that are, as well, oil producing countries, being this issue valuable to be discussed.

The estimates reveal that the effect of oil production on growth is negative. Indeed, it seems that there is a force that perpetuates the production structure of the economy, holding back its diversification towards "non-oil" activities. It is worth remembering that the cartel's variable of decision is the oil production quotas of the members. The effect observed for oil production is intrinsically coherent with the one observed for prices. In fact, both have the same sign. Furthermore, prices do not have any impact on the short run, which is explained by the fact that the resource curse is mainly a long run

phenomenon. Higher prices mean, *ceteris paribus*, bigger income inflows and, consequently, lower incentive to diversify other activities. Moreover, in the presence of that income, the governments are not pressured to consider the full needs of their people. In fact, those politicians' concern is to maintain the population submissive and dependent, which is attained by social support programs (Spiess, 2008), which is one of the characteristics of the presence of resource curse.

Exports reveal an elasticity superior to one, which is far from strange. In fact, it is expectable that GDP to be influenced by exports of goods or services with high added value. This added value could have two main sources. On the one hand, the added value can come from a technological component and diversification, which allow higher mark-up rates. On the other hand, the added value can come from the low cost of production, in comparison with the market price. Actually, in the OPEC countries, oil production is generally made *onshore*, having relatively low exploitation costs. Countries that have a significant technological component tend to show a high elasticity in exports. Hence, GDP is elastic, i.e., it quickly reacts to small variations in exports. For OPEC countries, where total exports are very alike oil exports, the same consequence is expectable. In short, in these countries, the central issue is not the added value of technology, but the added value of oil in exports.

The main finding is that oil production hampers growth in the long run, which deserves a particular discussion. Furthermore, taking into account that the decision variable of the cartel is the production quotas, the results suggest that the goal of economic growth is not being achieved. This result is in line with the one achieved for example by Noguera and Pecchecnino (2007). This finding is consistent with market failures provoked by the resource curse, given that the abundance of resources and rents hampers the development of non-oil activities, preferably tradable goods, in these countries.

In what concerns the speed of adjustment is low, under 20%, as revealed in Table 5 by ECM term. This is expected for economies that are strongly addicted to hydrocarbons production revenues and which are weakly diversified. This result is consistent with the "curse", since an economy that is strongly dependent on only one sector, is expected that adjustment to shocks takes longer.

5. Conclusion

The oil-growth nexus in OPEC countries was analyzed within a context, where oil production, exports and international oil prices were controlled for. A long time span is used, to bring confidence in the use of recent panel data estimators sensible to asymptotic properties. Despite working with long panels, heterogeneity in the parameters was not found while cross section dependence is present. The confrontation of the several panel data estimators constitutes a relevant contribution to the literature. The option to decompose short and long run revealed to be necessary.

This paper provides evidence for the growth hypothesis of the oil consumption-economic nexus in the OPEC countries, only in the short run. Moreover, the cointegration was detected and it was confirmed that the dynamic specification is suitable, since the adjustment speed of the variables is relevant for the nexus comprehension. The driving force of exports on growth was confirmed. They are predominantly oil exports, which are a source of income and are materialized in domestic demand, displaying an elastic effect on economic growth. Actually, it should be analysed if the exports behaviour found in this study is similar in countries with a well-diversified production.

The results are consistent with the presence of the phenomenon of resource curse. Both oil production and prices constrain economic growth. As consequence, the OPEC cartel leadership should rethink their own objectives and/or the available instruments to meet them. Indeed, assuming that oil production is not divergent from the established quotas by the cartel, i.e., the cheating phenomenon is not relevant, the results found for oil production prove the inability of the cartel to accomplish the objectives that were proposed in OPEC foundation. This internal discussion on the cartel's goals is even more urgent when the own geo-political dependence on the OPEC countries can be threatened soon with the new oil & gas discoveries, particularly in Brazil and Mozambique, respectively. In addition, the recent technological developments in the exploitation of shale gas & oil will put the United States of America as the world leader in the production of these primary energy sources. These facts deserve further research.

References

Akinlo, A., 2008, "Energy consumption and economic growth: evidence from 11 Sub-Sahara African countries", Energy Economics 30(5), pp. 2391-2400

Alam, M. J., Begum, I. A., Buysse, J., Van Huylenbroeck, G., 2012, "Energy consumption, carbon emissions and economic growth nexus in Bangladesh: Cointegration and dynamic causality analysis", Energy Policy 45, pp. 217-225

Alexeev, M., Conrad, R., 2009, "The elusive curse of oil", The Review of Economics and Statistics 91(3), pp. 586-598

Al-mulali, U., 2011, "Oil consumption, CO2 emission and economic growth in MENA Countries", Energy 36(10), pp. 6165-6171

Altinay, G., Karagol, E., 2004, "Structural break, unit root, and the causality between energy and GDP in Turkey", Energy Economics 26(6), pp. 985-994

Apergis, N., Payne, J. E., 2009a, "Energy consumption and economic growth in Central America: Evidence from a panel cointegration and error correction model", Energy Economics 31(2), pp. 211-216

Apergis, N., Payne, J. E., 2009b, "Energy consumption and economic growth: Evidence from the Commonwealth of Independent States", Energy Economics 31(5), pp. 641-647

Apergis, N., Payne, J. E., 2010a, "Energy consumption and economic growth in South America: Evidence from a panel error correction model", Energy Economics 32(6), pp. 1421-1426

Apergis, N., Payne, J. E., 2010b, "The emissions, energy consumption, and growth nexus: Evidence from the commonwealth of independent states", Energy Policy 38(5), pp. 650-655

Baltagi, B.H., 2005, "Econometric Analysis of Panel Data", Third edition, John Wiley & Sons

Bjorvatn, K., Farzanegan, M. R., Schneider, F., 2012, "Resource Curse and Per Balance: Evidence from Oil-Rich Countries", World Development 40(7), pp. 1308-1316

Blackburne III, E.F., Frank, M.W., 2007, "Estimation of nonstationary heterogeneous panels", 7 (2), pp. 197-208

Boyce, J.R., Emery, J.C.H., 2011, “Is a negative correlation between resource abundance and growth sufficient evidence that there is a “resource curse”?”, Resources Policy 36(1), pp. 1-13

Breitung, J., 2000, “The local power of some unit root tests for panel data”, Advances in Econometrics 15, pp. 161-177

Cavalcanti, T.V.V., Mohaddes, K., Mehdi, R., 2011, “Does oil abundance harm growth?”, Applied Economics Letters, 18(12), pp. 1181-1184

Chen, Ping-Yu, Chen, Sheng-Tung, Chen, Chi-Chung, 2012, “Energy consumption and economic growth – New evidence from meta analysis”, Energy Policy 44, pp. 245-255

Choi, I., 2001, “Unit root tests for panel data”, Journal of International Money and Finance 20, pp. 249-272

Chu, Hsiao-Ping, Chang, Tsangyao, 2012, “Nuclear energy consumption, oil consumption and economic growth in G-6 countries: Bootstrap panel causality test”, Energy Policy 48, pp. 762-769

Ciarlone, A., 2011, “Housing wealth effect in emerging economies”, Emerging Markets Review 12(4), pp. 399-417

Cunado, J., 2011, “Structural breaks and real convergence in OPEC countries”, Journal of Applied Economics 16(1), pp. 101-117.

Damette, O., Seghir, M., 2013, “Energy as a driver of growth in oil exporting countries?”, Energy Economics 37, pp. 193-199.

Dincecco, M., 2010, “The political economy of fiscal prudence in historical perspective”, Economics & Politics 22(1), pp. 1-36

Dormann, C.F., Elith, J., Bacher, S., Buchmann, C., Carl, G., Carré, G., Marquéz, J.R.G., Gruber, B., Lafourcade, B., Leitão, P.J., Münkemüller, T., Mcclean, C., Osborne, P.E., Reineking, B., Schröder, B., Skidmore, A.K., Zurell, D., Lautenbach, S., 2013, “Collinearity: A review of methods to deal with it and a simulation study evaluating their performance”, Ecography 36(1), pp. 27-46

Driscoll, J., Kraay, A.C., 1998, “Consistent covariance matrix estimation with spatially dependent data”, Review of Economics and Statistics 80, pp. 549-560

Eberhardt, M., 2011, “Panel time-series modeling: New tools for analyzing xt data”, 2011 UK Stata Users Group meeting

Eggoh, J. C., Bangake, C., Rault, C., 2011, “Energy consumption and economic growth revisited in African countries”, Energy Policy 39(11), pp. 7408-7421

Esfahani, H.S., Mohaddes, K., Pesaran, M. H., 2012, "An empirical growth model for major oil exporters", Journal of Applied Economics

Fuinhas, J. A., Marques, A. C., 2012a, "Energy consumption and economic growth nexus in Portugal, Italy, Greece, Spain and Turkey: An ARDL bounds test approach (1965-2009)", Energy Economics 34(2), pp. 511-517

Fuinhas, J. A., Marques, A. C., 2012b, "Rentierism, energy and economic growth: the case of Algeria and Egypt (1965-2010)", XXVI Congreso Internacional de Economía Aplicada ASEPELT

Fuinhas, J. A., Marques, A. C., 2012c, "An ARDL approach to the oil and growth nexus: Portuguese evidence", Energy Sources Part B, pp. 282-291

Hadri, K., 2000, "Testing for stationarity in heterogeneous panel data", The Econometrics Journal 3(2), pp. 148-161

Hausman, J., Mcfaden, D., 1984, "Specification test for multinominal logit model", Econometrica 52, pp. 1219-1240

Hoechle, D., 2007, "Robust standard errors for panel regressions with cross-sectional dependence", Stata Journal 3, pp. 281-312

Hossein, A., Yazdan, G.F., Ehsan, A. G., 2012, "The relationship between energy consumption, energy prices and economic growth: Case study (OPEC countries)", OPEC Energy Review 36(3), pp. 272-286

Idemudia, Uwafiokun, 2012, "The resource curse and the decentralization of oil revenue: the case of Nigeria", Journal of Cleaner Production 35, pp. 183-193

Im, K., Pesaran, H., Shin, Y., 2003, "Testing for unit roots in heterogeneous panels", Journal of Econometrics 115, 53-74.

Kropf, Annika, 2010, "Resource abundance vs. resource dependence in cross-country growth regressions", OPEC Energy Review 34(2), pp.107-130

Levin, A., Lin, C.-F., Chu, C.-S. J., 2002, "Unit root test in panel data: Asymptotic and finite-sample properties", Journal of Econometrics 108(1), pp. 1-24

Maddala, G.S., Wu, S., 1999, "A comparative study of unit root tests with panel data a new simple test", Oxford Bulletin of Economics and Statistics, 61, pp. 631-652

Mehrara, M., 2008, "The asymmetric relationship between oil revenues and economic activities: The case of oil-exporting countries", Energy Policy 36(3), pp. 1164-1168

Mehrara, M., 2009, "Reconsidering the resource curse in oil-exporting countries", Energy Policy 37(3), pp. 1165-1169

Mehrara, M., Maki, M., Tavakolian, H., 2010, "The relationship between oil revenues and economic growth, using threshold methods (the case of Iran)", OPEC Energy Review 34(1), pp. 1-14

Menyah, K., Wolde-Rufael, Y., 2010, "Energy Consumption, pollutant emissions and economic growth in South Africa", Energy Economics 32(6), pp. 1374-1382

Moscone, F., Tosetti, E., 2010, "Health expenditure and income in the United States", Health Economics 19, pp. 1385-1403

Murshed, S. M., Serino, L. A., 2011, "The pattern of specialization and economic growth: The resource curse hypothesis revisited", Structural Change and Economic Dynamics 22(2), pp. 151-161

Noguera, J., Pecchenino, R.A., 2007, "OPEC and the international oil market: Can a cartel fuel the engine of economic development?", International Journal of Industrial Organization 25, pp. 187-199.

Ozturk, Ilhan, 2010, "A literature survey on energy-growth nexus", Energy Policy 38(1), pp. 340-349

Payne, J.E., 2010, "Survey of the international evidence on the causal relationship between energy consumption and growth", Journal of Economic Studies 37(1), pp. 53-95.

Pesaran, M.H., 2007. A simple panel unit root test in the presence of cross-section dependence. Journal of Applied Econometrics 22, 265-312.

Pesaran, M.H., Shin, Y., Smith, R.P., 1999, "Pooled Mean Group Estimation of Dynamic Heterogeneous Panels", Journal of American Statistical Association 94(446), pp.621-634

Pradhan, R. P.,2010, "Energy consumption-Growth nexus in Saarc countries: Using cointegration and error correction model", Modern Applied Science 4(4), pp. 74-90

Radetzki, M., 2012, "Politics – not OPEC interventions – explain oil's extraordinary price history", Energy Policy 46, pp. 382-385.

Rosser, A., 2006a, "The Political Economy of the Resource Curse: A Literature Survey", Working Paper 268, Institute of Development Studies at the University of Sussex, pp. 1-36.

Rosser, A., 2006b, "Escaping the Resource Curse", New Political Economy 11(4), pp. 557-570

Sa'ad, S., 2010, "Energy consumption and economic growth: Causality relationship for Nigeria", OPEC Energy Review 34(1), pp. 15-24

Sari, R., Soytas, U., 2009, "Are global warming and economic growth compatible? Evidence from five OPEC countries?", Applied Energy 86(10), pp. 1887-1893

Spiess, A., 2008, "Developing adaptive capacity for responding to environmental change in Arab Gulf States: Uncertainties to linking ecosystem conservation, sustainable development and society in authoritarian rentier economies", Global and Planetary Change 64(3-4), pp. 244-252.

Squalli, J., 2007, "Electricity consumption and economic growth: Bounds and causality analyses of OPEC members", Energy Economics 29(6), pp. 1192-1205

Stevens, P., Dietsche, E., 2008, "Resource curse: An analysis of causes, experiences and possible ways forward", Energy Policy 36(1), pp. 56-65

Westerlund, J., 2007, "Testing for error correction in panel data", Oxford Economics and Statistics 69, 709-748.

Wiig, A., Kolstad, I., 2012, "If diversification is good, why don't countries diversify more? The political economy of diversification in resource-rich countries", Energy Policy 40, pp.196-203

Wirl, F., 2010, "Dynamic demand and noncompetitive intertemporal output adjustments", International Journal of Industrial Organization, 28, pp. 220–229.

Wolde-Rufael, Y., 2005, "Energy demand and economic growth: The African experience", Journal of Policy Modeling 27(8). Pp. 891-903

Wolde-Rufael, Y., 2006, "Electricity consumption and economic growth: A time series experience for 17 African countries", Energy Policy 34(10), pp. 1106-1114

Yang, Hao-Yen, 2000, "A note on the causal relationship between energy and GDP in Taiwan", Energy Economics 22(3), pp. 309-317

Zhang, Yue-Jun, 2011, "Interpreting the dynamic nexus between energy consumption and economic growth: Empirical evidence from Russia", Energy Policy 39(5), pp. 2265-2272

Zhao, Chang-hong, Kang, Jian-gang, Yuan, J., 2008, "Oil consumption and economic growth in China: A multivariate cointegration analysis", The 2008 International Conference on Risk Management & Engineering Management, pp. 178-183

Zou, G., Chau, K. W., 2006, "Short- and long-run effects between oil consumption and economic growth in China", Energy Policy 34(18), pp. 3644-3655