Strategic Alliance in Energy Sector & Implications for Economic Growth and Technical Efficiency: The Case of Petrobras and Galp

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Abstract

This study stemmed from the lack of evidence and uncertainties regarding the economic and political effects of a strategic alliance between leading oil companies like Petrobras and Galp on their host economies. This paper investigates whether public and private corporations in the energy sector can influence the economic growth of their respective countries. A Panel data analysis was performed by employing quarterly data from (2006-2013). We also used Data Envelopment Analysis (DEA) approach to measure the technical efficiency (TE) effect of the alliance on the performance of both companies from 1999 to 2012. It was found the exploration and export of oil and gas do not play a significant role in output growth of the home economy and that exploration activities were inflationary, destabilising and inimical to growth, at least in the short-run. On another positive side, both companies showed increased technical efficiencies in the chosen time period. Petrobras enjoyed TE on average of 90% in the variables studied whereas Galp showed an average TE of 70%. These results reflect the corporate strategies of both firms, which focussed on achieving profitable and sustained growth and enhancing their efficiencies in their collective and individual activities.

Key Words: - Economic Growth, Exploration, Oil and Gas, Technical Efficiency, Strategic Alliance

JEL Classification: L1, L4, Q43

Introduction

At the present time, oil and gas are considered as the precursor of economic growth (Shelley, 2005). Simmering geopolitical tensions, high speculation in oil markets, sometimes inadequate fiscal and monetary systems, weak recover of the world economy from crises, and political and

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social conditions in many parts of the world, have combined to create numerous challenges for the oil and gas industry (Mirani, 2009; El-Badri, 2012). However, the major issue that the global oil and gas market faces is the uncertainty that surrounds the global economy (El-Badri, 2012; Shelley, 2005).

The reaction to the uncertainty in the global economy has been the revaluation of business priorities. A number of changes have been implemented to focus on outsourcing more services, decentralization, and cost-reductions programs among others (Mirani, 2009). These efforts resulted in more productivity and efficiency gains in the oil and gas industry and better returns since oil plays an important role in satisfying worldwide energy necessities. According to OPEC (2012), oil and gas prices have increased and will continue to rise due to inflation and average prices may reach $155 per barrel by 2035. Similarly, according to the International Energy Agency (2010) estimate, energy consumption between the periods of 2010-2035 will rise 54%. Nevertheless, this scenario represents an overwhelming challenge for the oil and gas industry since the demand for natural gas and oil is continuously growing, import dependency in the long term will intensify (Shelly, 2005). On this issue, Ortega (2011) recommends that the industry maximizes and improve the recovery of the existing reserves, increase exploration for new reserves.

Studies focused on analysis of oil and gas import dependency by states recommend that companies must implement a collaborative style of work (Toft and Duero, 2011). Drawing on it, oil companies have implemented partnerships and alliances to take advantage of their strengths and capabilities creating values throughout their business, and generating sustainable competitive advantage while minimizing risks and uncertainty (Newman and Chaharbaghi, 1996; Ortega, 1997, Toft and Duero, 2011; James 2011;). In this fast-moving market where there are numerous regional trade blocs, and integrated world economy, strategic alliances are the preferred choice for oil and gas companies as a response to these tendencies. Strategic alliances are implemented to increase quality, decrease cost, and enhance efficiency, share resources, technologies and risk (Ortega, 1997; Fadol and Sandhu, 2010). These alliances lead oil and gas companies sharing common goals, combine their efforts and eliminate wastage of resources (James, 2011). Study by James (2011) highlights the fact that the main benefit of an alliance between an International Oil Company (IOC) and a National Oil Company (NOC) is the potential access by the IOC to reserves which have positive impact on production and profitability. In addition the IOC can realise a significant reduction of political risk. On the other hand NOC-IOC alliances are a source of resources and technological transfer, especially

when an NOC that possesses large amount of resources requires expertise and the know-how of an IOC to develop and efficiently utilise those resources.

This study is focused on the analysis of a strategic alliance between a National Oil company (NOC) and an International Oil Company (IOC). The main characteristic of National Oil Companies is that they act in response to goals of the nation (Nolan and Thurber, 2010) and are often seen as instruments of foreign policy (Losman, 2010). The function and configuration of an NOC can alter broadly dependent on governments and could bring political concerns (Victor *et al,* 2012), whereas International Oil Companies are highly specialized and competitive in their operations (Jaffe and Soligo, 2007; Nolan and Thurber, 2010). Notwithstanding, prior body of works indicates that NOCs and IOCs are considered forthright competitors and that both can create threats to their existence in an era where state control is increasing (Nolan and Thurber, 2010).

The NOCs or state-controlled oil companies and IOCs are significant and influential economic organizations in the world (James, 2011). NOCs control the oil and gas industry (hydrocarbons) as they possess 73% of the world's oil reserves and 61% of the production. Their control in the gas sector is similar consisting of 68% of reserves and 52% of the production (Victor *et al,* 2012). On the other hand ICOs only control 10% of worldwide oil and gas reserves (Jaffe and Soligo, 2007). Although national oil companies own the bulk of oil and gas resource bases, IOCs are the world's major oil and gas producers and also achieve higher returns on capital invested than NOCs (Jaffe and Soligo, 2007). However, a study by Victor *et al,* (2012) suggests that there are gaps in the existing literature about NOCs. They emphasize the inadequacy in studies which explain how NOCs behave and function, as well as the explanations of the different ways they perform and their business strategies. There is also a gap in the existing body of knowledge to clarify how NOCs interact with their host governments. In light of this, it is important to evaluate strategic alliances and the competitive strategies used by the oil and gas firms. This study attempts to develop a better understanding of the real benefits of strategic alliances amongst oil and gas companies which is eminently important for the evaluation and assessments of alliances in this industry. The aim of this study is to analyse to what extent strategic alliances in the oil and gas industry can influence the economy. In our study we will look at Petrobras SA of Brazil which is an NOC and Galp Energia of Portugal which is an IOC. Consequently the research aims to answer the question about the implications that would arise from the strategic alliance. In conclusion this study should provide a deeper knowledge of strategic alliances in the oil and gas industry and their effects on the wider economy.

Review of Literature

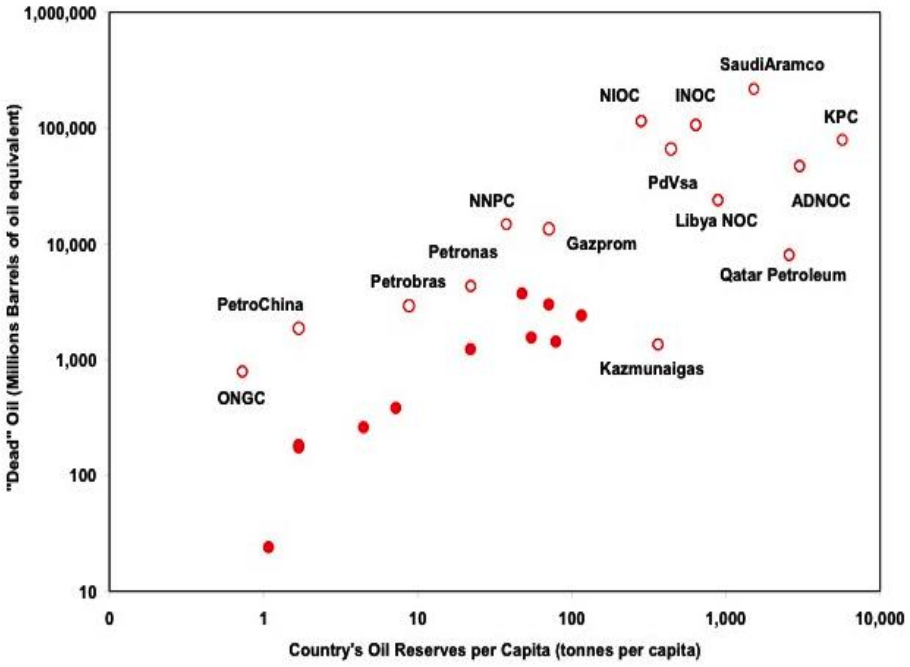
Oil remains the prime source of primary energy. Crude oil, gas and refined products collectively form the largest exclusive items of international trade, either measured by value or volume. The worldwide economy is highly dependent on this energy source and it remains important for the health of economies (Stevens, 2005; Behmiria and Manso, 2012). The oil and gas industry is characterised by technology intensity and huge investments and a high degree of rivalry. The current era is characterised by a period of challenges and complexity due to the high tariffs on oil prices and above average marginal costs, swings in oil prices, and supply uncertainty surrounding the main resources (Mirani, 2009; Victor, 2007 and IEF, 2012). The political economy of states that possess huge oil and gas resources causes inherent strains between the private sector and the role of the state over the control of the revenues produced by these natural resources (Basher & Sadorsky, 2006; Robinson, 2009; Matutinovic, 2009). Hvozdyk and Mercer-Blackman (2010) observe how hydrocarbons companies can influence economies and that additional variables can be considered in this respect such as company size, if the company had a merger, whether and when, reserves, interest rates and past investments. However it is necessary to include variables characterizing the host-country environment including the share of oil and gas revenues to total general government revenues, political stability and fiscal balance of the host country. The study further claims that the companies' strategies and ownership structure needs to be considered[2].

Prior research indicates that there can exist a separation between state control and state governed NOCs (James, 2011), where the state retains a minority of the shareholder with veto right or substantial approval, for instance the case of Petrobras or Eni (Xun *et al.,* 2011). It has also been noted that NOCs are a hard faction to define because NOCs shapes and functions can differ extensively if the government wants to control and benefit from their hydrocarbon sector (James, 2011; Nolan and Thurber, 2010). Nationally, these companies are used by their states as tools of economic development and fulfil important economic and social functions that compete for capital budgets that potentially can be designated for commercial activities like oil production activities and reserves replacement (Jaffe, 2007; Stevens, 2008; James, 2011;). Similarly, Pirog (2007) argued that NOCs may be involved in redistributing the oil wealth of the nation to society in general and to ensure national energy sufficiency. The redistribution

2 It is necessary to take into account that NOCs influences are significantly different from IOCs influences.

function here may be accomplished through employment policies; social welfare programs fuel subsidies and jobs programs.

The expanding influence of state-owned companies on the global supply-demand balance brings up questions about the objectives, priorities and emerging policies of these organizations. Principally, changes in those objectives, priorities and policies will have considerable impacts on the future development of the hydrocarbons markets (James A. Baker III Institute, 2012).



Source: *Victor (2012)*

Fig 1: NOCs and Country Oil Reserves Per Capita in 2012.

A considerable body of research has examined the close relationship between NOCs and their national governments and finds that many governments benefit from NOCs to achieve a vast number of socio-economic policy objectives including incorporating industrial development and income redistribution. This close relationship means that strategic and geopolitical intent is more important than commercial consideration as a factor for foreign investment decisions (Stevens, 2008; Robinson, 2009). NOCs are often regarded as a government tool thus making them vulnerable to political pressures. However, state-owned companies are not exposed to bankruptcy or risk of takeover because they are backed by governments (Nolan and Thurber, 2010; Toft and Duero, 2011). Hults (2012) investigated the relationship between the

performance of NOCs and governance and argued that the weakness of state-owned companies lies in the fact that they do not have competitive pressures in their domestic markets. Due to this, NOCs have a lack of incentive to establish strong risk management capabilities that are necessary to survive in a competitive environment and to earn decent returns on capital investment (Hults, 2012; Victor *et al.,* 2012, James, 2012). On the performance aspect, Hults (2012) suggests three interactions on the relationship between NOCs performances and governance elements. The study argues that performance of the NOC is superior if the state has total control over the enterprise and poor performance results if control of the state if fragmented. State-owned enterprise performs better when the state has law-based mechanisms to administrate them and poorly performs when the state depends on informal mechanism of control. Finally, NOC performance is positively associated with monitoring-heavy oversight system and negatively related to procedure-heavy system.

Unlike state-owned companies, where the responsibilities and motivations depend on state goals, IOCs are market-driven and profit maximization oriented and a truly internationally focused. To achieve the profit maximization objectives, IOCs must compete with other oil companies worldwide, and to gain the opportunity to invest in development or exploration, an enterprise needs to guarantee value to the host country. The distinction of IOCs is that each company is highly specialized in what it does. Progressively, IOCs have become general contractors and coordinate operations of different suppliers which undertake seismic work, provide drilling rigs and crews, analyse data and host oil field services. Nevertheless, despite the high revenues and the rise in oil prices, the majority of IOCs in recent years have not been able to replace their oil reserves (Jaffe and Soligo, 2007; Robinson, 2009).

It has been noted that the relationship between NOCs and IOCs have gradually changed in the last twenty years as NOCs have increased their activities to expand influence on controlling their countries' natural resources and the selection of which IOC should have access to the reserves. In turn, IOCs have had to re-evaluate their strategies in other to meet NOC's current requirements (Ledesma, 2009; Loung and Weinthal, 2010). In these volatile markets, the alliances between NOCs and IOCs are becoming a tool to minimize conflicts between partners. Firms in the oil and gas sector recognize that alliances are the only way to minimize risk associated with market and technology uncertainty (IEF, 2012). The main motivations of the alliances between NOCs – IOCs appear to be access to resources, exploitation of local resources, competitive advantages, scale economy advantages, reduction of risks, technology

complementarities and overcoming access barriers (Murani, 2009). Nevertheless, the evolving business environment of the oil and gas industry has changed and consequently the main motivations of NOCs and IOCs to form alliances have also changed. The traditional areas of competence, the roles and spheres of influence of NOCs and IOCs are in constant change since they aim to create sustainable business models competent in withstanding worldwide economic challenges and myriad associated uncertainties (IEF, 2012).

According to recent studies, NOCs and IOCs have been focused lately in examining and finding new strategies for the development of (liquefied natural gas) LNG[3] projects (Ledesma, 2009; Loung and Weinthal, 2010). The traditional model argued that IOCs entirely manage the LNG chain, mostly using their own resources but always with the support of an NOC that is the natural resource-holder (Ledesma, 2009). This study argues that, nevertheless, this trend has changed over the years where lately NOCs have gained expertise in the area and have been more involved in operations and development of LNG projects. However, due to the relationship between NOCs and governments, and the risks associated with these projects some governments may not take this risk and therefore political rationale has slowed this process (Loung and Weinthal, 2010).

In the energy market there is an increasing demand for natural gas, which is playing an important part in the evolution of the business environment. NOC-IOC alliances based on natural gas exploitations are expected to grow and are favoured by the discovery of substantial shale gas deposits around the world (Loung and Weinthal, 2010). This new discovery brings has a significant impact on the global gas industry which could represent new possibilities for NOCs and IOCs to create long-term sustainable alliances by sharing financial and operational risk particularly in difficult environments and in very large scale projects (James, 2012; Mirani, 2012). In the same line of thoughts, Hults (2012) suggested that cross-accessing resources, technology, markets and capitals offer mutual opportunities for cooperation when firms form alliances for investment throughout the value chain based on horizontal and vertical integration. The study also mused that mutual trust and respect may serve to strength long-term alliances between NOCs and IOCs and when a NOCs form alliances outside their home country they generate added value for their shareholders.

3 LNG is natural gas cooled to (-162 -260 degrees Fahrenheit) that shrinks the volume of the gas 600 times. Liquefied natural gas value chain is composed of four elements: Upstream: Searching, exploration and production of gas; Liquefaction: Process in which the gas is cooled to a minimum of 160 degrees, turning into liquid; Shipping: the process of LNG shipping; Regasification: process through which LNG is transformed to gas by the addition of heat.

The advantages of strategic alliances in the oil and gas industry are different for NOCs and IOCs (Mirani, 2012; James, 2012). The reason for this is that although operationally and technically these firms are part of the same market and industry, they do face different problems and concerns[4] (Ledesma, 2009). NOCs form alliances with IOCs when they need to expand and venture into international markets due to the vertical integration of IOCs which makes it easier to access the different portions of the global market. NOCs that would like to operate in a global market can obtain benefits from such alliances since IOCs have an enhanced familiarity with and a higher standing in those markets (Mirani, 2009). However, strategic alliances can be an unpopular decision for some governments mainly when the alliance implies investment in technology with significant environmental footprint or investment in states with dubious governance reputations (Zanoyan, 2002). Another challenge in strategic alliance occurs when the host nation depends on the alliance rather than on unmitigated competition for individual tenders (Hults, 20012; Victor *et, al.,* 2012). Consequently, the state can lose the competitiveness that allows it to get a favourable total return (De Olveira, 2012).

Access to oil and gas reserves in the actual competitive market is the main concern of IOCs. It has been argued that the main reason for alliances is to facilitate international oil companies' access to reserves (Mirani, 2009; Hults, 2012). Zanoyan (2002) characterised this relationship as positive for both since the place where IOCs look for potential access benefits from the resources and technology of the IOCs. In addition, IOCs could face a decline in political risk by being in an alliance where the action by the host government against foreign firms might be less likely to occur. Well-structured alliances could lead to increase of investment levels in the hydrocarbon industry as a whole precisely if the returns and risks from these alliances are appropriately distributed (Nolan and Turber, 2012). Nowadays, NOCs own the majority of global oil and gas reserves, and as a result IOCs realize that their future activities only can increase if they take part in alliances in which control, risks and profits are shared. In turn, states of origin of NOCs need to ensure strong governance and more transparent and stable investment environment (Hults, 2012).

4 NOCs concerns: Access to markets, capitals, technology, management of IOC presence, managing risk, organizational politics, local policies and government bureaucracy. IOCs concerns: profitability, access to opportunities, risk management, share price, commercial competition, investor relations, and legal and regulatory issues.

Nolan and Turber (2010) assert that risk and uncertainty are plentiful in the oil and gas industry. The study argues that the magnitudes of the investment risks for the oil and gas industry can vary depending on the capital investments (Nolan and Turber, 2010). There is also exploration risk due to geological uncertainty despite the modest capital exposure involved (Hults, 2012; Ernst and Steinhubl, 1997). In contrast, field development is a high risk venture even though there is no uncertainty. However, when a field is discovered it is necessary to invest a great deal of capital to develop it. Studies by Hults (2012) and Victor (2007) argued that the levels of risks are a function of the magnitudes of the production and exploration programmes. The risks and uncertainty decrease as experience and knowledge acquired over time increase and as unused oil and gas reserves are proven commercially and eventually become mature. The uncertainties that alliances in the oil and gas industry face are not only geological but, are also related to the future conditions of the market (Nolan and Turber, 2010; Hults, 2012). Another risk faced by alliances in this industry is related to natural gas developments which require expensive infrastructure investment throughout the value chain, and this risk is more noticeable in cross-border projects. Alliances face supply risk in downstream investments which are in almost all cases uncertain since for instance, refinery will require inputs of oil and gas to run at capacity over long period of time in order to recover cost (Nolan and Turber, 2010). Hence, the relationship between National Energy Companies and International Energy Companies has gradually changed in the last thirty years with an increase in the number of players in the industry. The new players in the field seek to have access to reserves and to obtain strategic and early positions in potential LNG projects. The behaviour of IOCs has gradually changed in the oil and gas industry offering NOCs part of the chain that previously they had been unwilling to provide. IOCs have to evolve to respond to the new opportunities since NOCs seek new partners to develop alliances to add value to their operations.

Overview of Petrobras SA: Strategy and Performance

Petrobras SA is one of the most successful national Oil and Gas Companies in the world, and stands out as particularly successful in the production and exploration of deep-water oil with a dominant position in the Brazilian oil and gas sector and a growing presence internationally

(De Oliveira, 2012). This Brazilian state-owned company has on several occasions used its political connections, along with its offshore technological capabilities to create partnerships with IOCs. Usually the company explored overseas opportunities in countries with connection to the Brazilian state, mainly in South America where Petrobras serve as an instrument of political integration (Bell, 2011). From the mid-1990s, the Brazilian government implemented a strategy of competition as a way to encourage investment in the country's oil reserves. In 2008 this strategic ambition showed result when the company reached self-sufficiency in oil and became a net exporter. Today, oil imports are no longer a macroeconomic concern for the government. The Brazilian government turned the attention to oil revenues as a future source of government revenue. According to Adelman (2003) the Petrobras's success is due to the company's continuous strategic orientation to the minimization of risks that are a critical aspect of the oil industry.

When the imports of the company started to rise, Petrobras's risk management strategy changed to a more commercial one. To deal with these commercial risks, the company developed logistics refineries, which was a huge investment for the company but not a risky investment due to the company's monopoly position. With this it was possible to increase the output as upstream operations found and produced more oil. To minimize technological risk in these operations, the company relied heavily on technological partnerships with other companies while building its in-house capabilities (Bell, 2011). In 1974, the company faced the necessity of cooperation with IOCs to speed up the development of new identified fields that hold sizable oil reserves because the company had little capacity of its own to operate offshore (Petrobras, 2013). The Brazilian government provided Petrobras with a large set of regulatory and economic incentives to achieve its main goals. The autonomy and legal oil monopoly granted to Petrobras have allowed the company to develop a vertically integrated renowned oil company. The monopoly power enhances the company's capacity to invest, moving along the technological learning curve and enjoying economies of scale. With the purpose of becoming an international energy company, Petrobras has increased its investments to protect its competitive position overseas and in the domestic market. The company has declared its intention to develop new projects in the power sector to utilize gas reserves in the country as well as in renewable energy and petrochemical businesses (De Oliveira, 2012).

Overview of Galp Energia: Strategy and Performance

Galp Energia has an integrated energy operation and has a presence throughout the value chain of oil and natural gas, and increasingly active in renewable energy. It is a leader in the energy sector in Portugal (oil and natural gas). The company owns Petrogal (the only refining company and leading distributor of oil products in Portugal) and GDP Gás (the company responsible for the transportation, distribution and importation of natural gas in Portugal). It also has a strong presence worldwide operating in countries like Spain, Angola, Venezuela, Brazil, Mozambique, the Gambia, Guinea-Bissau, and Timor-Lester (Galp, 2013).

The company's structure is divided into three main parts: Production and Exploration, Refining and Marketing and Gas and Power Sectors. The corporate strategy of Galp has developed a new aspect known as *Tri-Fuel* – oil, gas and electricity. The new strategy considered strengthening of the exploration and production of oil, investment in refining, the entry in the electricity sector and the growth into natural gas (Barreto, 2012). The company and its subsidiaries have worldwide activities, with over 40 projects across the world. In the Refining and Marketing sector, the company has its activities of refining oil and gas and producing final goods for their consumers including gasoline, diesel, jet fuel and others. The Gas and Power sector is focused on the supply and distribution of natural Gas in Portugal, as well as in Spain. The company also produces electricity and thermal energy (Santos, 2012).Galp Energia has been profitable from its three segments of Gas and Power, Exploration and Production and Refining and Marketing businesses. Galp Energia has a goal to increase production and exploration and the company achieved in 2010 to produce 150 thousand barrels of oil per day (Santos, 2012).

Galp aims to develop potential multi-energy strategies bounded by environmental, economic and social restrictions with the purpose to grow existing activities and look for investment in new opportunities. This measure is intended to improve the efficiency and profitability of their assets, increasing the ability to compete in markets where it operates, and intensify efforts for innovation, quality and safety (Galp, 2011). In the exploration and production sector, Galp has a goal of achieving a production level 10 times higher than the volume of production in 2008 and equal to half of its refining capacity. In refining and distribution the company plans to generate more value from its assets, especially refineries and distribution network of oil products (Galp, 2012). In short, Galp Energia attempts to integrate the business of gas supply capacity of natural gas, developing the water sector and its range of wind farms and eventually become a prominent company in the markets where it opreates (Barreto, 2012).

Methodology & Data

We use a combination of cross-sectional and time series data from 2006 to 2013. The frequency of the data is quarterly obtained from Compustat database. It is not possible to use a longer time series because the Petrobras - Galp alliance on started in 2006. The variables chosen are for the examination of the effectiveness of the strategic alliance between the state-owned company and the private company. To analyse the effect of this alliance on the national and economic policies of Brazil and Portugal from 2006 to the present we use national GDP growth as a measure of national effect. To able to investigate this effect we include measures of constraints and strengths in this alliance proxied by Oil Refining, Oil Exploration and Revenues and Reserves of each company. On the other hand we also include the exports of each country as a regressor. This quarterly data starts from the first quarter of 2006 to the second quarter of 2013. We fit a balanced panel data for the two countries and companies to the equation explained below.

Panel Data Model

A panel data analysis is known to improve econometric analysis in a number of ways including increasing the number of data points therefore improving the efficiency of the regression estimates (Hsiao, 2003). It also allows for the analysis of more research questions relative time-series and or cross-section data alone. In our case with only two countries (companies) and 30 quarters, a longitudinal data analysis increases our data points significantly to 60.

The standard multiple regression models shows how each of the explanatory variables predicts GDP growth (the response variable). Hence, the growth of GDP will also represent the influence upon the two economies of Brazil and Portugal of the strategic alliance. We first considered the variables of both companies – Petrobras and Galp- for the regression model, presented in panel data as Oil Refining, Oil Exploration, Revenues of the companies, proven reserves of the companies and exports. The empirical model looks as follows:

$$lnGDP_{it} = \beta_0 + \beta_{it} lnRefining + \beta_{it} lnExploration + \beta_{it} lnRevenue$$

$$+\beta_{it} lnReserves + \beta_{it} lnExports + \varepsilon_{it} \quad (1)$$

Where β_0 is the constant term, GDP is growth in gross domestic product, $Refining$ is refining capacity, $Exploration$ is expenditures on exploration for oil and gas, $Revenue$ is revenue received by each company, $Reserves$ is total proven oil and gas reserves for each company, $Exports$ are the export volumes of oil and gas for each country, $\beta_{it}'s$ are coefficients on the independent variables and ε_{it} is the overall error term.

Empirical Analysis and Discussion of Results

We fit the longitudinal data to the equation above and estimate it by OLS in STATA. We use robust standard errors to correct for heteroskedastcity and the regression results are presented below in the table below: we run three regressions with refining and exploration in all the regressions with alternately revenue, reserves and export separately in the three regressions because of high correlation between the last three variables. All the variables are in natural logarithms.

In all three regressions the *R*-squares are reasonable and the F-statistics support the notion that the coefficients are not all zeros. In regression1, exploration is weakly significant and refining is significant at the 1% level and has a positive sign suggesting that the refining activities of the two companies contribute positively to the growth of the respective countries national income. In all three regressions the coefficient on exploration is robust and stable but negative.

Table 1: Effects of Petrobras-Galp strategic alliance on GDP growth of Brazil and Portugal

Dependent Variable: GDP growth

	regression 1	regression 2	regression 3
DependentVariables			
Exploration	-0.229	-0.287	-0.203
	(-1.660)*	(-2.480)***	(-1.700)*
Oil Reserves	0.091	-0.054	0.067
	(1.040)	(-0.650)	(0.620)
Oil Refining	0.344***		
	(2.260)		
Revenues		0.294***	

		(3.580)	
Exports of oil			0.215
			(1.460)
Constant term	-1.366	0.495	0.429
	(-2.900)	(0.810)	(0.470)
R-squared	0.187	0.265	0.174
N	60	60	60

t-values are in parentheses and are based on heteroskedastic-robust standard errors. *** shows significance at 1%, ** significance at 5% and * significance at 10% level.

The negative sign for exploration although unexpected but may suggest that exploration expenditures initially are a leakage to the economies and subtract rather than add to growth in the short term. There might be another explanation that the coefficient might be capturing the negative effects between oil prices which are volatile and GDP which is extensively accepted in the literature, the so called "Oil-GDP relationship" (Awerbuch and Sauter, 2005). According to Yang *et al.,* (2002), the exploration of oil and gas is dependent upon the oil prices and it is likely that exploration of oil has negative effects on GDP growth, which is supported by our findings. The negative relation between oil exploration and growth finding has also been supported by Hamilton's (1983) work suggesting that exploration is affected by the oil prices and consequently the increase of exploration reduces GDP growth output. Hamilton found that between 1948 -1980, the growth in oil exploration in the US was accompanied by output decrease. It is likely that the increase in exploration associated with oil price increases reduce GDP growth due to rise in production cost. Additionally, large explorations and higher oil price changes may affect aggregate output growth due to the delay in business investments that increase uncertainty. When companies such as Petrobras and Galp face these higher costs and increase prices for their outputs, this leads to increase in inflation and consequently negatively affecting the GDP growth of Brazil and Portugal.

In regression 2, exploration is strongly significant this time but the coefficient is not significantly different than in regression 1. Revenue is very significant and positive as expected signifying the positive contribution of increased revenues for the two companies to growth of national income. This is consistent with neoclassical growth theory where oil revenues may affect growth positively through increased investment spending, and empirically this result is borne out by numerous findings including Segal and Sen (2011) and Dreger & Rahmani (2014). The *R*-squared here is slightly higher than in the other two regressions. Refining which is a very capital intensive business also contributes positively to growth through capital investment

and value added. This is also consistent with empirical evidence for example Cross, et al.,(2013).

In regression 3 only exploration is slightly significant and oil export is positive but not significant. The significance of this result is that oil export did not contribute significantly to the growth of the economies of the two countries. It has however, been largely accepted in the literature that export contributes to economic growth directly. However, our regression result suggests that oil exports from 2006 to 2013 have not significantly contributed to growth for both Brazil and Portugal during this period. The result therefore suggests that Brazilian and Portuguese GDPs have not achieved significant benefit from the opportunities generated by the increase in oil exports. It is likely that the Brazilian and Portuguese economic growth generated by Petrobras and Galp is independent of the expansion of oil exports and oil price increases. The fact that the Brazilian and Portuguese GDPs did not benefit from opportunities generated by Petrobras and Galp through the increases in oil exports may not be that surprising, but plausible as the growth rates of all the sectors in Brazil and Portugal were much lower during this period of rising oil prices than during the period of recession.

Data Envelopment Analysis (DEA)

Based on the initial idea of Farrell (1975), Data Envelopment Analysis (DEA) or frontier analysis was applied to evaluate the technical efficiency (TE) of various comparable entities, designed by DMUs (Decision Making Units). The DEA evaluates by linear programing techniques and the measure of efficiency is based on the difference between the observed units and best practices (SCRS, 1997). The performance measure tools as DEA can provides guidance to companies to evaluate the allocation of their main competitive advantage and resources in other to determine the way that competitive advantages and resources may be administered and assigned to value-adding activities. Consequently DEA can help companies to identify fields where resources can be misallocated. This study demonstrates the DEA approach as a non-parametric technique for measuring the technical efficiency of oil and gas companies in our study. Besides, this approach can provide a measure of the performance of each company.

This study analyses separately the technical efficiency for both companies[5]. To measure the technical efficiency of these companies, we use following steps.

For this study two output measures, refining capacity and employment and two inputs measures, export and production were used and incorporated into the DEA model to represent the input/output data for both companies from 1999 to 2012.

Model selection: the efficiency was computed by the following equation:

$$Efficiency = \frac{weighted\ sum\ of\ outputs}{weighted\ sum\ of\ inputs}$$

Model development: fourteen years/models for each company, used to evaluate the corresponding efficiency score for each DMU during 1999 to 2012.
We used Excel package to perform the calculation for Petrobras and Galp from 1999 to 2006. To compare both companies Petrobras and Galp and measure their performances, the commonly used method of *ratios* was utilized. We first took an output measure which was divided by an input measure. More precisely as follows:

$$\frac{export}{capacity}\ ;\ \frac{export}{employment}\ ;\ \frac{production}{employment}$$

The next equation followed was the sum of the outputs and inputs for each of the equations:

$$\frac{weighted\ sum\ of\ outputs}{weighted\ sum\ of\ inputs}$$

Then the results were transformed to % and with this the *technical efficiency* for each of the three equations was obtained. The results show that the major technical efficiency for export/capacity obtained for Galp was in 2006 with (100 %) of efficiency. This result can be justified first, as a continuation of the good result obtained in 2005 (TE = 91,8%), representing an increase of 10%. Second the high levels of net profit achieved by the company (755 million euros). This net profit excluded gains from the sales of the regasification of natural gas to the National Grid and of transport assets (Galp Sustainability Report, 2005/2006). Beside this, it is important to recognize that in 2006, Galp and Petrobras signed their strategic alliance. Regarding the TE for export and employment the more significant values were obtained from

[5] Ajalli et al. (2010), Oliveira et al. (2007) and Ines and Martinez (2011) used case study approach to measure the technical efficiency in the energy industry.

2009 to 2012 (87, 98%, 95,70%, 98,30% and 93,77% respectively) where the company reached a TE of more than 95%, this was in 2011 when the RCA[6] net profit for Galp was € 306 million (43% more than in 2009). This huge revenue was due to the improvement in the performances in the different business segments of Gas and Power, Refining and Marketing (Galp, 2011). In relation to Production and Employment the most significant efficiency value was achieved by the company in 2007 with a TE of 87, 72% this was due the discovery of new oil wells in Bacia De Santos – Brazil. This new discoveries transformed the profile of Galp and the Brazilian government authorized the company to increase the production in oil wells discovered previously and there was also new oil wells discovery in Angola. Galp also signed a contract with Eni for the exploration of five oil wells in Timor-Leste and Mozambique. Moreover, the company also signed an agreement with the Portuguese Government for the exploration of oil and gas in the Portuguese cost.

As mentioned earlier, the technical efficiency was calculated for Petrobras as well. In 2009 the company reached they major TE for Export and Capacity – 100 %, and additionally Petrobras achieved the largest revenues since the beginning of its operations and the biggest result of a publicly traded company in Brazil. According to IBGE (2010)[7], this result reflected the expansion of the Brazilian economy in 2010 that achieved a growth rate of 7.5%. Petrobras increased its exports and there was a recovery in the international oil and gas prices (BP, 2012). In 2010, there was increase in the nominal capacity utilization of the refinery – 93% (Petrobras, 2010). The results for the technical efficiency in Exports and Capacity for Petrobras between 1999 to 2012 period was very good. These results are likely to have been influenced by the greater number of oil wells exploitation without any restrictions made by the Brazilian government (Petrobras, 2011).

In relation to the technical efficiency for export and employment applied to the DEA model, the company achieved their higher efficiency in 2001 – 100%. According to a study by the Brazilian Centre for Infrastructure, the total number of employees of Petrobras grew at a rate higher than the production of oil and gas between 1998 and 2011 (Folha de Sao Paulo, 2012). The above finding can justify the higher values of TE for Export and Employment in this time period analyzed for this particular case study. It is important to highlight that the TE for this measure were always up to 89 %. Between 2000 and 2011 Petrobras recorded a growth of

[6] RCA: Replacement Cost Adjusted – Accounting practice for reporting profits in the oil industry.
[7] IBGE: Instituto Brasileiro de Geografia e Estatística – Brasilian Institute of Geography and Statitisc

reserves and production of Oil and Gas above the world average. The oil production of Brazil grew 73%, compared to the 12% of global growth. In relation to the production of natural gas, there was an increase of 61% in Brazil in comparison to the 36% rate of worldwide growth. The oil reserves for Brazil grew 73% in this period in contrast with the 38% of the global oil reserves growth (Fatos E Dados – Petrobras, 2013).

With results of the Data Envelopment Analysis approach using the data of the Brazilian NOC and the Portuguese IOC, some inferences are emphasized here. For the Brazilian national company the achievement of their macroeconomic performance goals is of high priority shouldering the social responsibilities that the company has with the Brazilian government. From these results it can be argued that Petrobras possess capabilities to perform and undertake political and social tasks and objectives. It is worth highlighting that the Brazilian government has influence when the company is formulating their corporate strategy as well as their other economic goals.

In relation to the private Portuguese company, the results of the DEA approach demonstrated that the strategy of Galp's was designed to take advantage of the current and future dynamics of the Oil and Gas industry, which include the expected sustained increase in demands for oil and natural gas worldwide. With the results obtained, it can be argued that the primary objective of the company is to create a sustainable value for its shareholders, especially through exploration and production, and in particular exploration activities. This strategy reflects a focus on obtaining a profitable sustained growth for production, which is likely to be supported by the cash flow generated by the worldwide business.

Based on the results obtained from our analysis, both companies were highly efficient from 1999 to 2012 period in exporting and capacity with an average result of 90.5%. Exporting and employment achieve 89.28% of technical efficiency in the same period time. Regarding production and employment both companies achieved as well a good technical efficiency of 84.03%. These results might be related with the strategies of both companies as taking advantage of their competitiveness, creating value through the exploration of oil and gas wells and developing world-class resilient and profitable businesses.

Conclusions

We can conclude that the exploration of oil consistently had negative effects on the GDP growth of Brazil and Portugal. This is because exploration is positively related to rising and variable

oil and gas prices which are inflationary and destabilizing and affect investment and therefore growth adversely. This negative impact is consistent with theory and supported by previous empirical evidence. Exports of oil were not found to be significant for the GDP growth. Refining and company revenue increases are found to promote growth of GDP. This is consistent with neoclassical growth theory where oil revenues can affect growth positively through increased investment spending. This result is also borne out by numerous empirical findings including Segal and Sen, 2011; Dreger & Rahmani, 2014).

Contribution to the existing body of knowledge was achieved by using a specific case study and from the results it was clear to see how the alliances contributed to enhancing the efficiency of both companies. However, it was not evident how these companies can contribute positively for the host countrys' income growth directly as an alliance, since the results obtained for GDP growth were negative.

On the basis of empirical results presented and discussed earlier, we can conclude that the companies showed an established and sustainable growth. Petrobras and Galp achieved good levels of technical efficiency on exports, capacity, employment and production. It was identified that Petrobras achieved excellent result in technical efficiency in more than segment analyse, it is also concluded that their results in level of technical efficiency related with employment are constantly high. It is evident from the analysis that Galp obtained major technical efficiency in exports and capacity. Since 2006, when the strategic alliance was began those values have progressively increased.

A limitation of this study which we can acknowledge is that the focus on a particular case of only two firms. There will be numerous factors that would have an impact on strategic alliances for instance the type of business model adopted, organisational characteristics, dimensions of infrastructures and Geographic variables, which however we have not addressed and leave it for future research.

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