Three essays on Government Intervention in the Oil and Gas Industry

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To my parents,

Στους γονείς μου,

Declaration

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Abstract

From resource nationalism to ‘softcore’ government intervention through regulatory changes, this thesis attempts to comprehend in depth and formally analyse both the economic as well as the non-financial factors influencing the development of hydrocarbon resources and the investment decision-making in the oil and gas industry. The empirical work of Chapter 1 is inspired by the competition between IOCs ad NOCs and the phenomenon of resource nationalism. It provides empirical evidence on how the socio-economic conditions can affect the way a country will choose to develop its natural resources presenting the social determinants which contribute to the rise of nationalisation in the oil and gas industry. Chapter 2 focuses on government intervention on the upstream pipeline transportation networks and the issue of third party access under conditions of natural monopoly. It applies basic regulatory economic principles on oil and gas transportation networks and explores various regulatory tools and their application in different basins. Special focus is given in the government intervention and the market conditions under which State interference in the market is justified and successful. Finally, Chapter 3, taking into consideration the theory developed in Chapter 2, provides policy recommendations which aim to tackle market inefficiencies in the UKCS for the utilisation of the remaining reserves. The chapter also discusses the role and limitations of government ownership in the UKCS. The three chapters analyse different, but interlinked, issues surrounding the relationship between the government and the oil and gas industry- from hardcore nationalisation of the natural resources to the unique Norwegian model of State ownership.

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Abbreviations

bbl	billions of barrels of oil and natural gas equivalent
BEIS	Department for Business, Energy and Industrial Strategy
BG	British Gas
BNOC	British National Oil Corporation
boe	barrels of oil and natural gas equivalent
boepd	Barrels of Oil Equivalent per Day
bpd	billions of barrels of oil and natural gas equivalent per day
BSUoS	Balancing Services Use of System
Capex	Capital Expenditure
CATS	Central Area Transmission System
CEGB	Central Electricity Generating Board
CNS	Central North Sea
COP	Cessation of Production
CT	Corporate Taxes
CUSC	Connection and Use of System Code
DECC	Department of Energy and Climate Change
DEMOC	Institutionalised Democracy
DRC	Democratic Republic of Congo
E&P	Exploration & Production activities
EIA	Energy Information Administration (U.S)
EOR	Enhanced Oil Recovery
EU	European Union
FDI(s)	Foreign Direct Investment(s)
FDP(s)	Field Development Plan(s)
FERC	Federal Energy Regulatory Commission
FPS	Forties Pipeline System
FPSO	Floating Production, Storage, and Offloading vessels
GB	Great Britain
GDP / GDP per capita	Gross Domestic Product (per capita)
GEMA	Gas and Electricity Markets Authority
GNI	Gross National Income (per capita)

GoM	Gulf of Mexico
GPSA(s)	Gas Purchase and Sale Agreement(s)
HDI	Human Development Index
HFCE	Household Final Consumption Expenditure
HSE	Health, Safety & Environmental
ICoP / ICOP	Infrastructure Code of Practice / 2004 Revision
IEA	International Energy Agency
IOC(s)	International Oil Company(s)
IOR	Improved Oil Recovery
IS	Irish Sea
JV(s)	Joint Venture(s)
LNG	Liquefied Natural Gas
MER-UK	Maximisation of Economic Recovery of the UKCS
MPE	Norwegian Ministry of Petroleum and Energy
MW	Megawatts
NCS	Norwegian Continental Shelf
NGET	National Grid Electricity Transmission plc
NHS	National Health Service
NNS	Northern North Sea
NIOC	National Iranian Oil Company
NOC(s)	National Oil Company(s)
NPV	Net Present Value
NSMP	North Sea Midstream Partners
OCS	Outer Continental Shelf
OECD	Organisation for Economic Co-operation and Development
Ofgem	Office of Gas and Electricity Markets
OFT	Office of Fair Trading
Ofwat	Water Services Regulation Authority
OGA	Oil and Gas Authority
OGUK	Oil & Gas UK
OLS	Ordinary Least Squares
ONS	Office of National Statistics (UK)
OPEC	Organisation of the Petroleum Exporting Countries
Opex	Operational Expenditure

OPS	Office of Pipeline Safety
PADD(s)	Petroleum Administration for Defence District(s)
PPP	Purchasing Power Parity
PRT	Petroleum Revenue Tax
PSC(s)	Production Sharing Contract(s)
PSA(s)	Production-sharing Agreement(s)
PSPA	Petroleum and Submarine Pipelines Act (1975)
PV(s)	Present Value(s)
R&D	Research & Development
RDP	Regional Development Plans
RFCT	Ring Fence Corporation Tax
RoL	Rule of Law
RPI	Retail Price Index
SAGE	Southern Area Gas Evacuation
SC	Supplementary Charge
SDFI	State's Direct Financial Interest
SNS	Southern North Sea
TEC	Transmission Entry Capacity
TNUoS	Transmission Network Use of System
TPA(s)	Transportation and Processing Agreement(s)
TPOSA(s)	Transportation, Processing and Operator services agreement(s)
TRA	Tariff Receipt Allowance
TSC(s)	Technical Service Contract(s)
U. N	United Nations
U. S	United States of America
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
UNDP	United Nations Development Programme
WGI	Worldwide Governance Indicators
WoS	West of Shetlands
XCONST	Executives Constraints
YTF	Yet-to-Find Resources

Introduction

The interrelation between economics, regulations, politics and security regarding the use of energy resources is a contemporary issue, but at the same time perennial. The risks associated with large oil and gas projects can technical, economic and, also, political. Over the last decade, the free market ideology worldwide has been questioned as governments in resource-rich nations are seeking to seize a greater share of the oil and gas profits deriving from the exploration of their natural resources. The world's demand for oil and gas is expected to rise over the foreseeable future mainly due to the increased consumption of developing economies, like China and India. According to the International Energy Agency (IEA), national oil companies (NOCs) will count for 80% of the total incremental oil production by 2030, assuming the necessary investments are made (EIA U. E., 2016) while older basins, where international oil companies (ICOs) dominate, are facing several economic and technical challenges primarily due to the depletion of their oil and gas reserves. With the growing trend of national control over the natural resources in the promising regions of the planet and the depleting, or hard-to-reach, resources in the more mature basins, several analysts raised concerns regarding the adequacy of future supplies.

It is important to highlight the fact that due to the typically large size of an oil and gas assets, energy projects can significantly affect the communities and nations where they are located and, if successful, even improve the social and economic conditions of a region. As a result, governments often view projects, such as oil and gas pipelines and platforms, not only as commercial agreements but also as a vital instrument of public policy which is capable to influence the country's socio-economic development. As consequence, international oil and gas unique business features may play a significant role in a country's foreign policy and vice versa, especially considering the relation between energy policy, security of supplies, external trade and foreign relations. When it comes to energy 'mega-projects', it is extremely difficult to separate business from politics since the geopolitical issues involved in a project might affect the economic decisions behind their realisation. Energy industry is still viewed as strategically important and is considered intrinsically linked to issues of economic competitiveness.

Both private as well as national oil and gas companies are nowadays under pressure to embrace global business models, streamline their portfolios and deal with lower oil prices. In this framework, it is essential to explore in depth the dynamics between the State, private companies and market forces to unravel the radical changes in the relationship between Government and business. As mentioned above, several governments have identified the importance of retaining control and ownership over large strategic reserves resolving to protectionism practices to keep full control over their natural resources. From the Caspian Sea to South America, the Western oil major companies are being squeezed out of resource-rich provinces and, as a result, their production is coming mostly from mature regions, like the North Sea. However, even in areas with a liberalised oil and gas industry, such as the UK, market inefficiencies in combination with political and social pressures, can make the case for government intervention to protect public interest and ensure that high levels of output growth are achieved.

The thesis begins in Chapter 1 by investigating the, far from new, concept of resource nationalism which has been identified by Ernst & Young as the biggest risk for the mining, metal and hydrocarbons industries in 2011-12 (Ernst & Young , 2013). The aim of the first chapter is to explore the determinants of the phenomenon of resource nationalism in the oil and gas industry worldwide aiming to investigate in which countries and under which conditions, resource nationalism is more possible to occur. This work adds to the existing empirical literature on nationalisations in the oil and gas market by focusing not only on the economic indicators but also on the social determinants of the resource nationalism such as poverty, development and inequality. It also provides an alternative and broader definition and explanation of resource nationalism using components of the resource curse theory and institutional economics by incorporating variables in the models not directly linked with economic activities such as Rule of Law, Human Development Index and Household Final Consumption expenditure. Finally, Chapter 1 provides an empirical demonstration of the significance of the, often unnoticed by the current literature, political and socio-economic conditions which can greatly affect the way a country will select to develop its natural resources.

The second chapter of this thesis consists of an analysis of pipeline networks focusing on the economics of regulation and the issue of third party access to infrastructure under conditions of natural monopoly in the oil and gas upstream transportation market. It explores how basic principles of regulation economics can be applied in the oil and gas transportation networks. The key economic and technical features of the oil and gas pipeline networks are presented as well as the market failures often arising in the upstream industry which may call for the appropriate regulatory tools. This chapter presents the peculiar characteristics of oil and gas transportation networks and discusses the advantages and disadvantages of the various regulatory tools employed to tackle economic inefficiencies arising in the upstream market. Special focus is given to the economic and business impact of a potential government intervention in a critical industry for the economy. Although the existence of economies of scale and sunk costs in oil and gas transportation are the main reasons why monopoly is viewed as the most efficient market structure, unregulated procedures may substantially allow firms to exploit market power and raise prices that may negatively affect the efficiency of the industry. Therefore, and in combination with political and social pressures, a case may be made for government intervention in the market to protect public interest and ensure that high levels of output growth are achieved. Potential regulatory strategies, such as access regulation, vertical disintegration and government ownership, are discussed in this chapter.

Finally, Chapter 3 provides an analysis of current and future policy options for regulation of the oil and gas transportation networks in the United Kingdom Continental Shelf (UKCS). The arrangements around third-party access to infrastructure facilities in the UKCS are investigated along with the existing market conditions and regulatory framework. This chapter also analyses the monopolistic ownership structures of transportation facilities and the market inefficiencies arising in the market. Price discrimination, high pricing in access to infrastructure as well as the vertical structure of the market are examined in an effort to discuss various regulatory tools and their application in the UKCS. Special focused is given to the discussion around the role and limitations of government ownership followed by the conclusion, which summarises the key points and findings.

Overall, this study attempts to examine the political economy of regulations, presenting both companies' as well as governments' perspective while it attempts to understand in depth how the non-financial factor of politics influences, and is often reflected, on the investment

decision-making process in the oil and gas industry. The three chapter of this thesis can be considered stand-alone essays dealing with the economics of regulatory issues in the oil and gas industry. However, the theories and research developed in all chapters are centred under the umbrella of examining the dynamic relationship between Governments and private companies under the light of the political economy of regulations and institutional economics.

The empirical work of Chapter 1 is inspired by the competition between IOCs ad NOCs and the phenomenon of resource nationalism. It explores how the socio-economic conditions affect the way a country will choose to develop its natural resource putting emphasis in the social determinants which contribute to the rise of nationalisation in the oil and gas industry. Chapter 2 focuses on government intervention on a specific sector of oil and gas industry, the upstream pipeline transportation networks and the issue of third party access under conditions of natural monopoly. It applies basic regulatory economic principles on oil and gas transportation networks and explores various regulatory tools and their application in various basins. Special focus is again given in the government intervention and the market conditions under which is justified and successful. Finally, Chapter 3, taking into account the theory developed in Chapter 2 around government intervention, attempts to provide policy recommendations which aim to tackle market inefficiencies in the UKCS for the utilisation of the remaining reserves. The chapter aims to also provide a discussion of the role and limitations of government ownership in the UKCS.

From resource nationalism to justified ‘softcore’ government intervention through regulatory changes, this work attempts to comprehend in depth and formally analyse both the economic as well as the non-financial factors influencing the development of hydrocarbon resources and the investment decision-making in the oil and gas industry. The three chapters analyse different, but interlinked, issues surrounding the relationship between the government and oil and gas industry- from hardcore nationalisation of the natural resources to the unique Norwegian model of State ownership.

Chapter 1

An empirical Investigation of Resource Nationalism in the Oil & Gas Industry

A. Introduction

Chapter 1 explores the determinants of the phenomenon of resource nationalism in the oil and gas industry worldwide aiming to investigate in which countries and under which conditions, resource nationalism is more possible to occur. This work adds to the existing empirical literature on nationalisations in the oil and gas market by focusing not only on the economic indicators but also on the social determinants of the resource nationalism such as poverty, development and inequality. It also attempts to provide an alternative and broader definition and explanation of resource nationalism using components of the resource curse theory and institutional economics by incorporating variables in the models not directly linked with economic activities such as Rule of Law, Human Development Index and Household Final Consumption expenditure. Finally, Chapter 1 provides an empirical demonstration of the significance of the, often unnoticed by the current literature, political and socio-economic conditions which can greatly affect the way a country will select to develop its natural resources.

Identifying and managing the underlying conditions of resource nationalism occurrence in oil and gas industry is of paramount importance given the phenomenon's economic consequences in investments which may exceed the cost of US$1 billion each and take many years to reach completion (Vrooman LLP, 2003). The International Energy Forum defines resource nationalism as '*nations wanting to make the most of their endowment*', trying to highlight the ideological nature of the topic (Clarke & Cummins, 2012). The relatively recent

cases[1] of resource nationalism brought back the importance of energy security in the political agenda and policy discourse in the major energy-consuming states (Bremmer & Johnston, 2009). Oil and gas industry is usually high-profile and often controversial in almost every country with either national upstream petroleum operations or privatised energy sector (Vrooman LLP, 2003). Resource nationalistic actions are not confined to the third world as many times developed countries, like the UK, France or Italy, have raised concerns about nationalisation (Vrooman LLP, 2003). Specifically, in the content of a border definition of the phenomenon which includes 'creeping expropriation'[2], any changes in legislation that affect the industry (taxes, labour, economic measures, environmental regulations etc.) can be considered as a form of resource nationalism (Vrooman LLP, 2003). Therefore, it is not rare that subtle political changes can greatly affect the occurrence of resource nationalism.

From a government's perspective, the state may face the difficult dilemma of how to maximise the benefits from a natural resource while not discouraging foreign investments given the fact that, in many cases, the country needs the foreign investors to gain access to funds and/or expertise required to exploit and develop its hydrocarbon reserves. Thus, economic factors are interlinked with political, social and ideological considerations, as governments aim to gain a greater share in the natural resources. For example, in states with growing youthful population which faces limited access to jobs opportunities, populist politicians seek to distract attention from domestic issues by opposing international oil companies. Increased revenues from oil and gas are presented as the means of generating social programmes in order to ameliorate the effects of unemployment and disenchantment (Clarke & Cummins, 2012). Nevertheless, resource nationalism is not necessarily irreversible considering the fact that it usually follows a cyclical process. For instance, when the exploitation of reserves becomes technically difficult (i.e. deep-water drilling), the expertise of the international oil private sector is vital driving often a country with a nationalised oil

[1] For example, the expropriation of Repsol's assets in Argentina (2012), the nationalisation of German energy company E. ON's gas business by the Hungarian government (2013), and, the high-profile dissolvent of the TNK-BP partnership under suspicious conditions with all the BP assets in Russia being divested by the national giant Rosneft.

[2] 'Creeping expropriation' refers to a series of actions, which, over time, have the effect of depriving the investor of its ownership, control, or rights to its investment, and, it is considered a 'softer' indirect expropriation technique (Vrooman LLP, 2003).

and gas sector to follow an economically liberal approach to attract foreign investments (Clarke & Cummins, 2012).

It is predicted by many energy analysts that, in the foreseeable future, the majority of the world's hydrocarbon supplies will be produced in developing countries with low energy consumption while developed economies will be the main consumers of oil and gas heavily dependent on imports. Developing countries hold only the 20% of the world's stock of foreign direct investments (FDIs) in petroleum, mining and quarrying while North America, Europe, Australia and New Zealand attract almost 75% of the global FDIs for the same sectors (Ross, 2012). Hence, even though developing countries (including several OPEC[3] members) require further investments in order to be able to develop their oil sector, developed economies have a clear investment advantage with significant domestic investment already in place. Thus, several countries are required to choose between resource nationalism approach, which implies a nationalised oil industry, or a resource liberalism that promotes more private investments.

Although resource nationalism had been often viewed as detrimental for a country's economic and social development, a rational approach to the phenomenon can identify multiple benefits for a government through the nationalisation of oil industry. A country with nationalised oil and gas industry can obtain a strategic advantage to other dominant nations while the government itself can pursue policies uninfluenced by private economic interests as well as gain a certain level of independence from domestic social groups due to the great flows of oil revenues. The nationalisation of oil and gas industry seemed for many years to be the key for Middle East, Latin America and, generally, developing countries as they managed to gain greater control over their national assets and began to capture a much larger share of the industry's profits. Especially during the 1970s, OPEC countries increased world prices to record levels causing an unparalleled transfer of wealth from oil-importing states to oil-exporting ones (Ross, 2012). The formation of powerful National Oil Companies (NOCs) enabled the governments to fund themselves instead of relying solely to tax collection and royalties from foreign companies operating in their territory.

[3] Organisation of the Petroleum Exporting Countries. Member states are currently the following countries; Algeria, Angola, Ecuador, Equatorial Guinea, Gabon, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates, and, Venezuela.

According to A. Bressand's research (2009a) demonstrated in Table 1.1, NOCs are expected to hold 85% of world's annual oil production, with IOCs to account for only 10%. Almost ten years after A. Bressand's work (2009a), his projections seem to be significantly accurate as approximately 70% of global oil production is in the hands of NOCs- namely all of OPEC's national oil companies such as Saudi Aramco (the world's largest production company), PetroChina and Russia's Gazprom, Rosfnet and Lukoil (Forbes, 2016). More specifically, in Table 1.2, one can observe that, in 2013, according to Ernst &Young report (2013), seven out of the top 10 global oil and producers are NOCs with the only a limited number of private companies to be included in the list (namely ExxonMobil, Chevron and Shell). It appears, thus, that NOCs are dominating the global oil and gas production as after developing their countries' vast resources, they are able to compete in the same ground for the global reserves with the IOCs.

Table 1.1: Annual Oil Production and Projections; IOCs vs NOCs Competition for a depleting supply of oil resources

Year	*1972*	*2002*	*2020*
IOCs	70%	15%	10%
NOCs	20%	70%	85%
Independents	10%	15%	5%

Source: A. Bressand (2009a, p. 134)

International private companies face several challenges linked with the political and socio-economic conditions occurring in several resource-rich nations which greatly affect the development of oil and gas resources. Two of the main challenges are related to the academic terms of 'hostage situation' and 'obsolescing bargain'. The latter refers to the vulnerability of firms with large fixed investments when the terms of their operating agreements change, or be renegotiated, after the operations are in place and have been proved successful (Moran, 1998). However, after the exceptional increase of oil price from $10 a barrel in 1999 to $145 in 2008, IOCs were less risk-averse towards the possibility of working in remote, developing countries with weak institutional framework. For the IOCs, the risk of being involved I incidents that could be characterised as 'obsolescing bargain' was outweighed by the benefits of exploiting new promising reserves.

Table 1.2: 2013 Production-Top 10 Leading Companies[4]

Company Name	Millions of BOE per day
Saudi Aramco	12.7
Gazprom	8.1
National Iranian Oil Company	6.1
ExxonMobil	5.3
Rosneft	4.6
Royal Dutch Shell	4
Petro China	3.9
Pemex (Petróleos Mexicanos)	3.6
Chevron	3.5
Kuwait Petroleum Company	3.4

Source: Ernst & Young (2013)

Several analysts argue that the vulnerability of IOCs is increasing, as several oil-exporting countries no longer need private oil companies as a source of capital; their taxes on the sale of crude oil already provide a sense of independence. Additionally, the oil-exporting countries are no longer shut away from access to the technology of oil exploration and exploitation given the fact that numerous independent companies[5] are willing to provide the information and expertise required. Undoubtedly, an oil and gas firm cannot choose where a deposit will be located, but it can only decide whether to proceed with its development or not. Hence, after an oil rig is in place, the company is tied to the asset until an ownership change or the natural depletion of the resource, a phenomenon called 'hostage situation' (Chermak, 1992). The capital investment firm may be face changes to the original contract, or, in extreme cases, even uncompensated expropriation due to the ambition of the government to have higher revenues at the expense of the firm (Chermak, 1992).

It appears that, in most of contemporary studies, the issue of resource nationalism and, more generally, the decision of a government regarding the way in which the natural resources will

[4] Barrels of oil and natural gas equivalent.

[5] An independent oil and gas company is defined as a non-integrated company which operates exclusively in the exploration and production segment of the industry, with no downstream marketing or refining within their operations. Independent companies are also the service companies which provide mainly drilling and oilfield services.

be developed, becomes closely related with both institutional and social indicators. Analysing the established economic determinants of resource nationalism in the oil industry and attempting to give an alternative broader explanation through the incorporation of social factors in the empirical analysis aims to reveal a correlation between resource nationalism occurrence and low levels of institutional quality as well as the presence of negative social parameters, such as poverty.

Drawing theoretical inspiration from the work of T. Andersoon & K. Brannas (1991), who identified historically the number of years in which a country was nationalised, this work attempts to create a Resource Nationalism Index to serve as dependent variable. The Index aims to categorise the governmental actions which lead to the nationalisation of the oil industry in a country during the period 1996-2013. S.J. Kobrin ((1979), (1980), (1984)) indicated that a government could take over the country's natural resources through regulation rather than direct acts of nationalisation (i.e. expropriation). This point has been taken into consideration for the categorisation process in the Index providing also an empirical representation of S.J. Kobrin's work.

Inspired by the economic literature on the role of institutional quality, this chapter aims also to explore the phenomenon of resource rationalism in a broader perspective without though incorporating into the empirical analysis any element that would suggest that resource nationalism is correlated solely with an authoritative political status quo. G. Wright & J. Czelusta (2004), Karl (2005) and H. Mehlum et al. (2006) were some of the first researchers to support the idea that resource nationalism should not be always linked with the regime type in a country. F.v.D. Ploeg's (2011) work complimented their research and, as a result, nowadays, resource nationalism is viewed as a worldwide phenomenon driven by different factors which can take place under the umbrella of both a democratic as well as an authoritative regime. Driving by their theory, this work intent to demonstrate the correlation between institutional quality and resource nationalism independently from the political regime existing in the country.

Chapter 1 also borrows several social indicators used in the resource curse theory under the hypothesis that a number of social features, such as poverty and inequality, can have a great effect on the possibility of resource nationalism occurrence and, as consequence, the

relationships between the host country and private operators. The effect of oil and gas wealth to the consumption spending, an economic dimension directly linked with households' well-being, as well as the relation between household income and economic growth in oil states, were first appeared in the works of J.D. Hamilton (2009) and N.H. Barma et al. (2012). The aim is to expand the literature of the phenomenon of resource nationalism and add empirical evidence in the existing literature to support the important of institutional as well as social indicators in the way a country chooses to develop its oil and gas resources. To achieve that, we incorporate variables in the models directly linked with institutional quality and social indicators, such as Rule of Law, Human Development Index and Household Final Consumption expenditure.

Finally, the most closely related paper to the empirical work of this chapter is the one from S. Guriev et al. (2011). Specifically, the central idea of using cases of nationalisation to create a proxy measure for resource nationalism as well as most of the data on expropriations come mainly from S. Guriev et al. work (2011) complemented by additional research. This chapter extends the time-period covered in S. Guriev et al. (2011), which reaches until 2006, and provides an additional examination of incidents of nationalism which was required in order to convey a broader definition of the phenomenon. We account for a wider spectrum of categories falling into the definition of 'nationalisations' (comparing to the definition provided by S. Guriev et al. (2011)) in order to present two components that P. Stevens assumes in one his studies (2008)- limitations in IOCs operations and greater national control on behalf of the government over oil resources development. The broader definition of resource nationalism aligns also with the above-mentioned work of S.J. Kobrin ((1979), (1980), (1984)) while allowing the researcher to more effectively explore the relation between resource nationalism and institutional as well as social parameters.

This research uses data on resource nationalism actions in major oil producing countries occurring around the world during 1996-2013 focusing on high-profile events and attempting to expand the definition of resource nationalism as stated from the literature. Two dependent variables are included in the empirical work; a binary dummy variable and the Recourse Nationalism Index. More specifically, the binary dummy variable incorporates cases of nationalism in the oil industry used as a proxy for resource nationalism. It consists of an original variable created solely for the purpose of this work and inspired by the previous

work of S. Guriev et al. (2011). The Resource Nationalism Index is used as well as the dependent variable in a similar way as the above-mentioned binary variable enriching the resource nationalism categorisation and offer, thus, a broader definition of the phenomenon by capturing any additional dimensions. The explanatory variables as well as time fixed effects and regional dummies are introduced gradually into the regressions formulating five different logit models of logistic regressions. The three main variables of interest, which are related with the quality of institutions and social factors, are the Rule of Law (RoL), Human Development Index (HDI) and Household Final Consumption Expenditure (HFCE).

This chapter aims mainly to investigate in which countries and under which socio-economic conditions, resource nationalism is more possible to occur. This study indicates that the phenomenon of resource nationalism steams from not only economic but also social determinants, which were often overlooked by the literature, through the incorporation of variables linked with social factors and welfare. It also adds empirical evidence to the existing literature regarding the negative correlation between nationalisation and institutional quality. By creating two new dependent variables, Chapter 1 expands the work of S. Guriev et al. (2011) by providing a comprehensive framework to define more broadly the phenomenon of resource nationalism as a wider spectrum of categories falling into the definition of 'nationalisations' is offered. The first section of the chapter consists of a critical literature review on resource nationalism in the oil and gas industry. Special attention is given to the increasing importance of institutional quality as a determinant of nationalisation as well as the social factors affecting the phenomenon, which are borrowed from the resource course theory's vast literature. The second part presents the methodological approach of the research including the rationale behind the identification of the appropriate measures of resource nationalism, the process of creating the Resource Nationalism Index and the definition of all explanatory variables. The analysis of the empirical results follows while conclusion and discussion can be found in the last section of the chapter summarising the main points, contributions and findings.

B. Literature Review

The literature on resource nationalism is expanding rapidly as the phenomenon often influences greatly the investment climate in the oil and gas industry through the geographical allocation of future FDIs. The first attempts to analyse the phenomenon were focusing mainly in expropriation incidents in the oil industry as the focal form of nationalistic actions on behalf of the government providing numerous examples and setting the historical framework on the topic. T.H. Moran (1973) discussed the role of international treaties in increasing the cost of nationalisation, J. Eaton & M. Gersovitz (1983) described the risks several international corporations face when they invest abroad, and, D. Yergin (1991) unfolded a comprehensive narrative of key events in the oil industry considering the fate of international oil majors. As A. Rosser (2006) states, the research nowadays should be focussing on the political and social factors which may enable, or not, the resource-rich countries to make the most out of their geological endowment rather than exploring solely the political pathologies that natural resource wealth may cause. In fact, several researchers incorporated ideas from classical political studies, political economy and institutional economics in their work and draw their attention to the role of various political variables that affect greatly the relationship between natural resource abundance and economic growth.

The 'obsolescing bargain' theory, mentioned briefly above, resulted from the effort of R. Vernon (1981) to understand in dynamic terms the evolution of relations between host governments and foreign investors in the developing world. As it was stated in chapter's introduction, the term 'obsolescing bargain' refers to the vulnerability of firms with large fixed investments when the terms of their operating agreements change, or be renegotiated, after the operations are in place and have been proved successful (Vernon, 1981). It is worth mentioning that earlier attempts to model government/ investor relationships were based on the idea of bilateral monopoly. This early approach suggested that the host government controls the conditions of entry to the market while the foreign investors hold the capital and technology required for the development of natural resources. Therefore, each side is likely to attempt structuring an investment agreement to capture any rents for itself. This early reasoning has been deemed too static as it was ignoring the role of risk and uncertainty and

led to later researchers, like R. Vernon, to undertake a more dynamic stand in an effort to explain government/ investor relationships.

At this point, it is important to define "political risk" as it is a term often seen in the literature and it is not to be confused with resource nationalism, or, being correlated solely with expropriation incidents. Specifically, prior to late 1950s, political risk was viewed as a diplomatic issue with the international law enforcement to be emphasised. During the 1970s, 'economic nationalism' was used as an early term for political risk and importance was put not just to the event of nationalisation but also to the effect the event might have in firm's operations. J.M. Chermark introduced the 'hostage situation' theory, mentioned above, in an attempt to link nationalisations with political risk while including a probabilistic aspect to the phenomenon (Chermak, 1992).

B.1. Discussion on Resource Nationalism; Institutions in the front line

Some of the first empirical attempts to explore and measure the phenomenon of resource nationalism in natural resources industries came in early 1990s and they were focusing mainly on economic indicators, especially the size of the economy, tax rates and investment rates. T. Andersson & K. Brannas's (1991) econometric model deals with cross-country variation in nationalisation frequencies across all sectors between 1968 and 1979 for a variety of countries. The dependent variable is the number of years (between the years 1968-1979) in which a country nationalised with this number to term the frequency of nationalisation ranging from '0' to a maximum of '12'. They based their model in two main hypotheses; direct investment is 'traded' in a market where the firms are the 'supplier' and host countries the 'consumer' and, also, in a world of incomplete information, countries' past behaviour is likely to influence the estimated risk of future nationalisations through a signalling effect (Andersson & Brännäs, 1991). T. Andersson & K. Brannas (1991) concluded that countries which have higher export commodity concentration, a large stock of foreign investment and/or or lower taxes, result in a lower frequency of nationalisation (Chermak, 1992).

A noteworthy paper which examines hold-up type problems common to sunk cost investments was the one written by J.M. Chermak in 1992 (1992) . He developed a limited

dependent variable model using the annual change in the effective tax rate as a political risk measure with data from five copper mines in both Chile and Peru. In his analysis, a Tobit model had been used to identify five significant independent variables affecting the dependent variable; the annual percentage change in GDP per capita, the percentage of GDP contributed by mining, the percentage of GDP contributed in agriculture, the rate of inflation and the percentage of profits reinvested in the country (Chermak, 1992). In addition, S.J. Kobrin ((1979), (1980), (1984)) explored nationalism in detail under the initial argument that nationalistic actions are selective given that they occur either in specific firms or industries. In his theoretical paper in 1979, S.J. Kobrin provides a critical review of the economic literature on nationalisation attempting to redefine the concept of political risk[6] and argue that nationalisations are driven mainly by economic rather than ideological motivations (Kobrin S. J., 1979). In his first empirical attempt to explore the phenomenon of nationalisation, S.J. Kobrin analysed a large number of expropriations of foreign firms in 76 developing countries from 1960 to 1976 (Kobrin S. J., 1980). With the focus to be on firm and industry factors that affect enterprise vulnerability, he distinguished between 'mass ideologically motivated' and 'selective' expropriation concluding that the latter represents a policy instrument used to achieve national political and economic objectives rather than a mean itself helping the government to gain control over foreign investors. In his later empirical work, S.J. Kobrin expand his empirical work by looking at the pattern of expropriations over time supporting that a government can gain control over strategic resources through regulation rather than direct nationalisation of foreign firms' assets (Kobrin S. J., 1984). He also puts emphasis in the historically visible 'domino effect' which refers to the phenomenon of oil-exporting governments learning from experience once a fellow oil-exporting state expropriates oil and gas assets.

Apart from the economic drivers of resource nationalism, a vast part of the literature on the topic is dedicated to the institutional framework and the level of institutional quality in a country as a great determinant of industry's orientation towards resource nationalism or liberalism as well as overall economic performance. Well-functioning law and justice institutions are widely considered as the milestones of political, economic and social development. Hence, they have been viewed as both an ideal in western political thought as

[6] The term "political risk" was often used during the 1970s as a synonym to the risk of nationalisation occurrence.

well as a primary goal of any development policy. The notion of legal and juridical reforms, which lead to better economic performance, is widely accepted by the theory of institutional economics which attempts to link the quality of a nation's institutions (including legal institutions) with resource development outcomes. Nowadays, institutions that prevent coercion, reduce transaction costs for business and secure clear and enforceable property rights cannot be taken for granted in many developing countries, but they are considered an integral part of developed economies. This correlation between institutional quality and economic development is based on the argument that good quality institutions affect directly governance features which affect the overall economic performance of a nation. Essentially, the institutions can create the conditions under which a government will choose either to create an appropriate framework that enhances economic activity, or, to redistribute wealth to itself and its supporters. Without a doubt, the complex nature and structure of institutions makes the assessment of institutional quality significantly challenging.

Despite though the difficulty in measuring the quality of institutions, almost all empirical work on this subject indicates a strong correlation between institutional quality and economic growth. As T. Gylfason states (2001), the quality of resource management and the institutional framework of a country constitutes of the main determinant of economic growth, and not, as it used to be supported for many years, resource abundance per se. Given the fact that resource nationalism is a political phenomenon to its core, the field of institutionalism theory is the one where a possible explanation can be found in questions related to the political drivers for the phenomenon. Even though the quality of institutions is a vital factor that determines a country's economic performance, it is at the same time the parameter most widely hypothesized, partly due to the fact that there is an on-going debate regarding the causality between institutional quality, natural resources and development. In relation to economic growth, institutions can be the result rather than the cause (endogenous). Tax systems, intellectual property rules, social safety nets and the structure of financial markets tend to evolve endogenously in response to the level of income (Frankel, 2010). Several researchers have questioned previous assumptions arguing that oil wealth is endogenous (effect) rather than exogenous (cause) in relation to the institutional framework of a country. In other words, oil wealth can also be the effect rather than the cause of a poor institutional framework, while the institutions per se can evolve exogenously. In this work, with the incorporation of qualitative variables related to institutions, institutional quality is considered

one of the main drivers of resource nationalism as it affects, directly or indirectly, government's decision to move towards a nationalised oil industry.

The importance of timing in the exploitation of oil and other minerals had been highlighted by few researchers partly because it is linked with the causality between good or poor institutions, exploitation of resources and economic growth. F. Ploeg (2011) tests the hypothesis that if countries, which industrialised first, also had good institutions in place to begin with while the regions that remained underdeveloped had poor institutions, that may indicate that, in the first stages of resources exploitation, corruption and political struggles were easier to arise. The key to this question is considered to be the contractual basis; the effective property rights accompanied with relatively low transaction costs that will allow natural resources to be developed efficiently. According to the Coase theorem, high transaction costs may hinder the efficient outcomes which are to be expected from well-defined property rights and voluntary negotiations. It is not a surprise that the more valuable resources, such as minerals or hydrocarbons, tend to have more well-defined property rights as, despite the cost of defining and enforcing such rights, benefits can be enormous in the long-run.

Hence, this work is considering property rights as one of the parameters directly linked with institutional quality. In their model, H. Bohn & R.T. Deacon (2000) explored the impact of property rights protection on production and investment in the natural resources industries. They assumed an exogenous probability of nationalisation where the risk may have two countervailing effects; firms underinvest in long-term production capacity and firms may try to extract and sell resources inefficiently early. H. Bohn & R.T. Deacon (2000) used cross-sectional regressions to demonstrate that the first effect dominates and, as consequence, uncertain ownership rights cause underinvestment rather than overinvestment. In J. Thomas & T. Worrall work (1994), an insufficiently protected property rights environment is introduced where the state and the firm are involved in a multi-period interaction. The state is unable to produce hydrocarbons on its own and can expropriate the firm during the first period while getting nothing in subsequent periods. The firm, from the other hand, has the bargaining power but no access to any revenues coming from oil sales (Thomas & Worrall, 1994). Thus, during the first period, the firm underinvest; however, it invests at the socially optimal level (for certain parameter values) in the long run (Thomas & Worrall, 1994).

At this point, it is important to highlight the fact that a democratic regime does not always equate with well-functioned institutions. If the pre-existing to oil development institutions are weak, the revenues from petroleum tends to produce a rentier state[7], which depends solely on oil profits where the lines between private and public sector are usually not well-defined (Karl, 2005). In this case, rulers tend to remain longer in power by diverting the revenues to themselves and their supporters through overspending, subsidiaries and/or creation of public employment (Karl, 2005). In their work, H. Mehlum et al. (2006) argue that resource rents, in relation to the quality of institutions, need to be high enough to attract 'grabbers' and, therefore, it is hard for resource-rich countries to avoid seizing of rents in the long-term. However, G. Wright & J. Czelusta (2004) point out the fact that a significant amount of U.S. mineral land was transferred into private interests outside of the procedures set by federal law[8] highlighting the fact that, even in democracies, 'outlaw' agreements may occur.

Finally, S. Guriev et al. (2011) study nationalisations in the global oil industry during 1960–2006 to prove empirically that governments are more likely to nationalise when oil prices are high and when political institutions are weak. In the empirical part of their research, they test through their model the increase of the risk of nationalisation due to, firstly, a positive oil price shock and, secondly, the presence of weak political institutions. The dependent variable is a dummy binary variable with value '1', if there was at least one nationalisation in a country during the period under study, and, '0' otherwise. The main independent variables of interest are the oil price, the 'institutionalised democracy' (DEMOC), the quality of political institutions (XCONST as proxy) and the GDP per capita. While controlling for country fixed effects, their results conclude that nationalisations are more likely to occur during periods of higher oil prices and in countries with poor institutions.

[7] Rosser defines a 'rentier' states as '*states that receive regular and substantial amounts of 'unearned' income in the form of, for instance, taxes on natural resource exports or royalties on natural resource production*' (Rosser, 2006, p. 15). The term 'rentierism' is linked with the rise of authoritative regimes and be considered partly responsible for the end of political pluralism and democracy in many countries.

[8] In U.S., nearly 6 million acres of coal lands were privatised between 1873 and 1906 mostly disguised as farmland (Wright & Czelusta, 2004).

B.2. Exploring social factors; borrowing elements from the resource curse theory

We can observe that resource nationalism shares many common 'drivers' (or, to phrase it differently, causes) that we find in the resource curse literature; over-dependence on natural resources, evolving political conditions, inappropriate legal framework and poor-quality institutions. These are some of the main fields that researchers were focusing so far to provide robust explanations for the presence of resource nationalism. The literature suggests that countries which experience resource nationalism tend to be either highly dependent on their natural resources or ex-colonies with negative investment-related experiences in the form of foreign companies exploiting their resources in the past and, as consequence, 'forcing' these nations to often develop a political ideology around the development of the reserves which tends to lean towards nationalism.

The current resource curse literature includes several studies, emerged late in the 20th century, attempting to both analyse and empirically test the observation that resource-rich countries tend to perform poorly despite the excess resource wealth derived from their geological endowment. A significant empirical question, often found in the literature, is concerned with the widespread idea that natural resources facilitated several wealthy countries to achieve higher levels of development. The resource curse theory is considered controversial as it opposes the traditional discussion of growth and competitive advantages. Traditional economic theory supports that economic progress can be facilitated through the large revenues derived from natural resources, such as oil. Although economic historians argue that natural resources can generate great economic benefits for a country, nowadays, it is widely accepted that resource-rich countries face various socio-economic problems despite their vast geological wealth. The supporters of this position base their claim in some empirical facts related with growth and development indicators of some resource-rich nations, such as the fact that the whole GDP per capita on average for OPEC nations decreased by 1.3% each year from 1965 to 1998 (Robinson, Torvik, & Verdier, 2006). In the empirical resource curse literature, the negative correlation between resource endowments and GDP growth is one of the most common findings. However, this outcome is not set in stone as researchers, such as D.A. Jodice (1980), supported that resource nationalism may occur more often when high GDP and satisfactory government capacity for the development of natural resources are in place.

E.H. Bulte et al. (2004) focus on the impact of resource wealth on various proxies of economic underdevelopment and welfare viewing these variables as dependent on economic growth, but, at the same time, with distinct characteristics. Specifically, E.H. Bulte et al. (2004) state two important differences; firstly, the underdevelopment and welfare proxies incorporated in their work are typically expressed as "levels", whereas economic growth is usually measured as a change in levels over time, and, secondly, these indicators capture distributional considerations, often overlooked in aggregate growth statistics. J.A Frankel (2010) considers seven aspects of commodity wealth which could have led to sub-standard economic performance; volatility, long-term trends in world commodity prices, poor institutions, permanent crowding out of manufacturing, war, unsustainability and cyclical Dutch Disease[9]. His study incorporates labour and government considerations directly related to social development, while he is highlighting the fact that countries with rich natural resources industries are included in both best but also worst performers in terms of governance, democracy, stability, rapid growth of income and several others human development indicators (Frankel, 2010).

Furthermore, F. Ploeg (2011) in his survey-based paper provides welfare-based fiscal rules for developing natural resources following the assumption that a resource boom may affect negatively the appreciation of the real exchange rate, initiating deindustrialisation as well as civil conflict and creating, thus, negative growth prospects especially in countries with low institutional quality, corruption, and underdeveloped financial systems. He also emphasises the effects of natural resources discoveries on income beyond the lifespan of the natural resources reserves (Ploeg, 2011). Specifically, F. Ploeg argues that an initial increase in income generated by the newly discovered reserves may lead to an account surplus which can be reversed when natural resources are exhausted (Ploeg, 2011).

[9] As defined recently by Y. Bourdet & H. Flack (2006) : "*The Dutch Disease theory suggests that the effects of capital inflows on resource allocation are traced through their effects on the real exchange rate. More precisely, it tells us that large inflows of capital can give rise to an appreciation of the real exchange rate and eventually a deterioration of the competitiveness of the sectors exposed to international competition, thus preventing the development of a dynamic export sector. The main concern of this theory is to assess the effects of a capital inflow on the real exchange rate and the country's international competitiveness*". The term appeared for the first time after the Dutch economic crisis of the 1960s following the discovery of North Sea natural gas reserves.

However, depending on the resource management and policies in place, a natural resource windfall does not necessarily cause common Dutch Disease effects, such as decreasing manufacturing exports and increased unemployment. Under the assumption that the resource windfall is anticipated, the real exchange rate will appreciate, and the unemployment will rise ahead of the windfall. J.D. Hamilton (2009) attempts to explore similarities and differences between the dramatic increase of oil prices in 2007-08 with earlier oil price socks and identify their effects on consumption spending; an economic dimension directly linked with households' economic well-being in the broad environment of an economic recession. In their book, N.H. Barma et al. (2012) explore briefly household income in relation to economic growth and living standards in natural resource-led economies, and specifically oil states.

C. Methodology

C.1. Measuring Resource Nationalism

One of the main goals of this chapter is to expand the contribution of S. Guriev et al. (2011) by incorporating social factors in the empirical research, redefining the concept of "nationalisations" and approaching a different period under study. The idea of using cases of nationalisations to create a proxy measure for resource nationalism as well as most of the data on expropriations come mainly from S. Guriev et al. work (2011) complemented by additional research on Google and ProQuest in order to cover the period 2006-2013 which is not included in their study. More specifically, S. Guriev et al. (2011) study the period 1960-2006 covering 161 countries and using data from four main sources. This chapter focuses on the period 1996-2013 and, as a result, an update of the nationalisations (including expropriations which were the focus of S. Guriev et al. (2011)) occurring in the years after 2006 was required. In addition, a further examination of incidents of nationalism which does not fall into the category of 'nationalisations' as it was defined by S. Guriev et al. (2011) was deemed necessary in order for this chapter to be able to present a broader definition of resource nationalism based on the two components P. Stevens assumes in one his studies (2008); limitations in IOCs operations, and, greater national control on behalf of the government over oil resources development.

Resource nationalism can take a variety of forms, from outright expropriations of private assets to fiscal and regulatory measures which deprive private investors of the value of the resource under exploitation and, at the same time, increase the host state's participation. To capture the various methods and forms of nationalistic incidents taken place in the countries under study during the period 1996-2013, it was deemed useful to create an index of resource nationalism (named Nationalism Index), which will attempt to categorise the governmental actions that lead to the nationalisation of the oil industry.

At this point, it is vital to make the distinction between the concept of 'resource nationalism' and 'nationalisation in the natural resources'; two concepts that often overlap in the literature since they have a similar notion, but depending on their interpretation, they can have

significant implications on the empirical work. The International Energy Forum has defined resource nationalism as '*nations wanting to make the most of their endowments*' highlighting the ideologically charged nature of the phenomenon[10]. The 1962 United Nations (UN) resolution regarding the sovereignty of natural resources mirrors this definition as resource nationalism was presented as '*the inalienable right of all States freely to dispose their natural wealth and resources in accordance with their national interests'* (Clarke & Cummins, 2012)[11]. Resource nationalism can take a variety of forms; from outright expropriations of private assets to fiscal and regulatory measures which deprive private investors of the value of the resources under exploitation and, at the same time, increase the host state's participation. The term 'nationalisation' is used to express the *process* of confiscation of oil development operations from private hands for the host government to obtain more revenue (Ayoub, 1994). The main difference between the two concepts lies on their time framework; while 'nationalism' refers to a broad phenomenon of states moving towards a nationalised oil industry, 'nationalisation' reflects the per se momentarily action of a state seizing a private asset or applying a policy that would result the deprivation of a private investor's property and/or operations. For example, both terms can be used in the case of an expropriation causing different analytical implications; the actual event of an expropriation is a de facto act of nationalisation the moment it occurs (short-run), and, simultaneously, a manifestation of resource nationalism on behalf on the host state (long run).

C.1.1. The Binary Variable on Nationalisations

The dependent variable is a binary variable which incorporates cases of nationalism in the oil industry and it is used as a proxy for resource nationalism. It consists of an original variable created solely for the purpose of this work and inspired by the previous comprehensive work of S. Guriev et al. (2011). It includes both the data on expropriations from S. Guriev et al. (2011) along with three additional resource nationalism manifestations which aim to offer a

[10] Middle East Economic Survey (2006) 49, p.39, referred to in Paul Stevens, "*National oil companies and international oil companies in the Middle East: Under the shadow of government and the resource nationalism cycle*" (2008, p.1., Journal of World Energy Law & Business).

[11] M. Clarke & T. Cummins (2012, p. 220), referred to in General Assembly Resolution 1803 (XVII) of December 14, 1962, "*Permanent sovereignty over natural resources*".

broader definition and capture any additional dimensions of the phenomenon. In more detail, the dependent variable includes:

a. Updated data on expropriations from S. Guriev et al. (2011) for years 2006-2013
b. Cases of constitutional prohibition of foreign companies to operate in the oil industry and/or possess assets related to oil resources
c. Cases of clear dominance of state-controlled entities (National Oil Companies, NOC) in the oil industry based on reformations of the legal framework, and,
d. Cases of illegal breach of contracts leading the case to international arbitration

The binary dependent variable is as follow:
'1', if there is at least one instance of the above expressions of resource nationalism in the country under investigation for any given year, '0' otherwise.

From a legal perspective, as G. Joffe et al. (2009) analyse in their work, the state has the legitimate power to regulate matters involving public order, health and safety, currency, foreign exchange resources, balance of payments and emergency situations. The distinction between actions that are falling within the proper exercise of regulatory power on behalf of the government and actions that can be considered indirect deprivation of private rights, depends on the 'sole effects doctrine'; the degree of control and deprivation, the measure of 'proportionality', and, investor's legitimate expectations. In other words, G. Joffe et al. (2009) suggest observing the *effects* and not the form of a nationalistic action to decide upon its nature. G. Joffe et al. (2009) in effort to classify nationalistic actions introduced the 'substantive effect' test by considering the degree of interference and deprivation. For example, in the case of an expropriation, the substantial loss of control or value that will result from the seizure of control, use or operation to the investor is an absolute requirement to qualify this action as resource nationalism. Regarding indirect expropriation acts, state regulation can give under certain circumstances rise to resource nationalism in oil sector through, for instance, taxation. Even environmental sanctions can be viewed as expropriatory based on the 'sole effects doctrine'. For example, as G. Joffé et al. (2009) mention, most of the recent cases of resource nationalism are dealing with host states which altered the legal environment at the time the investment was already in place.

Although this work is not a legal study, a reflective understanding of some features of the legal literature on resource nationalism is essential in order to provide a broader definition of the phenomenon and achieve a more holistic view of the conditions of its occurrence. Observing the economic impact of governmental interference in both the country and the investments and deciding if this act has radically deprived the investor of the value of the asset is the basis of constructing the dependent variable. According to the data sources, during this period, 47 out of 99 countries have experienced one of the above cases of nationalism at least once for the period 1996-2013. Most cases of nationalism were concentrated in the beginning of the period under study (mid-end of 90s), around the years 2006-2008, and during the last three years 2011-2013.

C.1.2. Creating the Resource Nationalism Index

The Nationalism Index is used as the dependent variable in a similar way as the above mentioned binary variable given the fact that it works as well as a proxy for resource nationalism. The Nationalism Index is an original variable created solely for the purpose of this work and includes both the data on expropriations from S. Guriev et al. (2011) along with additional resource nationalism manifestations, which attempts to offer a broader definition of the phenomenon and capture any additional dimensions. The main difference with the binary variable is the fact that the Nationalism Index aims to group nationalistic actions to three main categories; hard-core, midcore and softcore resource nationalism. In more detail, the Index is structured as follow:

a. '0', if there were no incidents of resource nationalism for the period 1996-2013

b. '1', for softcore nationalism, which includes;
    i. Legal changes in the licencing process, organisational structure of the oil industry in the country, and/or
    ii. Concerns of transparency that lead the case to international arbitration

c. '2', for midcore nationalism, which includes;

i. Cases of monopoly, preferential rights and/or clear dominance of state-controlled entities (NCOs) in the oil industry based on reformations of the legal framework
ii. Price Controls
iii. Clear barriers of entering the oil upstream market, and/ or
iv. Weak property rights

d. '3', for hard-core nationalism, which includes;
   i. Expropriations
   ii. Cases of constitutional prohibition of foreign companies (IOCs) to operate in the oil industry and/or possess assets related to oil resources
   iii. Cases of illegal breach of contracts leading the case to international arbitration

At this point, it is worth mentioning that a single country might has experienced more than one of the above cases, therefore, it is not unusual that the same country might receive two or more scores for the period 1996-2013 accordingly to the categorisation of the incidents taking place. Thus, the Index is constructed in a year-to-year basis for each country and not as the average of incidents occurrence.

C.2. Defining the Explanatory Variables

One of the main goals of this chapter is to expand the contribution of S. Guriev et al.S (2011) by incorporating social factors in the empirical research. This work attempts to redefine the concept of "nationalisations" by providing empirical evidence than the phenomenon is also driven by social determinants. Analysing the established economic determinants of resource nationalism in the oil industry and attempting to give an alternative broader explanation through the incorporation of social factors in the empirical analysis aims to reveal a correlation between resource nationalism occurrence and low levels of institutional quality as well as the presence of negative social parameters, such as poverty. To achieve that, we incorporate variables in the models directly linked with institutional quality and social

indicators, such as Rule of Law, Human Development Index and Household Final Consumption expenditure.

Chapter 1 borrows several social indicators used in the resource curse theory under the hypothesis that several social features, such as poverty and inequality, can have a great effect on the possibility of resource nationalism occurrence and, as consequence, the relationships between the host country and private operators. The effect of oil and gas wealth to the consumption spending, an economic dimension directly linked with households' well-being, as well as the relation between household income and economic growth in oil states, are investigated. In S. Guriev et al. (2011), the main independent variables measuring the institutional quality were the 'institutionalised democracy' (DEMOC) and the quality of political institutions (XCONST as proxy) along with the GDP per capita. While controlling for country fixed effects, their results conclude that nationalisations are more likely to occur during periods of higher oil prices and in countries with poor institutions. The two variables are often used as proxy for institutions given the fact that they are related to two different aspects of institutional quality; XCONST attempts to measure institutional quality as the rules of the game understood from all parties, while DEMOC includes the implicit incentives for any executive to regard highly social welfare by providing the citizens with procedures which allow them to remove any executive that does not perform effectively. Although many other data sources on institutional quality exist, S. Guriev et al. (2011) chose to incorporate these two Polity IV variables in their research mainly because they cover effectively the whole period they study.

However, since this work covers a different time period, the variables which represent institutional and social factors were selected based of availability of data but also based on their reliability and wider use by the contemporary literature. Specifically, as D. Kaufmann et al. state (2010), the advantage of Rule of Law comparing to other approaches lies to the fact that its method of calculation is based on expert evaluation, frequently collected by private firms specialising on country risk assessments. Thus, it incorporates a series of parameters that influence deeply the overall institutional quality of a country allowing the researcher to capture the whole of the institutional environment including aspects that have been proved problematic to measure otherwise. Without a doubt, the HDI alone cannot provide a full picture of a country's development level given the fact that it does not reflect many

components of human development, such as gender inequalities and political participation. Nevertheless, for the purpose of this research, the HDI has been identified as the most suitable source of information which could serve as a comprehensive proxy reflecting some key issues of human development, like poverty and inequality. The HDI index has been widely used by both academics and policy-makers who are seeking to evaluate development not only by economic advances but also by improvements in human and social equality. Finally, the HFCE reflects what people spend on goods and services to satisfy their needs, household's economic well-being in each country can be expressed in terms of its access to goods and services. The more people can consume, the higher the level of economic well-being, signifying the fact that by measuring the HFCE we can essentially measure the economic well-being in the society's micro-level.

Since this work is closely related to S. Guriev's et al. work (2011), the incorporation of DEMOC and XCONST was unavoidable in order to be consistent with the literature already in place but also examine how these variables respond in a different dataset. However, introducing three main variables under investigation, namely Rule of Law, HDI and HFCE, was deemed necessary, not on only in relation to the availability of data in relation to the time-period and country coverage, but most importantly in order to capture dimensions of institutional and social factors affecting the phenomenon of resource nationalism which were not examined by S. Guriev et al. (2011), such as poverty, inequality and human development.

Rule of Law (RoL)- Institutions & Economic Development

The Worldwide Governance Indicators (WGI) project was launched by World Bank and provides both aggregated and individual indicators for 215 countries over the period under study taking into consideration six separate, but interrelated, dimensions of governance; voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, control of corruption and rule of law. As D. Kaufmann et al. state (2010), these qualitative indicators are based on 32 individual data sources produced by a variety of international organisations, non-governmental organisations (NGOs), private sector firms, think tanks and survey institutes. Rule of Law, as defined by World Bank '*captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and, in particular, the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence'* (Kaufmann et al., 2010, p.4.). It is an

estimate of governance and ranges from approximately -2.5 (weak) to 2.5 (strong) governance performance.

In the fields of institutional economics and resource curse theory, the Rule of Law is one of the most commonly used proxies, or direct indicators, used to either measure directly the level of institutional quality in a country, or, to identify the relationship between institutions and economic indicators (see M. Alexeev & R. Conrad (2009), T. Persson & G. Tabellini (2003), S. Bhattacharyya & R. Hodler (2010), J. Isham et al. (2002), H. Mehlum et al. (2006), J.A. Robinson et al. (2006), J. Sacks & M. Warner (2001), S. Bulte et al. (2004), and, R. Deacon (2011)). Other studies, such as R. La Porta et al. (1998), have adopted different approaches to capture institutional quality, like the existence of legal protection of creditors in an investment level or the governmental structure in relation to the facilitation of policy changes. However, these methods are only applicable to a limited set of formal institutions and, as a result, often disregard informal institutions as well as several aspects of the institutional framework of a country setting significant limitations in the domain of study.

D. Kaufmann et al. (2010) support that the advantage of Rule of Law comparing to other approaches lies to the fact that its method of calculation is based on expert evaluation, frequently collected by private firms specialising on country risk assessments. Thus, it incorporates a series of parameters that influence deeply the overall institutional quality of a country, like the protection of property rights, the frequency of corruption, the efficiency of dispute resolution procedures, the juridical independence, the quality of contract enforcement, the likelihood of crime and violence etc. Therefore, one of the reasons Rule of Law is so widely used by the existing literature is the fact that allows the researcher to capture the whole of the institutional environment including aspects that have been proved problematic to measure otherwise.

Human Development Index (HDI)- Assessing Inequality

The variable of Human Development Index (HDI) comes from the United Nations Development Programme (UNDP) and Human Development Reports 2013 Update. It was created aiming to highlight people's capabilities as the ultimate criterion for assessing a country's development level. Hence, the HDI does not put emphasis only to the economic growth of a country like other development indicators, but it also attempts to link

development issues with social progress as well as national policies with human development outcomes. It was generated by the UNDP to stimulate the debate around government policy priorities in cases where countries with similar economic growth experience different human development effects. The HDI consists of the geometric mean of normalised indices of average achievement, so a summary for each of the three key dimensions of human development are weighted equally: a long and healthy life, being knowledgeable and have decent standards of living (UNDP, 2014).

More specifically, as one of HDI's components, the life expectancy at birth is measured by using a minimum value of 20 years and maximum value of 85 years and is used to assess the health dimension. The education component consists of two indices combined into one single education index using arithmetic mean. The two indices are calculated by means of years schooling for adults aged 25 years (estimated by UNESCO Institute of Statistics through educational attainment data from surveys and censuses) as well as expected years of school attendance for children entering school age (estimated also by UNESCO Institute of Statistics). Finally, gross national income per capita (GNI) is used to measure the standard of living dimension setting a minimum income of $100 (PPP[12]) and a maximum of $75,000 (PPP).

The HDI has been criticised for focusing exclusively on national performance ranking, lacking attention of development from a global perspective and undermining any contributions to the human civilisation, technological growth and ecological considerations, providing, consequently, an ideologically biased egalitarianism index towards what is called 'western model of development'. From an econometric point of view, H. Wolff et al. (2011) emphasised some measurement error of the underlying statistics of health, education and income which can lead to misclassification in the categorisation of the countries as 'very high', 'high', 'medium' and 'low' human development. According to H. Wolff's et al. (2011) work, there are three main sources of data error caused mainly by data updating procedures, frequent formula revisions and thresholds in the classification of the countries. H. Wolff's et al. (2011) concluded that from 11% up to 34% of all countries included in the HDI could be considered misclassified because of the three data error sources, arguing that the arbitrary

[12] Purchasing Power Parity

classification might mislead investors, politicians and academics who use HDI index. The UNDP responded to the criticism by revising the methodology used to calculate the HDI and by continuously updating the human development categories after any data or formula revisions. To address the methodological issues, the UNDP also started updating the thresholds to classify countries as 'high', 'medium', and 'low' human development nations (UNDP, 2014).

Nonetheless, the HDI has been incorporated as a significant variable in several resource curse theory related works which attempted to prove a negative correlation between exploitation of natural resources and human development (see E.H. Bulte et al (2004) and J. Frankel (2010)). Without a doubt, the HDI alone cannot provide a full picture of a country's development level given the fact that it does not reflect many components of human development, such as gender inequalities and political participation. To capture the broad concept of human development, an in-depth analysis of other indicators is required. Nevertheless, for the purpose of this research, the HDI serves as a comprehensive proxy reflecting some key issues of human development, like poverty and inequality. The HDI index has been widely used by both academics and policy-makers who are seeking to evaluate development not only by economic advances but also by improvements in human and social equality. Given the limitations regarding data availability and country coverage of other sources and indices that could be used as a proxy for development and inequality, the HDI has been identified as the most suitable source of information for the objective of this work as it provides the more complete framework in terms of indicators and countries included.

Household Final Consumption Expenditure (HFCE)- Exploring Well-Being

Household final consumption expenditure (measured in current US$) has been retrieved from the World Development Indicators 2013[13] and it is defined as the market value of all goods and services, including durable products, purchased by households. Although purchases of dwellings are excluded, the imputed rent for owner-occupied dwellings, payments and fees to governments to obtain permits and licenses and expenditures of non-profit institutions serving households are all included. Household expenditure has been widely investigated by the resource curse literature (see F.v.D. Ploeg (2011), J.L. Hamilton (2009), N.H. Barma et

[13] World Bank at http://data.worldbank.org/indicator/NE.CON.PRVT.CD

al. (2012)) in an effort to connect economic growth and living standards in natural resource-led economies.

While in previous years consumption was considered a rather insignificant factor, especially in comparison to production and the economic and political disputes, the increasing development of a consumer society brought the HFCE back to the centre of many studies. At this point, it is worth mentioning that, in national accounts, the HFCE is the main component of the expenditure approach to GDP (Vertera & Osakwe, 2014) and allows not only the assessment of purchases made by households but, also, the investigation of changes in the wages, the savings behaviour and the employment fluctuations. In this research, the HFCE serves as a proxy for well-being and living conditions of the citizens in the countries under investigation as it encompasses the domestic costs for individual needs.

The HFCE may reflect various socio-economic patterns as well as consumption habits that vary substantially among different countries. Several factors, from household composition, degree of urbanisation and culture to income, economic structure and weather, can all have a great impact on the HFCE in each country (Vertera & Osakwe, 2014). Therefore, since the HFCE reflects what people spend on goods and services to satisfy their needs, household's economic well-being in each country can be expressed in terms of its access to goods and services. The more people can consume, the higher the level of economic well-being, signifying the fact that by measuring the HFCE we can essentially measure the economic well-being in the society's micro-level.

Institutionalised Democracy (DEMOC) and Executives Constraints (XCONST)

DEMOC and XCONST were used by S. Guriev et al. (2011) as proxy for the cost of expropriation. These two variables are part of the Polity IV dataset and attempt to measure the quality of political institutions (Marshall & Jaggers, 2013 Update). Specifically, DEMOC ranges from '0' to '10' and is regarded as three interdependent elements;

- the presence of institutions and procedures through which citizens can express effective preferences about alternative policies and leaders
- the existence of institutionalised constraints on the exercise of power by the executive, and,

- the guarantee of civil liberties to all citizens in their daily lives and in acts of political participation (Marshall & Jaggers, 2013 Update).

XCONST (or Decision Rules) ranges from '1' to '7' and captures the existence of decision rules in the economy. It essentially expresses the extent of institutionalised constraints on the decision-making powers of chief executives (individuals or collectivities).

The two variables are often used as proxy for institutions given the fact that they are related to two different aspects of institutional quality; XCONST attempts to measure institutional quality as the rules of the game understood from all parties, while DEMOC includes the implicit incentives for any executive to regard highly social welfare by providing the citizens with procedures which allow them to remove any executive that does not perform effectively. Although many other data sources on institutional quality exist, S. Guriev et al. (2011) chose to incorporate these two Polity IV variables in their research mainly because they cover effectively the whole period they study. Since this work is closely related to S. Guriev's et al. work (2011), the incorporation of DEMOC and XCONST was unavoidable in order to be consistent with the literature already in place but also examine how these variables respond in a different dataset and, also, test their affect in the three main variables under investigation (namely Rule of Law, HDI and HFCE).

GDP per capita

The Gross Domestic Product (GDP) per capita for years 1996-2013 (measured in current US$) comes from the World Development Indicators 2013[14]. GDP per capita is gross domestic product divided by midyear population and was calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. From 1996 up to 2013, none of the countries under investigation has '0' production so all 99 countries are included.

[14] World Bank at http://data.worldbank.org/indicator/NY.GDP.PCAP.CD

Population

The measurement of total population for years 1996-2013 (measured in millions for midyear estimates) by the World Bank Development Indicators 2013[15] amounts all residents regardless of legal status or citizenship. Refugees not permanently settled in the country of asylum are generally considered part of the population of their country of origin and, therefore, are not included.

Total Oil Production and Proved Oil Reserves

Both total oil production and proved reserves for years 1996-2013 are coming from International Energy Agency (IEA) Statistics 2013 Update[16]. Production is measured in thousands of barrels per day while proved reserves in billions of barrels per day[17]. Both variables had been calculated annually for all years under examination.

Oil Price

Data from BP Statistical Review of World Energy June 2014[18] has been used for the oil price variable, including historical crude oil prices in US dollars ($) per barrel, value of 2013.

Country & Time-Period Coverage

This chapter examines a different time-period (1996-2013) than the one covered in S. Guriev et al. (1960-2006). This period was selected for various reasons including mostly the availability of data as databases of paramount importance for this work, such as the HDI, do not extend prior to the 90s. The availability of data for social variables incorporated in the empirical work was key in order to convey a broader definition of resource nationalism. In addition, this Chapter is examining the phenomenon from a contemporary and not historical perspective. Aiming to examine recent cases of resource nationalism in the oil and gas industry and the new rise of the phenomenon in several countries, it was necessary that the period under study would reconcile national and subnational statistics from the regions that

[15] World Bank at http://data.worldbank.org/indicator/SP.POP.TOTL

[16] IEA- International Energy Statistics at: http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=54&aid=4&cid=regions&syid=1996&eyid=2012&unit=TBPD

[17] 1 US barrel corresponds to 158.9873 litters and 0.136 tons of oil.

[18] BP website at: http://www.bp.com/en/global/corporate/about-bp/energy-economics/statistical-review-of-world-energy.html

have experienced events of breakup and unification is often problematic. In contrast with S. Guriev et al. (2011), the Soviet Union along with Yugoslavia, Germany, Namibia, Vietnam, Yemen and Eritrea are included in the sample as the time period under study do not coinciding with political reformations these countries were undergoing.
In S. Guriev's et al. (2011) work, as well as in other similar studies on the field, countries of the former Soviet Union along with Yugoslavia, Germany, Namibia, Vietnam, Yemen and Eritrea are excluded from the sample due to the time period under study coinciding with political reformations. Moreover, in centrally planned economies like the above-mentioned states, there was no private property and, consequently, nationalism or acts of nationalisation are, by definition, impossible. In this study, the period under examination stretches after 1996 when most events of breakup and unification had been already taken place.

Consequently, the new states that had been formulated after the breakup of Soviet Union and Yugoslavia, along with Yemen, are included as there was no sufficient reason, or issues with the data collection, to prevent their inclusion. The only parameter that was taking into consideration regarding any restrictions on the country coverage was the volume of oil production. The countries included in the dataset produce more than 1000 bbl. /day, with any other states with less production for the period under study to be excluded. Any country with oil and gas production lower than 1000 bbl. /day cannot be considered a significant hydrocarbon producer and, therefore, its inclusion creates the risk of biased results. Hence, the final sample comprises of 99 countries over the period of 18 years (1996-2013).

C.3. Discussion on the Methodological Approach & the Literature

Some of the first empirical attempts to explore and measure the phenomenon of resource nationalism in natural resources industries came in early 1990s and they were focusing mainly on economic indicators, especially the size of the economy, tax rates and investment rates. Apart from the economic drivers of resource nationalism, a vast part of the literature on the topic is dedicated to the institutional framework and the level of institutional quality in a country as a great determinant of industry's orientation towards resource nationalism or liberalism as well as overall economic performance. The correlation between institutional quality and economic development is based on the argument that good quality institutions

affect directly governance features which affect the overall economic performance of a nation. Without a doubt, the complex nature and structure of institutions makes the assessment of institutional quality significantly challenging.

Chapter 1 draws inspiration from the work of S. Guriev et al. (2011) while borrowing elements from institutional economics and resource curse theory. Specifically, the central idea of using cases of nationalisation to create a proxy measure for resource nationalism as well as most of the data on expropriations come mainly from S. Guriev et al. work (2011) complemented by additional research. As highlighted in previous section of this chapter, a different time-period than the years covered in S. Guriev et al. (2011) was chosen mainly due to data availability of the additional explanatory variables linked with social indicators. The attempt to convey a broader definition of the phenomenon is deriving from the approach taken by P. Stevens in one his theoretical studies (2008) where he identified two important components of nationalisation- the limitations in IOCs operations and the greater national control on behalf of the government over oil resources development. This chapter, thus, account for a wider spectrum of categories falling into the definition of 'nationalisations' comparing to the definition provided by S. Guriev et al. (2011)). Creating the Nationalisation Index in order to provide a broader definition of resource nationalism aligns also with the theoretical work of S.J. Kobrin ((1979), (1980), (1984)) while allowing the researcher to more effectively explore the relation between resource nationalism and institutional as well as social parameters. The Index aims to categorise the governmental actions which lead to the nationalisation of the oil industry in a country during the period under study. S.J. Kobrin ((1979), (1980), (1984)) was the first to indicate that a government could take over the country's natural resources through regulation rather than direct acts of nationalisation (i.e. expropriation). This point has been taken into consideration for the categorisation process of the Index providing also an empirical representation of S.J. Kobrin's work.

More specifically, S.J. Kobrin was one of the first researchers who attempted to empirically explain the phenomenon of nationalisation by using expropriations as a variable. In his empirical work, he analyses expropriation data in 79 developing countries from 1960 to 1979 as a proxy for Government's attempt to control foreign firms (Kobrin S. J., 1984). S. Guriev et al (2011) draw inspiration from S.J. Kobrin's study by using also expropriations as a measure of nationalisation without though accounting for S. J. Kobrin's conclusion that a

government can gain more effectively control over strategic resources through regulation rather than direct nationalisation of foreign firms' assets (Kobrin S. J., 1984). Therefore, although the use of expropriations as a proxy for resource nationalism was deemed necessary for the empirical work of this chapter to stay in line with the literature, the second half of the empirical analysis is focusing on a broader understanding of the phenomenon through the creation of the Nationalisation Index. The Index is in line with S.J. Kobrin's approach as it classifies incidents of nationalisation in three different categories accounting from expropriation and breach of contracts to State monopoly and regulation.

Inspired by the economic literature on the role of institutional quality, this chapter aims also to explore the phenomenon of resource rationalism without incorporating into the empirical analysis any element that would suggest that resource nationalism is correlated solely with an authoritative political status quo. G. Wright & J. Czelusta (2004), Karl (2005) and H. Mehlum et al. (2006) were some of the first researchers to support the idea that resource nationalism should not be always linked with the regime type in a country. F.v.D. Ploeg's (2011) work complimented their research and, as a result, nowadays, resource nationalism is viewed as a worldwide phenomenon driven by different factors which can take place under the umbrella of both a democratic as well as an authoritative regime. Driving by their theory, this work intent to demonstrate the correlation between institutional quality and resource nationalism independently from the political regime existing in the country.

F.v.D Ploeg (2011) tests the hypothesis that if countries, which industrialised first, also had good institutions in place to begin with while the regions that remained underdeveloped had poor institutions, that may indicate that, in the first stages of resources exploitation, corruption and political struggles were easier to arise. The key to this question is the contractual basis; the effective property rights accompanied with relatively low transaction costs that will allow natural resources to be developed efficiently. In their empirical research, H. Bohn & R.T. Deacon (2000) explored the impact of property rights protection on production and investment in the natural resources industries by using ownership security as dependent variable in one of their models. They concluded that increased ownership risk reduces extraction rates and hinders investment rates in petroleum and potentially other capital-intensive resources industries. In J. Thomas & T. Worrall work (1994), an insufficiently protected property rights environment is introduced where the state and the firm

are involved in a multi-period interaction. The state is unable to produce hydrocarbons on its own and can expropriate the firm during the first period while getting nothing in subsequent periods. The firm, from the other hand, has the bargaining power but no access to any revenues coming from oil sales (Thomas & Worrall, 1994). Thus, during the first period, the firm underinvest; however, it invests at the socially optimal level (for certain parameter values) in the long run (Thomas & Worrall, 1994).

S. Guriev's et al. (2011) study does not include any explanatory variable linked with the quality of the contractual agreements and the security of property rights. These two parameters are interlinked and had been considered by the literature as key components of institutional quality in a country that directly affect the development of natural resources. In this work, we incorporate as a main explanatory variable of interest Rule of Law which accounts, among others, for the protection of property rights, the efficiency of dispute resolution procedures, the juridical independence and the quality of contract enforcement. Including Rule of Law as an explanatory variable allows this work to be in line with both the parameter of contractual basis as identified in Ploeg's work and also the factor of property rights as highlighted by various researches (H. Bohn & R.T. Deacon (2000), J. Thomas & T. Worrall (1994)). The addition of Rule of Law was deemed necessary to complement S. Guriev's et al. work (2011) and more effectively examine the phenomenon of resource nationalism while align this work effectively with the literature.

Moreover, Chapter 1 borrows social indicators used in the resource curse theory under the hypothesis that several social features, such as poverty and inequality, can have a great effect on the possibility of resource nationalism occurrence and, as consequence, the relationships between the host country and private operators. The effect of oil and gas wealth to the consumption spending, an economic dimension directly linked with households' well-being, as well as the relation between household income and economic growth in oil states, were first appeared in the works of J.D. Hamilton (2009) and N.H. Barma et al. (2012). The aim is to expand the literature of the phenomenon of resource nationalism and add empirical evidence in the existing literature to support the importance of institutional as well as social indicators in the way a country chooses to develop its oil and gas resources. To achieve that, we incorporate variables in the models directly linked with institutional quality and social

indicators, such the Human Development Index and the Household Final Consumption expenditure.

As T. Gylfason states (2001), the quality of resource management and the institutional framework of a country constitutes of the main determinant of economic growth, and not, as it used to be supported for many years, resource abundance per se. In relation to economic growth, institutions can be the result rather than the cause (endogenous). Tax systems, intellectual property rules, social safety nets and the structure of financial markets tend to evolve endogenously in response to the level of income (Frankel, 2010). Several researchers have questioned previous assumptions arguing that oil wealth is endogenous (effect) rather than exogenous (cause) in relation to the institutional framework of a country. In other words, oil wealth can also be the effect rather than the cause of a poor institutional framework, while the institutions per se can evolve exogenously. In this work, with the incorporation of qualitative variables related to institutions, institutional quality is considered one of the main drivers of resource nationalism as it affects, directly or indirectly, government's decision to move towards a nationalised oil industry.

One of the main goals of this chapter is to expand the contribution of S. Guriev et al. (2011) by incorporating social factors in the empirical research. To achieve that, we incorporate variables in the models directly linked with institutional quality and social indicators, such as Rule of Law, Human Development Index and Household Final Consumption expenditure. Since this work covers a different period, the variables which represent institutional and social factors were selected based of availability of data but also based on their reliability and wider use by the contemporary literature. In this constantly growing field of research, several contemporary studies attempt to extend the relation between natural resource abundance and economic growth by accounting important social indicators, such as social underdevelopment and welfare, as well as the effects of natural resources development on economic growth in relation to its dimensions on the human well-being. This work, by creating two new dependent variables, expands the work of S. Guriev et al. (2011) and provides a comprehensive framework to define more broadly the phenomenon of resource nationalism. Chapter 1 provides empirical evidence that the phenomenon of resource nationalism steams from not only economic but also social indicators by incorporating variables linked with social factors and welfare.

D. Empirical Results

D.1. Ordered Logistic Model for Dummy and Index Dependent Variables

The first part of the empirical work includes data for 99 countries for the years 1996-2013 with the dependent variable to be, firstly, the binary dummy variable for nationalisation (value of '1' if the country experience, at least once, an incident of nationalism for the period under study, '0' otherwise) and, secondly, the Resource Nationalism Index. The explanatory variables are presented gradually into the regressions formulating five different ordered logistic models. The use of ordered logistic models (xtologit) was deemed desirable as this type of models are used to estimate relationships between an ordinal dependent variable and a set of independent variables. Given the random effects used before the introduction of time fixed effects in the third and firth model, the conditional distribution of the dependent variable is assumed to be multinomial with success probability determined by the logistic cumulative distribution function.

Using STATA 2015, the first model introduces the three main variables of interest which are related with the quality of institutions and social factors- Rule of Law (RoL), Human Development Index (HDI) and Household Final Consumption Expenditure (HFCE). In the interest of knowledge accumulation and comparability of findings, the same measures employed by S. Guriev et al. (2011), namely DEMOC and XCONST, are used in the second model, along with the logged/lagged variables of GDP, Population, Reserves, Production and Oil Price. The third one incorporates all the above variables with time fixed effects (as produced automatically by STATA 2015) but excluding the Oil Price variable. In the fourth model, regional dummies are also introduced along with the above-mentioned variables while in the last, and most demanding model, both regional dummies and fixed effects are included. Introducing gradually the variables into the model enables the understanding of the impact and correlation between the different factors which we assume that affect resource nationalism occurrence.

The use of the lagged values is necessary to predict and identify the correlation between the dependent variable with the past values (lags) of the explanatory variables as the level of nationalism might heavily be determined by the past levels of the main variables of interest, namely the Rule of Law (RoL), HDI and HFCE. Including lagged values of independent variables aims to address the issue of endogeneity and identify the determinants of nationalism from another perspective; it is likely that past values of some independent variables are affecting today's values of nationalism. Since the main purpose of this work is to identify the determinants of resource nationalism in oil industry through relating the dummy dependent variable to socio-economic explanatory variables, we need to test how the variables can influence one another with a time lag. Using lags, therefore, enables the incorporation of feedback over time based on theoretical considerations of how, and under which conditions, the nationalism occurrence react to the shifting economic, political and social conditions in a country.

Table 1.3: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
NatioDummy	1,782	1.296857	.4570014	1	2
NatioIndex	1,782	.7418631	1.127288	0	3
RoL	1,476	-.0495664	1.03589	-2.21	2
HDI	967	.7119979	.1453914	.262	.944
HFCE	1,697	59.98255	15.5905	5.14	207.23
DEMOC	1,621	5.613202	4.101075	0	10
XCONST	1,622	4.869297	3.174767	-88	7
GDP	1,540	4.91e+11	1.56e+12	2.32e+08	1.68e+13
Population	1,782	5.61e+07	1.73e+08	83195	1.36e+09
Reserves	1,782	4.55e+12	1.39e+13	0	1.09e+14
Production	1,782	2.66e+08	5.82e+08	-759640	4.32e+09
OilPrice	1,782	60.925	28.54429	20.83	106.93

Observing the summary statistics (see Table 1.3), it is worth mentioning that the top oil producing countries included in this dataset have a lower mean for Rule of Law, HDI and HFCE comparing to the mean of all countries included in these indexes (average mean of all countries included in these indicators is -0.049, 0.711 and 59.982 respectively). Therefore, one can assume that oil-producing countries tend to have a poorest performance for the period 1996-2013 in comparison to the rest of the world. It is also noteworthy that the dataset is highly clustered around the mean with low standard error for the HDI (0.145) while

significantly spread out with high standard error for the HFCE (15.59) indicating increased variability between countries. Nonetheless, given the relatively small size of the dataset, an inversely proportional standard error to the sample size is expected to appear.

D.1.1. Binary Nationalism Dummy Regressions- Ordered Logistic Model

In the summary table of the ordered logistic results for all five models (see Table 4.1), Rule of Law is consistently significant at 1% with a negative coefficient in all five models indicating a strong negative correlation between institutional quality and nationalism occurrence in oil industry. The correlation between nationalism and institutions may be driven by reverse causality as, for instance, a shift towards a nationalised oil industry causes the concentration of so much power in the hands of the rulers to the point that institutional quality is, as a result, undermined; a point also stated in the work of S. Guriev et al. (2011). However, the estimates in this work do not suffer from the reverse causality issue given the fact that the Rule of Law lagged variable represents a proxy for institutional quality which is based on political procedures. These procedures, apart from the fact that are measured in a rather objective way by the World Bank, they are also unlikely to change dramatically within a few years' time.

The consistent significance of HFCE in all models (varying from 1% statistical significance in the first model to 5% in the rest) with the persistent negative coefficient strengthens the assumption that nationalism is closely interrelated with social factors and, specifically, with the living standards in oil-led economies. The HFCE serves as a proxy for well-being and living conditions of the citizens in the countries under investigation given the fact that it encompasses the domestic costs for individual needs. The HFCE may reflect various socio-economic patterns as well as consumption habits which vary substantially among different countries. Therefore, since this variable reflects what people spend on goods and services to satisfy their needs and wants, household's economic well-being in each country can be expressed in terms of its access to goods and services. The more people can consume, the higher the level of economic well-being, signifying the fact that by measuring the HFCE can

be a way of measuring economic well-being in society's micro-level. In fact, the countries with the lowest HFCE scores are mainly Middle East and African countries which, for the same period, experienced strong cases of nationalism in the oil industry.

Table 1.4: Summary of Panel Data Ordered Logistic Model for Nationalism Dummy

Dependent Variable: Resource Nationalism Binary Dummy					
VARIABLES	(1)	(2)	(3)	(4)	(5)
lRoL	-2.450***	-2.484***	-3.037***	-2.509***	-2.883***
	(0.611)	(0.794)	(0.929)	(0.863)	(0.980)
lHDI	2.102	-0.581	-3.113	-13.36	-15.10*
	(4.082)	(7.441)	(8.217)	(8.546)	(9.148)
lHFCE	-0.0797***	-0.0741**	-0.0806**	-0.0771**	-0.0797**
	(0.0253)	(0.0361)	(0.0379)	(0.0352)	(0.0361)
lDEMOC		-0.0660	-0.134	-0.110	-0.163
		(0.357)	(0.379)	(0.350)	(0.368)
lXCONST		-0.0833	0.0144	-0.137	-0.0589
		(0.651)	(0.682)	(0.624)	(0.648)
llGDP		0.733	1.492	1.063	1.534
		(0.739)	(0.991)	(0.753)	(0.967)
llPopulation		-0.335	-0.875	-0.517	-0.871
		(0.735)	(0.898)	(0.783)	(0.917)
llReserves		0.288	0.251	-0.0203	-0.0240
		(0.341)	(0.350)	(0.336)	(0.344)
llProduction		0.117	0.0583	0.252	0.187
		(0.552)	(0.569)	(0.534)	(0.554)
Year Fixed Effects			✓		✓
llOilPrice		-0.629		-0.269	
		(0.605)		(0.609)	
Regional Fixed Effects				✓	✓
Observations	821	557	557	557	557
Number of ID	98	70	70	70	70

Standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Null hypothesis: error is normally distributed for all models. The increased missing values resulted from lack of data on oil production and reserves for some countries added to the already missing values on variables DEMOC and XCONST.

In addition, more than half of the top twenty countries with the lowest HFCE score have a nationalised oil industry. Hence, especially given the fact that the significance of the variable remains persistent in all models, it appears that in countries with low HFCE, which

corresponds to lower level of economic well-being, the probability of nationalism occurrence is higher, or, to put it in reverse, states with nationalised oil industry and an economy heavily dependent on oil revenues, experience poorer living standards.

The 10% statistical significance of HDI in the last and most demanding model, which incorporates both the time fixed effects and the regional dummies, indicates that the level of human development in a country is potentially correlated to resource nationalism. It is important to highlight the fact that, although the variable appears to have positive coefficient in the first model, it turns to negative when time fixed effects and regional dummies are introduced. Even though there are theoretical arguments in the resource nationalism literature that suggest that human development levels are decreased in countries with high oil dependency, there are no empirical evidence to support this view. The top 10% HDI scores of all countries under consideration belongs to rich developed economies with no nationalism incidents in their oil sector during the period under study, such as Canada, Norway, Australia, Switzerland, Sweden, U.S and the U.K. Consequently, given these evidence, it is safe to assume that HDI is negatively correlated with nationalism level in a country as socio-economic developments and progressions might directly, or indirectly, influence the behaviour and decision-making of the government and political stakeholders.

Last but not least, DEMOC and XCONST do not appear to have any significance in these regressions. Nonetheless, this outcome can easily be explained as Guriev et al (2011) incorporate a different, and much larger, sample of countries in their time-series model covering a longer period.

D.1.2. Resource Nationalism Index Regressions- Ordered Logistic Model

In this section, the Resource Nationalism Index is being used as the dependent variable utilising the same explanatory variables, methodology and dataset as above. As it appears in Table 1.5, the results for Rule of Law remain significantly consistent with the previous findings. Both Rule of Law and HDI persist to be negatively correlated to the dependent variable. It is noteworthy that, when the Resource Nationalism Index is used as dependent

variable, the significance of HDI increases to 1% in all models. The HFCE seems to be losing significance when the Resource Nationalism Index is the dependent variable, but its negative correlation with resource nationalism remains constant.

Table 1.5: Summary of Panel Data Ordered Logistic Model for Resource Nationalism Index

Dependent Variable: Resource Nationalism Index					
VARIABLES	(1)	(2)	(3)	(4)	(5)
lRoL	-2.741***	-2.028***	-3.417***	-2.370***	-3.321***
	(0.693)	(1.485)	(1.122)	(0.876)	(1.023)
lHDI	6.043	-18.03***	-20.88***	-30.08***	-32.50***
	(4.429)	(7.145)	(7.546)	(11.17)	(11.66)
lHFCE	-0.0307	-0.0264	-0.0403	-0.0240	-0.0308
	(0.0258)	(0.0369)	(0.112)	(0.0315)	(0.0323)
lDEMOC		-0.630	-0.879	-0.656	-0.851
		(0.645)	(1.242)	(0.489)	(0.544)
lXCONST		0.743	1.067	0.691	0.993
		(0.882)	(0.957)	(0.832)	(0.908)
llGDP		1.372	3.296***	1.710**	3.211***
		(0.936)	(1.038)	(0.789)	(1.067)
llPopulation		-1.838	-3.023***	-1.890*	-2.902**
		(1.150)	(1.186)	(1.024)	(1.250)
llReserves		0.479	0.287	0.0433	-0.0468
		(2.685)	(1.779)	(0.396)	(0.409)
llProduction		1.160	1.193	1.109*	1.010
		(0.630)	(0.621)	(0.632)	(0.651)
Year Fixed Effects			✓		✓
llOilPrice		0.359		0.730	
		(0.606)		(0.578)	
Regional Fixed Effects				✓	✓
Observations	821	557	557	557	557
Number of ID	98	70	70	70	70

Standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Null hypothesis: error is normally distributed for all models. The increased missing values resulted from lack of data on oil production and reserves for some countries added to the already missing values on variables DEMOC and XCONST.

Furthermore, the lagged/logged GDP, Oil Production and Population show some significance of 1%, 10%, and 5% respectively. Regarding the Oil Production, the positive correlation between natural wealth and nationalism is not a surprise considering that resource nationalism became increasingly important mainly due to the fact that world's oil and gas production pattern is directly linked to specific geographical location. Nowadays, the most significant reserves can be found in regions characterised by an unstable political environment (Vrooman LLP, 2003).

The consistent positive coefficient of GDP (with 1% significance in models (3), (4) and (5)) is an interesting research outcome as, in the empirical resource curse literature, the negative correlation between resource endowments and GDP growth had remained for years one of the most robust findings. Nevertheless, the inclusion of welfare and development criteria could have affected this contradictory to the literature outcome as previous analysts have considered the effect of resources on economic growth mostly measured as the average increment in GDP over some period. The positive correlation between GDP and resource nationalism can be explained based on the theory that, in some countries, the oil and gas sectors make a disproportionately large contribution to economic activity, often accounting for between one-third and one-half of GDP. For example, in countries such as Nigeria or Saudi Arabia, where oil exports can make up for more than 50% of GDP, the nationalisation of oil resources becomes of paramount importance in economic terms.

Nonetheless, this finding is in line with the work of some researchers, like D.A. Jodice (1980) who supported that resource nationalism may occur more often when high GDP and satisfactory government capacity for the development of natural resources are in place.

D.2. Linear Regression Model (OLS) for Dummy and Resource Nationalism Index Dependent Variables

In this section, the same variables and five-model methodology are utilised through an ordinary least squares linear regression model to test both the dummy dependent variable as well as the Resource Nationalism Index.

D.2.1. Binary Nationalism Dummy Regressions- Linear Regression Model (OLS)

According to the regression results showed on Table 1.6, the Rule of Law and HFCE seem to be yet again negatively correlated with the phenomenon of nationalism in the oil industry while they appear to be statistically significant at 5% and 1% respectively in the last and more demanding model. The results are substantially consistent with the ordered logistic model regression presented in the previous section of the chapter, strengthening the argument that the main variables of interest, which are linked with social and institutional factors, are strongly correlated with the phenomenon of resource nationalism.

Although HDI does not get any significance in these regressions, the variable consists of an interesting outcome as its coefficient is not constant but changes from positive (in Models (1), (2) and (3)) to negative (Models (4) and (5)). However, a positive coefficient between the level of human development in a country and nationalism seems puzzling and unexpected given the fact that literature suggests that human development levels are decreased in countries with high oil dependency; a fact that has been shown in the results of the three more demanding models (negative coefficient of HDI). There can be, though, a possible explanation for this regression outcome as countries with high HDI score might tend to have high nationalism. However, this does not seem to be the case in this dataset as the top 10% of HDI highest scores goes to rich developed economies with no nationalism incidents in their oil sector. It might be possible to assume that in some cases, nationalism can improve their HDI levels.

It appears that oil producers with long-term established nationalised oil industries, like Kuwait, Qatar, Saudi Arabia, Russia and United Arab Emirates, tend to achieve higher HDI levels, while states with some nationalisation occurrence during the last approximately twenty years, like Libya, Poland, Estonia, Hungary, Brazil and Argentina, has also managed to improve their position in the Human Development Index. The issue of stability not only in an economic, political and social level, but also in the oil industry specifications and organisational structures appears to be key. It is likely that countries with long-term and well-established nationalisation structures in their oil industry might experience in the long-run positive outcomes and an increase in their HDI index score. On the other hand, in countries

with an unstable environment, nationalistic actions in an, otherwise, liberalised industry can be considered more the exception rather than the rule. As a result, these nationalistic actions can destabilise not only oil sector but, even further, the socio-political status quo leading to negative economic and development aftermaths which affect adversely HDI scores.

Table 1.6: Summary of OLS for Nationalism Dummy

Dependent Variable: Resource Nationalism Binary					
VARIABLES	(1)	(2)	(3)	(4)	(5)
lRoL	-0.148***	-0.176***	-0.199***	-0.149**	-0.160**
	(0.0398)	(0.0596)	(0.0615)	(0.0603)	(0.0627)
lHDI	0.122	0.140	0.111	-0.995	-0.947
	(0.286)	(0.577)	(0.578)	(0.629)	(0.623)
lHFCE	-0.00479***	-0.00412	-0.00407	-0.00455*	-0.00455*
	(0.00157)	(0.00255)	(0.00255)	(0.00251)	(0.00252)
lDEMOC		0.00682	0.00664	0.00281	0.00392
		(0.0263)	(0.0262)	(0.0258)	(0.0257)
lXCONST		-0.0318	-0.0328	-0.0372	-0.0381
		(0.0499)	(0.0497)	(0.0483)	(0.0480)
llGDP		0.0401	0.0677	0.0661	0.0738
		(0.0566)	(0.0657)	(0.0559)	(0.0644)
llPopulation		-0.0267	-0.0443	-0.0414	-0.0452
		(0.0578)	(0.0618)	(0.0593)	(0.0631)
llReserves		0.0177	0.0213	-0.00158	0.00158
		(0.0218)	(0.0217)	(0.0218)	(0.0217)
llProduction		0.0220	0.0110	0.0330	0.0264
		(0.0359)	(0.0362)	(0.0352)	(0.0357)
Time Fixed Effects			✓		✓
llOilPrice		-0.0497		-0.0157	
		(0.0478)		(0.0482)	
Regional Fixed Effects				✓	✓
Observations	821	557	557	557	557
Number of ID	98	70	70	70	70

Standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Null hypothesis: error is normally distributed for all models. The increased missing values resulted from lack of data on oil production and reserves for some countries added to the already missing values on variables DEMOC and XCONST.

D.2.2. Resource Nationalism Index Regressions- Linear Regression Model (OLS)

The findings of the OLS regressions are significantly consistent with the ones in the previous section where the panel data ordered logistic model was used with dependent variable the Resource Nationalism Index (see Table 1.5). As it appears in Table 1.7, the Rule of Law and HDI remain highly significant in almost all models, with both reaching 5% significance in the last and most demanding model. Both variables seem to be negatively correlated with the phenomenon of resource nationalism- an outcome also consistent with the regressions of the previous section of this chapter on Table 1.5. Interestingly, the significance of the Rule of Law decreases from 1% to 10% in the fourth model when the regional dummies are introduced. This result may be linked to the fact that different geographical regions tend to have similar values in the Rule of Law indicator. However, in the last model where time fixed effects are included, the variable regain a significance at 5%.

The negative correlation of HFCE with resource nationalism remains constant while, in the OLS regressions, the variable appears to gain some significance (at 5%) in the first model, having, though, a positive coefficient. The consistency of the results regarding the lagged/logged GDP and Oil Production (again in comparison with Table 1.5), with the significance to vary from 5% to 10%, strengthens the arguments made in the previous section. Specifically, regarding the Oil Production, the variable loses significance in the last model where both time fixed effects and regional dummies are included, retaining though its positive correlation.

This persistent result reinforces the popular argument in the literature that natural wealth and nationalism are positively correlated. In countries with higher production, resource nationalism is more possible to occur as especially developing countries may seek to gain greater control over their national assets and capture a much larger share of the industry's profits. This result is in line also with the consistent positive coefficient of GDP, as in countries where the oil and gas sector make a disproportionately large contribution to economic activity, nationalisation occurrence is more likely. Undoubtedly, however, high hydrocarbon production and its high share in a country's GDP are not the only factors which

may encourage the appearance of resource nationalism, as other conditions should also apply, such as socio-economic and political developments.

Table 1.7: Summary of OLS for Resource Nationalism Index

Dependent Variable: Resource Nationalism Index					
VARIABLES	(1)	(2)	(3)	(4)	(5)
lRoL	-0.287***	-0.226*	-0.335***	-0.219*	-0.298**
	(0.0797)	(0.123)	(0.127)	(0.123)	(0.128)
lHDI	0.224	-1.163	-1.056	-3.616***	-3.341**
	(0.565)	(1.215)	(1.205)	(1.329)	(1.325)
lHFCE	-0.00671**	-0.00177	-0.00191	-0.00273	-0.00293
	(0.00292)	(0.00449)	(0.00450)	(0.00445)	(0.00447)
lDEMOC		-0.0296	-0.0276	-0.0387	-0.0332
		(0.0467)	(0.0466)	(0.0464)	(0.0463)
lXCONST		0.00164	-0.0101	-0.00502	-0.0149
		(0.0878)	(0.0875)	(0.0863)	(0.0861)
llGDP		0.103	0.231*	0.172*	0.258**
		(0.101)	(0.121)	(0.101)	(0.120)
llPopulation		-0.198*	-0.264**	-0.237*	-0.277**
		(0.119)	(0.124)	(0.123)	(0.128)
llReserves		0.0214	0.0278	-0.00494	0.00177
		(0.0385)	(0.0383)	(0.0383)	(0.0383)
llProduction		0.139**	0.0995	0.141**	0.106
		(0.0693)	(0.0692)	(0.0687)	(0.0694)
Time Fixed Effects			✓		✓
llOilPrice		0.0665		0.127	
		(0.0781)		(0.0788)	
Regional Fixed Effects				✓	✓
Observations	821	557	557	557	557
Number of ID	98	70	70	70	70

Standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Null hypothesis: error is normally distributed for all models. The increased missing values resulted from lack of data on oil production and reserves for some countries added to the already missing values on variables DEMOC and XCONST.

E. Conclusion

In most of contemporary studies, the issue of resource nationalism and, more generally, the decision of a government regarding the way in which the natural resources will be developed, becomes closely related with both institutional and social indicators. Analysing the established economic determinants of resource nationalism in the oil industry and attempting to give an alternative explanation through the incorporation of social factors in the empirical analysis reveals a correlation between resource nationalism occurrence and low levels of institutional quality as well as social development indicators. By incorporating variables in the models not directly linked with economic activities such as Rule of Law, Human Development Index and Household Final Consumption expenditure, this work provides empirical evidence in the existing literature that the phenomenon of resource nationalism is also driven by social determinants. The political and socio-economic conditions in the country during the development of the oil and gas resources are two parameters often unnoticed which though could influence greatly the way a country will choose to develop its natural resources.

Specifically, this chapter explores the determinants of the phenomenon of resource nationalism in the oil and gas industry worldwide aiming to investigate in which countries and under which conditions, resource nationalism is more possible to occur. This work adds to the existing empirical literature on nationalisations in the oil and gas market by focusing not only on the economic indicators but also on the social determinants of the resource nationalism such as poverty, development and inequality. It also attempts to provide an alternative and broader definition and explanation of resource nationalism using components of the resource curse theory and institutional economics by incorporating variables in the models not directly linked with economic activities such as Rule of Law, Human Development Index and Household Final Consumption expenditure. Finally, Chapter 1 provides an empirical demonstration of the significance of the, often unnoticed by the current literature, political and socio-economic conditions which can greatly affect the way a country will select to develop its natural resources.

This chapter draws theoretical inspiration from resource nationalism theories concerned with the role of institutional quality while it also borrows social indicators used in the resource curse theory under the hypothesis that the quality of institutions along with several social features, such as poverty and inequality, can have a great effect on the possibility of resource nationalism occurrence and, as consequence, on the relationships between the host country and private operators. A central idea of this work is the creation of the binary dummy dependent variable by using cases of nationalisation to create a proxy measure for resource nationalism based on the work of S. Guriev et al. work (2011) and complemented by additional research. This chapter extends the time-period covered in S. Guriev et al. (2011), which reaches until 2006, and provides an additional examination of incidents of nationalism which was required to attempt conveying a broader definition of resource nationalism. We account for a wider spectrum of categories falling into the definition of 'nationalisations' (comparing to the definition provided by S. Guriev et al. (2011)) in order to present the two components P. Stevens assumes in one his studies (2008)- limitations in private oil companies' operations and greater national control on behalf of the government over oil resources development. The second dependent variable used in the models is the Resource Nationalism Index, which also consists of an attempt to categorise the governmental actions that lead to the nationalisation of the oil industry in a country during the period 1996-2013. S.J. Kobrin ((1979), (1980), (1984)) indicated that a government can take over the country's natural resources through regulation rather than direct acts of nationalisation (i.e. expropriation). This point has been taken into consideration for the categorisation process in the Index providing also an empirical representation of S.J. Kobrin's theoretical work.

Both in the ordered logistic regressions and the linear regression models, the three main variables of interest (Rule of Law, HDI and HFCE) are lagged with the rest of the independent variables being lagged/logged. The use of the lagged values is necessary to predict and identify the correlation between the dependent variable with the past values (lags) of the explanatory variables as the level of nationalism might heavily be determined by the past levels of the main variables of interest. Including lagged values of independent variables is an effort to address the issue of endogeneity and sort out the determinants of nationalism from another perspective; it is likely that past values of some independent variables are affecting today's values of nationalism. Using lags enables the incorporation of feedback over time based on theoretical considerations of how, and under which conditions, the

nationalism occurrence react to the shifting economic, political and social conditions in a country.

The Rule of Law is one of the most commonly used proxies in the literature attempting to measure directly the level of institutional quality in a country. The correlation between institutional quality and economic development is based on the argument that good quality institutions affect directly governance features which influence the overall economic performance of a nation. Essentially, the institutions can create the conditions under which a government will choose either to create an appropriate framework that enhances economic activity, or, to redistribute wealth to itself or its supporters. Without a doubt, the complex nature and structure of institutions make the assessment of institutional quality in practice significantly challenging.

Given the fact that resource nationalism is a political and institutional phenomenon to its core, the field of institutionalism theory is the one where a possible explanation can be found in questions related to the political drivers for the phenomenon. The Rule of Law is consistently significant in all regression models with a persistent negative coefficient indicating a strong negative correlation between institutional quality and nationalism occurrence in the oil and gas industry. The correlation between nationalism and institutions may be driven by reverse causality as, for instance, a shift towards a nationalised oil industry may concentrate so much power in the hands of the rulers to the point that causes the institutional quality to be undermined. However, the estimates in this work do not suffer from the reverse causality issue given the fact that the Rule of Law lagged variable represents a proxy for institutional quality which is based on political procedures which, apart from the fact that are measured in a rather objective way by the World Bank, are also unlikely to change dramatically within a few years' time.

To capture the broad concept of human development, the independent variable of HDI serves as a comprehensive proxy reflecting some key features of human development, poverty and inequality. As one of the main explanatory variables, the HDI appears to be significant in the last and most demanding model that includes time fixed effects and regional dummies in both the binary dummy and Resource Nationalism Index regressions. The HDI appears to have significance only in the OLS regressions where the Nationalism Dummy acts as the

dependent variable. Although the results are not definite, it is safe to assume that they reveal a strong indication that the level of human development in a country may be correlated with nationalism. In addition, we cannot overlook the fact that although there are theoretical arguments in the resource nationalism literature which suggest that human development levels are decreased in countries with high oil dependency, there are no empirical evidence to support this view. The top 10% of the HDI scores in all countries under consideration belongs to developed economies with no nationalism incidents in their oil sector during the period under study, such as Canada, Norway, Australia, Switzerland, Sweden, U.S and the U.K. Consequently, given these evidences, it is safe to assume that HDI is negatively correlated with nationalism level in a country as socio-economic developments and progressions in a society level might directly, or indirectly, influence the behaviour and decision-making of the government and political stakeholders.

However, the coefficient of HDI changes from negative to positive in the simpler models (Models (1) and (2))- an outcome that, in the first instance, seems puzzling and unexpected given the fact that literature suggests that human development levels are decreased in countries with high oil dependency. There can be, though, a possible explanation for this regression outcome as countries with high HDI score might tend to have higher nationalism. However, this does not seem to be the case in this dataset as the top 10% of HDI highest scores goes to rich developed economies with no nationalism incidents in their oil sector. It might be possible to assume that in some cases, nationalism can improve their HDI levels. It is likely that countries with long-term and well-established nationalisation structures in their oil industry to experience in the long-run positive outcomes and an increase in their HDI index score. On the other hand, in countries with an unstable environment where nationalistic actions seem to be the exception rather than the rule, resource nationalism incidents short occurrence may destabilise both the oil sector as well as the socio-political status quo leading to negative economic and development aftermaths.

Similarly, the HDI is unlikely to change dramatically over a few years' time. It is important to also bear in mind that since this variable was originally created in an attempt to link development issues with social progress, it is not surprising if countries with long-term established and well-functioning oil industries, even if the sector is nationalised, experience sustainable human development outcomes. If the oil sector is nationalised, the flow of oil

revenues directly in the government may give the means to achieve policy outcomes which prioritise and reinforce some significant dimensions of human development measured by HDI, such as health, education and GNI. At the same time, those countries might in fact become more socially stable over time as a function of rising oil revenues. Nevertheless, the HDI does not capture several components of human development, like gender inequalities and political participation.

In this work, the HFCE serves as a proxy for well-being and living conditions of the citizens in the countries under investigation given the fact that it encompasses the domestic costs for individual needs. The effect of oil and gas wealth to the consumption spending, an economic dimension directly linked with households' well-being, as well as the relation between household income and economic growth in oil states, were first appeared in the works of J.D. Hamilton (2009) and N.H. Barma et al (2012). The results add empirical evidence in the existing literature to support the importance of social indicators in the appearance of resource nationalism. Specifically, the consistent significance of HFCE with the persistent negative coefficient strengthens the assumption that nationalism is closely interrelated with social factors and, specifically, with the living standards in oil-led economies.

More specifically, the HFCE may reflect various socio-economic patterns as well as consumption habits which vary substantially among different countries. Therefore, since this variable reflects what people spend on goods and services to satisfy their needs and wants, household's economic well-being in each country can be expressed in terms of its access to goods and services. In fact, the countries in the sample with the lowest HFCE score are mainly Middle East and African countries which experience for the same period strong cases of nationalism in the oil industry. In addition, more than half of the top twenty countries with the lowest HFCE score have a nationalised oil industry. Hence, it appears, especially given the fact that the significance of the variable remains persistent in all models, that in countries with low HFCE (which corresponds to lower level of economic well-being), the probability of nationalism occurrence is higher. To put it in reverse, countries with nationalised oil industry and an economy heavily dependent on oil revenues experience poorer living standards.

Two variables which are often used as proxy for institutions, given the fact that they are related to two different aspects of institutional quality, are the XCONST (it measures institutional quality as the rules of the game understood from all parties) and the DEMOC (it includes the implicit incentives for any executive to regard highly social welfare by providing the citizens with procedures which allow them to remove any executive that does not perform effectively). Although many other data sources on institutional quality exist, S. Guriev et al. (2011) chose to incorporate these two Polity IV variables in their research mainly because they cover effectively the whole period they study. Since this work is partly based on S. Guriev et al. study (2011), the incorporation of DEMOC and XCONST was unavoidable in order to examine how these variables respond in a different dataset and be consistent with the literature already in place. Both DEMOC and XCONST do not appear to have any significance in any of the regression models. Nonetheless, this outcome can easily be explained as S. Guriev et al. (2011) incorporate a different, and much larger, sample of countries and, in their time-series model, they cover a longer period. In addition, the dependent variables of this work may be inspired by the work of S. Guriev et al. (2011), but since they incorporate an alternative and more extensive definition of the phenomenon of resource nationalism, similar results were not assured.

Finally, an interesting finding was the consistent positive coefficient of GDP as in the empirical resource curse literature, the negative correlation between resource endowments and GDP growth had remained for years one of the most robust findings. Nevertheless, the inclusion of welfare and development criteria in the models can significantly alter the results comparing to previous analysts who have considered the effect of resources on economic growth (measured as the average increment in GDP over some period). The positive correlation between GDP and resource nationalism can be explained based on the theory that, in some countries, the oil and gas sector make a disproportionately large contribution to economic activity, often accounting for between one-third and one-half of GDP. Additionally, this finding is in line with the work of D.A. Jodice (1980) who supported that resource nationalism may occur more often when high GDP and satisfactory government capacity for the development of natural resources are in place.

In this constantly growing field of research, several contemporary studies attempt to extend the relation between natural resource abundance and economic growth by accounting

important social indicators, such as social underdevelopment and welfare, as well as the effects of natural resources development on economic growth in relation to its dimensions on the human well-being. This work, by creating two new dependent variables, expands the work of S. Guriev et al. (2011) and provides a comprehensive framework to define more broadly the phenomenon of resource nationalism as a wider spectrum of categories falling into the definition of 'nationalisations' is offered. Chapter 1 also provides empirical evidence that the phenomenon of resource nationalism steams from not only economic but also social indicators, which were often overlooked by the literature, by incorporating variables linked with social factors and welfare.

Chapter 2

Economics and Regulation of Oil and Gas Pipeline Transportation Networks

A. Introduction

The second chapter of this thesis consists of an analysis of pipeline networks focusing on the economics of regulation and the issue of third party access to infrastructure under conditions of natural monopoly in the oil and gas upstream transportation market. It aims to explore how basic principles of regulation economics can be applied in the oil and gas transportation networks. The key economic and technical features of the oil and gas pipeline networks are presented as well as the market failures often arising in the upstream industry which may call for the appropriate regulatory tools. This chapter explores the peculiar characteristics of oil and gas transportation networks and discusses the advantages and disadvantages of the various regulatory tools employed to tackle economic inefficiencies arising in the upstream market.

Special focus is given to the economic and business impact of a potential government intervention in a critical industry for the economy. Although the existence of economies of scale and sunk costs in oil and gas transportation are the main reasons why monopoly is viewed as the most efficient market structure, unregulated procedures may substantially allow firms to exploit market power and raise prices that may negatively affect the efficiency of the industry. Consequently, and in combination with political and social pressures, a case may be made for government intervention in the market to protect public interest and ensure that high levels of output growth are achieved. Potential regulatory strategies, such as access regulation, vertical disintegration and government ownership, are discussed in this chapter.

Due to their distinguished technical characteristics, the different stages of oil and gas production can be subject to several different patterns of ownership with vertical integration to be a key element of the market structure. In addition, the oil and gas transportation sector has all the features of a natural monopoly; the presence of strong economies of scale, the high level of sunk costs and the structural barriers to entry. The owners of pipelines and other infrastructure, such as offshore processing platforms and onshore terminals, can have substantial local bargaining power, especially in relation to the negotiation of tariffs with prospective third-party users affecting adversely, as a result, new entries and exploration outcome. In the majority of regulated or semi-regulated oil and gas markets, terms and condition of access are determined by bilateral (or multilateral) agreements. The complexity in ownership structures, the vertical integration of the market, the longevity of infrastructure sunk investments and the uncertainty regarding the potential reserves during the exploration phase create inevitably inefficiencies in pricing (i.e. third-party access tariffs) and several contracting issues.

At this point, it is of paramount importance to highlight the distinction between 'distribution' and 'transportation' networks. As H. Cremer et al. (2003) state, the oil and gas pipeline systems have two main functions; upstream transportation (or 'transmission')- the transport of hydrocarbons within a region or across regions- and 'distribution'- the transport of hydrocarbons to end-users, a.k.a. households. Transportation pipelines, which are the focus of this work, are used for carrying crude oil and gas from the oil fields to refineries and petroleum products, like gasoline, from the refineries to tank farms. The oil is usually moved through the pipelines by pump stations along the pipeline. In many instances, the hydrocarbons produced require an extensive and elaborate pipeline transportation network to be carried long distance from producing regions to consumption areas. A distribution network, in general, is the system a company uses to get products from the producer to the consumer in a retail basis. For example, gas leaves the transportation (or transmission) system in higher pressure and enters the distribution networks where it is carried through a number of reducing pressure tiers until it is delivered to consumers. Therefore, although transportation and distribution networks are interconnected, they have different technical characteristics that clarify their distinct features. The first is more related to the upstream movement of the hydrocarbons while the second is linked with the downstream sector and the final delivery to the retail market and the consumers.

The first section of Chapter 2 consists of the main literature linked to the economics around oil and gas transportation. Key economic concepts of interest are presented, such as natural monopoly, vertical integration and other regulatory tools. A description of the oil and gas production stages follows in order to provide a background understanding to the reader of the main technical characteristics which contribute to the development of the distinguished market and ownership structures in the upstream oil and gas sector. The third part explores the natural monopoly characteristics of the pipeline networks as well as the vertical integration and the issue of bundling in the upstream transportation market. The fourth part discusses the economic inefficiencies arising due to the strong presence of natural monopoly in the pipeline networks aiming to identify the main reasons for the justification of government intervention in the market. Special attention is given to the price discrimination in third party access tariffs while the social and political concerns related to the monopolistic nature of transportation networks to also being taken into consideration. Discussion on different regulatory tools along with examples of successful regulatory regimes are included in the fifth section. Conclusions and discussion are following in the last section of the chapter summarising the main points and findings.

B. Literature Review

In economic theory, natural monopoly in capital-intensive industries, such as oil and gas, is linked essentially with the concept of economies of scale- a situation where one firm can produce the market's desirable output at a lower average cost comparing to two companies operating on a smaller scale (Depoorter, 1999). W. J. Baumol (1977) was the one who defined the modern approach of natural monopoly through the concept of subadditivity. J.C Bonbright (1961, pp. 11-17) supported that economies of scale is a *sufficient*, but not *necessary* condition for natural monopoly, while Kaysen & Turner (1960) suggested that economies of scale is a concept which depends on the appropriate definition of both the relevant product and, also, the geographic markets. They have also put emphasis to the importance of sunk costs at leading a market to monopoly outcomes. A.E. Kahn (1970) recognises both economies of scale and sunk costs (in industries where they are a large fraction of total costs) as market features which may lead to destructive competition that may result to a single firm, or a small number of firms, to dominate the market in the long run. Furthermore, he identifies the latent social costs of ''duplicating facilities'' where a leading single firm can have less costly production comparing to multiple firm production.

As defined by P.L. Joskow, sunk costs *''...are associated with investments made in long-lived physical or human assets whose value in alternative uses (i.e. to produce different products) or at different locations (when transportation costs are high) is lower than in its intended use*'' (Joskow, 2007, p. 20). In extreme cases, some investments associated sunk costs might be valueless in an alternative use. Sunk costs are usually considered a 'short-run' concept given the fact that the related assets eventually lose their value in their intended use and are ultimately retired. Nevertheless, in most cases, the assets which have high sunk costs, such as oil and gas pipelines, have longevity and, therefore, the 'short-run' can be quite long from an economic perspective. Considering the time dimension, suck costs carry a stream of potential benefits over some period. However, once the associated asset (i.e. a pipeline) concludes its commitments, it cannot be shifted to alternative uses especially without reducing its value from that in the intended use. Consequently, sunk costs contribute enormously in the distinction between incumbents and potential entrants in the market. Without sunk costs entry and exit from the market are almost costless making the difference between existing market participants and potential entrants meaningless.

Economies of scale and cost advantages have been identified by the literature as some of the basic structural barriers. If entering the market requires a high-fixed cost and/or high-scale technology, like in the case of oil and gas industry, the new entrant needs to start operating at a large volume to achieve reasonable cost per unit of output (Kwoka, June 2008).

Furthermore, absolute cost advantages involve differential access to inputs such as capital or location. Many authors, like K.R. Harrigan (1981) and J.J. Siegfried & L.B. Evans (1994), through their empirical investigation, emphasised the fact that the extensive need for capital is probably the most important exogenous barrier for capital-intensive industries. When it comes to the oil and gas infrastructure, potential new entrants are often discouraged by the pipelines' great sunk costs. It is a technical fact that a pipeline cannot be shifted to alternative uses especially without decreasing dramatically its value after its decommissioning. Furthermore, the longevity of pipeline projects transforms the traditionally 'short-run' concept of sunk costs to a 'long-run' one.

Issues linked with technological advantages have been placed in the core of entry barriers in the oil and gas market. More specifically, if the new entrants have access to the same technology as the incumbent monopolist, it should be expected that, over time, the incumbent's market power would be eroded and eventually eliminated. In the literature, there is the traditional argument that a monopoly firm will discourage technological progress due to the fact that technological developments might lead to more competitive outcomes. However, there are indications which contradict the traditional allegation that monopoly can be responsible for under-innovation. J.A. Schumpeter (1965) argued that market power is a necessary incentive for Research and Development (R&D) as monopolistic profits can actually act as an incentive for firms to undertake R&D activities. He supported that allocative inefficiency can boost innovation of new products and technologies contributing towards the overall economic growth and increase in the quality of living standards (Schumpeter, 1965). Moreover, through the presence of external forces, it is possible that an incumbent monopoly firm will feel pressured to invest in innovation in order to safeguard its position in the market (Posner, 1968). When the market is unregulated, and the entry is free, successful R&D in the field of transportation or production methods could represent a threat to the incumbents. Anticipating this potential threat could act as an incentive for the

incumbent which wants to maintain its dominant position in the market and develop its own R&D.

Utility industries in general are capital intensive with durable, immovable and long-lived assets and there are often demands for regulation regarding 'fair' access with 'non-exploitative' prices. However, regulatory measures can cause the investors to feel like they are limited in the prices they can charge after having made big sunk investments, especially in relation to transportation infrastructure. Hence, the regulator needs to take into consideration the fact that expectations on future pricing policy can critically affect the incentive to invest. Consequently, balancing the costs of regulation against the expected benefits is a requirement for any successful government regulatory intervention in the industry.

Historically, in most countries, public sector's involvement has been justified for various reasons such as the need for raising revenue, promoting technical progress, safeguarding national interests and security of supplies, tackling market failures and more. In recent times, the 'Chicago School' of economics criticised vigorously public sector's involvement arguing that the regulation put in place with the purpose of overcoming alleged market failure was often ill-directed and lead to a range of inefficiencies that cause worst failures than the ones intended to be fixed. This criticism initiated a debate in the economic literature focused on the issues around market failure as the primary justification for the regulation of utilities. Market failure theories describe situations where increasing, or even preserving, competition may not be sufficient in order to promote good economic performance (C. Jr. Wolf (1979), S.J. Nickell (1996), W.R. Keech et al. (2012)).

Regarding infrastructure regulation, the post-World War II debate on economic development was focused on over- and under-investment in infrastructure as a result of regulatory intervention. More recently, the general perception was that the privatisation and regulatory approaches of the early 1980s, especially in the UK and other Anglo-Saxon countries, favoured a short-term perspective while putting some insufficient emphasis on longer-term aspects like investment. M.G. Pollitt supports that incentive regulation and privatisation practices since 1979 have taken place ''*without a noticeable reduction in the quantity and quality of investment or of the associated services*'' (Pollitt, 2002, p. 93), concluding that the

‘‘*message from UK privatization of utilities is that well-regulated companies have no difficulty in financing their investment efficiently*’’ (Pollitt, 2002, p. 71).

C.v. Hirschhausen et al. (2004) support that the greater number of infrastructure sectors can be considered government-designed given the fact that governments have established public or nationalised private enterprises, denied or restricted access of competitors, imposed regulation, and, finally, opened some segments for competition. Until the 1990s, most European and Asian key infrastructures, such as telecommunications, electricity, railways, oil and gas pipelines etc., were owned by public entities Regulating private enterprises was traditionally the dominant organisational form of infrastructure in the U.S and it is today the prevalent model worldwide, especially regarding telecommunications and energy industries. C.v. Hirschhausen et al. (2004) note that according to the degree of competition, three main different forms of regulation may apply: (i) the regulation of a vertically integrated monopoly, (ii) the integrated monopoly with access regulation, and (iii) the vertically disintegrated monopoly.

(i) Regulation of a vertically integrated monopoly

It applies usually in industries such as energy, water supply and railways. Various regulatory instruments can be used like price cap, rate-of-return regulation and franchising regulatory techniques.

(ii) Access Regulation

Introducing competition in telecommunications and gas and electricity supply are the most representative examples of access regulation. This type of regulation, which is concerned mainly with access rights and their pricing, can reduce, in certain cases, the incumbent’s investment incentives, if the access charges allow only the recovery of incremental costs. Innovative investments can be especially at-risk due to the fact that access rights can decrease their expected ex-ante pay-off (C.v. Hirschhausen et al., 2004).

(iii) Vertical Disintegration

Vertical disintegration was used in the U.S to organise electricity industry (especially in California) and in the UK to regulate the electricity and railways sectors. In this type of regulation, the regulated firms are often part of the public sector while there are various forms of market structures- from unregulated enterprises (Californian and British electricity

generation) to regulated monopolies (franchises in the UK railways system) (C.v. Hirschhausen et al., 2004).

The issue of vertical integration is related to the structure of both firms and the market. R.H. Coase (1937) and O.E. Williamson (1975) were the first scholars who raised the discussion on vertical integration focusing on contractual relationships between firms at the different levels of the production process as well as the determinants of this type of internal organisation (Joskow, 1988). K. Monteverde & D. Teece (1982) studied empirically the structure of vertical relationships in automobile production stages in Ford and General Motors concluding that there is higher possibility internal production (vertical integration) to be preferred in industries where engineering applications are more important.

The public interest theory often views policy makers and politicians as benevolent designers of government institutions with the sole aim of correcting market failures and reducing market imperfections. However, economic theories of regulation introduced the role of special interest, including both the interest of regulators and firms (R.A. Posner (1974), W.A. Brock & S.P. Magee (1978), R.G. Noll & B.M. Onwer (1983), B.R. Weingast (1995)). Regulatory commissioners can have their own agendas and engage in 'opportunistic behaviour' linked to income opportunities and political aspirations beyond current responsibilities. For example, not just firms have access to unique information, but also regulatory agencies which can obtain confidential data from a wide range of sources. This kind of information can easily be misused or misinterpreted in order to benefit the regulator.

It is important to bear in mind that the effectiveness of each type of regulation is greatly linked with the unique conditions of each market. The need for regulation must be balanced against regulatory failure, but, to date, the literature has not provided a universal view of the appropriate balance between the two. The main features of an industry and the attributes of the selected type of regulation to be implemented significantly interact providing, thus, different outcomes in different circumstances. Therefore, each case should be examined separately for the appropriate regulatory mechanism to be determined.

Government intervention establishes, by definition, a system of rewards and penalties for private decision-makers. Clearly, regulation affects firms' behaviour, as evidenced by

traditional and more recent varieties of regulation being implemented. The key question is how to make the intervention productive while promoting the achievement of economic objectives at minimum cost. S.V. Berg (1998, p. 3) supported that there is a number of factors which can influence the decision between incentive, and/or, control and command regulation, such as:

i. Regulator's knowledge of utility operations
ii. Regulator's ability to monitor utility
iii. Administrative costs of regulation
iv. Motives of the utility
v. Political environment
vi. Capital market discipline, and,
vii. Underlying market structure

Modern regulation theory emphasises the limitations of all pricing rules, including cost of service, due to the asymmetric nature of information between the regulator and the regulated firm (Kemp & Phimister, July 2010). In theory, there are two different situations where information asymmetries appear as market failure; when lack of information on behalf of some market agents causes inefficient allocation of resources, and/or, when inequality of access to information enables one party to make profit at the expense of the other (Church & Ware, 2000). When information asymmetries arise, the market can become severely distorted since the 'buyer' and 'seller' do not necessarily base their business decision on the same set of information (Berg, 1998). Hence, market inefficiencies often occur in situations where one party has access to information that other parties do not have.

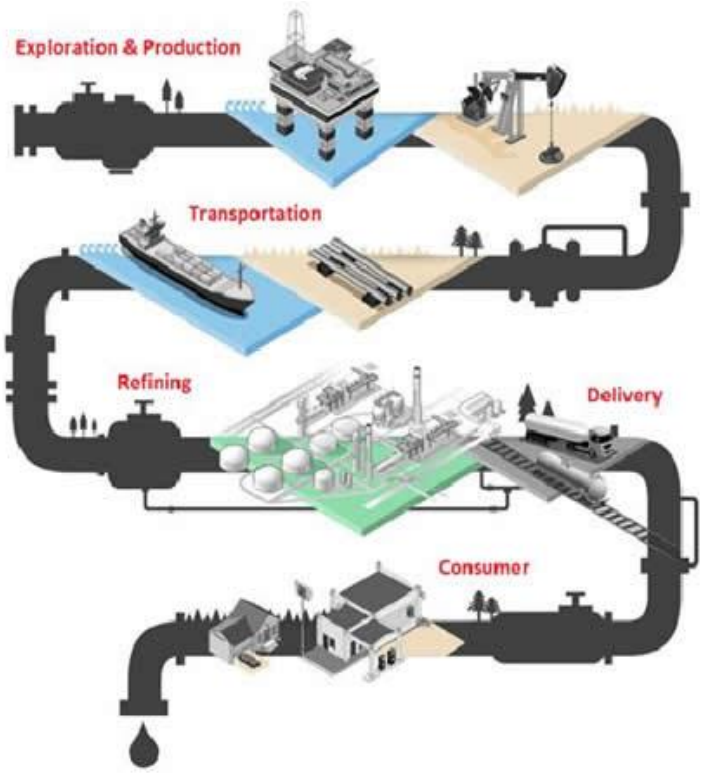
Finally, yet importantly, a major criticism of regulation practices is the two-dimensional principal-agent problem. Firstly, the agent (regulated enterprise) might be subject to substantially different motivations and incentives than the principal (government). As a result, the agent may pursue specific business objectives in a manner that is conflicting to the anticipation of the principal. Secondly, it is highly possible that the agent will usually possesses significantly more information regarding its costs, market conditions and customers than the principal ensuing, thus, to information asymmetry issues that can be used to the

advantage of the agent to manipulate outcomes (Church & Ware, 2000). The debate on the principal-agent problem concluded that the outcomes of regulation could be different to what it was expected by the regulator often resulting, thus, to market inefficiencies.

C. Oil and Gas Industry Vertical Structure of Production Stages

The various oil and gas facilities and systems are broadly defined into five categories based on their utilisation in the oil and gas production stream (see Figure 2.1); exploration (takes place prior to the decision for field development), production (for production and stabilisation of oil and gas), upstream transportation (transportation of hydrocarbons onshore or to terminal for onshore fields, initial offshore processing), refining (condensates' transformation into marketable products), and, distribution (distribution of hydrocarbons and petrochemicals to end-consumers) (Devold, 2013).

Figure 2.1: Oil and Gas Production Stages Schematic

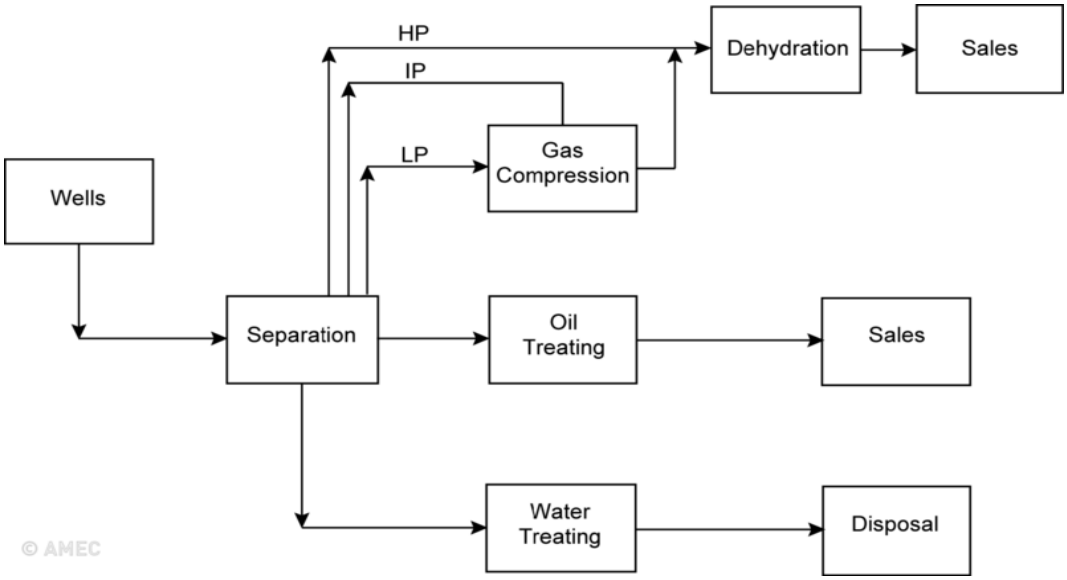


Source: Climate Institute (2012)

In the offshore upstream sector, the expected field life, reservoir fluid type, location and flow rate are some of the factors which affect the selection of the appropriate production facility (fixed, floating or subsea) for an oil and gas development. In general, a combination of subsea completions, manifolds and pipelines tying the development back to a surface facility (or host facility) for processing and onshore transportation purposes is used in smaller fields

as well as smaller parts of the offshore reservoir which are not accessible by direct drilling from the main facility's location (DTI, 2001).

Figure 2.2: Oil Facility Schematic



Source: Society of Petroleum Engineers (2016)

Oil and gas wells produce a mixture of oil, condensate and/or hydrocarbon gas along with water[19] and solids[20]. As Figure 2.2 shows, the purpose of oil and gas processing stage is to remove, separate and transform these various components to make the hydrocarbons ready for sale including High (HP), Intermediate (IP) and Low Pressure (LP) procedures. According to the schematic above (Figure 2.2), an oilfield facility is the equipment between the wells and the pipeline, or any other transportation system, where the initial separation of the different components takes place (SPE, 2016). It is important to highlight the fact that an oilfield facility, which provides usually some initial processing, is not the same as a refinery mainly because the initial processing does not consist of chemical reactions to make new molecules. The production process is identical for both onshore and offshore developments with the initial processing, though, in the case of an offshore field, to take usually place in offshore facilities. More specifically, in basins with well-established offshore production, the

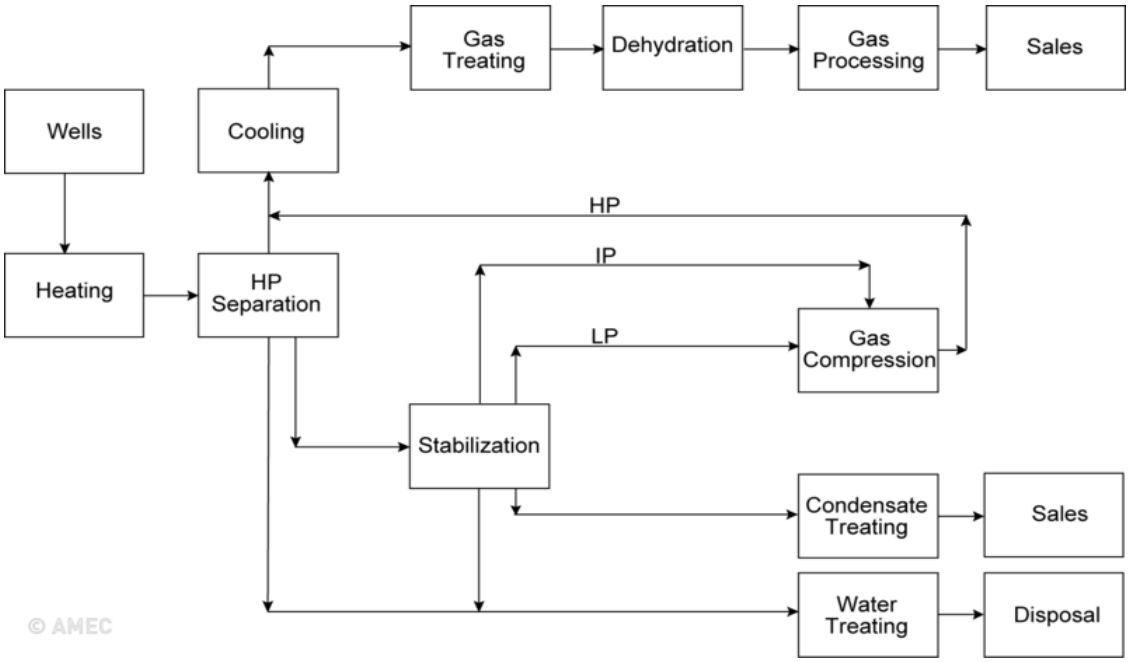
[19] Water mixed with dissolved minerals, usually including a large amount of salt and/or other gases like nitrogen, carbon dioxide (CO_2), and possibly hydrogen sulfide (H_2S) (SPE, 2016).

[20] Solids including sand from the reservoir, dirt, scale, and corrosion products from the tubing (SPE, 2016).

type and proximity of existing infrastructure drives the split between offshore and onshore processing (Bothamley, 2004)- with offshore processing's main function to be preparing the hydrocarbons for the final processing in the onshore refinery.

Therefore, the crude oil is not processed to the final sales specifications in offshore facilities but onshore. Nevertheless, sale specifications can be met when it comes to fields which offload crude to tankers to transport the oil directly to onshore refineries; advanced processing facilities often exist on Floating Production, Storage, and Offloading vessels (FPSO).

Figure 2.3: Gas Facility Schematic



Source: Society of Petroleum Engineers (2016)

The gas facilities are very similar with the oil facilities (both onshore and offshore) with some stages of production and initial separation for offshore fields to often coexist in the same offshore platform. As Figure 2.3 shows, the main difference between oil and natural gas facilities is the heating and cooling processes which take place before and after the initial separation respectively. Natural gas also requires facilities for stabilisation (could be done offshore) as well as compression and condensate treating (taking place onshore) before the gas is ready for sale.

Currently, most of oil produced worldwide is transported by pipelines, with the remained exported by tanker. In areas with well-developed export pipeline infrastructure, the production from small new developments can be expected to be transported via existing facilities. In the case of offshore tanker offloading, both oil storage and offloading facilities are required. However, if there is no sufficient storage on the main facility, a separate storage facility can be permanently anchored in the field (DTI, 2001). Nevertheless, in the case that storage facility's design does not allow the tanker to safely approach, an alternative mooring can be in safe distance (up to several kilometres away) (DTI, 2001). Then, the oil quantities are transported by short infield pipelines from the host facility to the storage and/or offloading units (DTI, 2001).

As mentioned above, crude oil volumes produced offshore are usually transported from platforms via subsea pipelines. The offshore transportation pipeline can be the most expensive element of an offshore installation, sometimes exceeding the cost of one or more platforms, depending on (SPE, 2016):

- Pipe diameter
- Water depth
- Length
- Need (or not) for burial
- Need (or not) for cathodic protection and coatings
- Various construction considerations

Despite, though, the high capital cost required, piping is considered the safest and more economical way of transportation of crude oil from offshore installations to land sites.

In the case of geographically remote oil fields with low production rates and/or short lifespan, the construction of a pipeline cannot often be economically justified. An alternative transportation way is the oil tankers, which require a loading system installed 1 to 2 miles from the platform, such as a moored buoy or articulated loading tower with a seafloor pipeline to connect the loading facility during the transfer of oil (SPE, 2016). Nonetheless, pipelines are still viewed as the preferred option in most basins as taker-loading operations hold two important disadvantages comparing to piping; they are sensitive to weather

conditions, and, they need a separate facility for oil storage (SPE, 2016). Regarding gas reserves, if the production of a well is mainly oil, the gas may be regarded as by-product and be disposed in the most economical method. If the economics of the field allow it, the transportation of the gas produced through pipelines is considered again the preferred option.

The primary function of process equipment, whether on a platform or on land-based facilities, is to stabilise produced fluids and prepare them for shipping or disposal (SPE, 2016). After separation, the various fluids are measured in order to either be shipped onshore, injected back into the reservoir, or alternatively, flared. Regarding the process equipment[21], there are no significant differences between the equipment installed on a platform and those installed on land. However, when possible in offshore operations, consideration is given to using vessels and machinery which are compact and lightweight (SPE, 2016).

C.1. Oil and gas infrastructure; Ownership structures

Potential issues regarding contractual agreements and third-party access to transportation and processing infrastructure arise when patterns of ownership imply an, at least partial, separation of ownership between owners of infrastructure and those developing new fields. In such cases, the owners of pipelines and other infrastructure facilities, such as processing platforms and terminals, can have substantial local bargaining power, especially in relation to the negotiations of tariffs with prospective third-party users.

In the majority of regulated or semi-regulated oil and gas markets where terms and condition of access are determined by bilateral (or multilateral) agreements, a user shall have the right to use a facility on objective and non-discriminatory terms without the infrastructure owners granting one or more companies an unfair advantage. The term ‘non-discriminatory’ relates to both the terms as well as the rates included in the agreements and, as the name suggests, this commitment requires that licensors treat each individual licensee in a similar manner. This does not mean that the rates and payment terms cannot change. The ‘non-

[21] Oil and gas separators, gas scrubbers, free-water knockouts, compressors, pumps, etc.

discriminatory' obligation enables to maintain respect to existing competitors and to ensure that potential new entrants are free to enter the market on the same basis.

The different stages of oil and gas production, as presented above, can be subject to several different patterns of ownership. Both onshore and offshore developments follow a similar pattern with offshore transportation networks, though, to be subject to even higher complexity. Specifically, there are three main steps in order to get the hydrocarbons onshore; the pipeline network, the offshore processing facilities and the onshore terminal where the final processing is taking place. For onshore, the steps are the same with the difference being that instead of the onshore terminal, the final destination is the refinery (practically these two terms represent in general the same facilities). These steps are subjects to three main ownership patterns which are taken into consideration for this work;

1. Different owners for the pipelines, initial processing (onshore or offshore) and terminal (or refinery)
2. One owner for all the three production stages
3. One owner for both the transportation pipeline network and the processing facilities, and a different owner for the terminal (or refinery).

It is important to highlight the fact that, in the above-mentioned ownership alternatives, when referring to ''one owner'' or ''different owners'' includes also any joint ventures (JVs). It is common to find multiparty ownership agreements in offshore platforms, infrastructure facilities and, especially, onshore terminals. The last case of an incumbent owning the pipeline network along with the offshore processing while the terminal is under different ownership is probably the most common scenario. Most frequently, the infrastructure owners have also their own production fields in the same geographical area transporting, thus, their own hydrocarbons through the same infrastructure facilities. Usually, all infrastructure facilities in a basin are initially created by one firm (often a big multinational with extended funds) after the discovery of a reserve big enough to support financially the construction of offshore pipelines and processing facilities. The smaller fields developed later in the same geographical area and in close proximity to the already existing infrastructure are connected through tied-backs to the 'original field's transportation and processing facilities as it would not be economically feasible to create their own.

D. The Economics of Oil and Gas Transportation Networks

D.1. The natural monopoly characteristics of the pipeline networks

Natural monopoly is one of the most challenging policy dilemmas. Classic economic theory of natural monopoly suggests that production efficiency can be better satisfied if a single firm supplies the market. However, the absence of competition may allow the incumbent firm to exploit its monopolistic power to achieve higher profit maximisation creating, thus, inefficiencies in the market. Industries such as electricity, water supply and oil and gas are often cited as examples of experiencing natural monopoly in some of the production stages. In these markets, a single firm can produce the socially desirable market outcome at a lower unit cost than two, or more, firms (Depoorter, 1999). Therefore, a competitive market is generally deemed as socially undesirable given the fact that many operating firms would create an unnecessary duplication of capital equipment.

The oil and gas transportation stage has all the features of natural monopoly. The presence of economies of scale is strong and competition does not easily arise as the duplication of infrastructure facilities is simply unnecessary. In addition, the pipeline infrastructure is characterised by high level of sunk costs while potential investors are dealing with structural barriers to entry as going into the market requires high-fixed costs and high-scale technology while the extensive need for capital is considered to be the most important exogenous barrier. It is important to highlight the fact that, in oil and gas sector, most of the transportation and storage costs are fixed while the variable costs for maintenance and operation are relatively low compared to the total capital costs of the investment. The use of an oil and gas pipeline, named 'load factor'[22], does not affect significantly the total cost of transportation. Given the fact that the capital investment is fixed, when the volume of hydrocarbons transported through the pipeline changes, the operational cost of the facility remains mostly unaffected as a higher or lower load factor can alter the per unit transportation cost but has no, or little, effect to the total cost. The International Energy Agency (IEA) states that "*operation and*

[22] The percentage use of capacity, relative to maximum, or peak capacity (Austvik , 2001).

maintenance cost of pipelines, excluding compressors are fixed costs; estimates for them as an annual proportion of construction costs are in the region of 2 % onshore and 1 % offshore'' (IEA, 1994, p. 49), while the estimated maintenance costs for compressor stations "*run about 3-6 % of investment cost per year of operation at a relatively high load factor*'' (IEA, 1994, p. 49).

Oil and gas industry has been used by the economic literature as a classic example of economies of scale (A.E. Kahn (1970), H. Cremer et al. (2003), P.L. Joskow (2007)) as the required unit production costs are significantly high and the average costs decline with every unit produced. The presence of strong economies of scale is one of the main reasons why competition is usually deemed undesirable for the oil and gas industry. Monopoly has often been viewed as the most efficient market structure partly due to the need of avoiding needless duplication of capital equipment. It would be inefficient for both the firms as well as the market, if two oil companies were constructing two different pipelines in the same geographical region to transport the hydrocarbons produced from the platforms to the terminal.

Transportation infrastructures, such as pipelines, exhibit economies of scale mainly because of the large fixed cost component on their total costs. Both the cost of the bare pipe and the oil, or gas, throughput[23] influences the overall capital costs of the pipeline network. Various technical factors determine the extent of economies of scale. For example, seeking to increase the pipeline's throughput causes an increase in the cost of the pipe (from construction to daily operational costs), decreasing, though, the cost of compression. Additionally, as H. Cremer et al. (2003) state, considering the fact that oil and gas transportation facilities provide a range of services apart from transportation, such as storage facilities, pipeline networks are likely to also exhibit economies of scope.

Under these conditions, potential entrants would have to be certain that, if they entered the market, the post-entry competitive equilibrium would generate enough revenues to cover the entrant's total costs. Given the relatively low global oil price as well as the large economies of scale and high sunk costs, entry in the oil and gas infrastructure market is impeded as

[23] The quantity of hydrocarbons which can be transferred in a unit of time.

potential entrants often anticipate that their profits post-entry will be negative, or very low. The anticipation of negative post-entry profits can be considered as a contributing factor to the barriers of entry as it affects adversely new entrants' incentive to join the market. As a result, the incumbent does not really face the danger of new entrants and, thus, can exercise fully its monopolist power.

D.2. Vertical integration with processing facilities

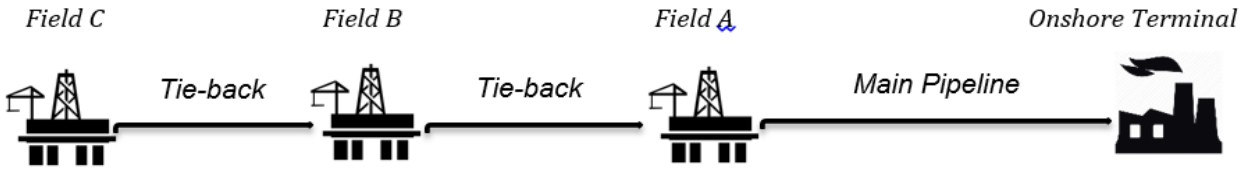
The effects of vertical integration in the oil and gas industry can become easily apparent mainly since the production stages are straightforwardly differentiated. Vertical integration can lead to barriers of entry and excess profits on behalf of the monopolist. The incumbent can increase the capital requirements for new entrants by integrating into an additional stage of production. In the oil and gas transportation networks, the market is often vertically integrated, or in other words, one firm is being involved in two or more stages of production process normally operated by separate firms.

The big sunk investments (or physical asset specificity) enhance vertical integration. In addition, the complex ownership patterns and uncertainty regarding the exploration outcome make the creation of full contingent contracts in the oil and gas industry unfeasible. As a result, 'market contracts' tend to be incomplete revealing several ex-post performance problems and enhance the opportunistic behaviour of incumbents in an industry where natural monopoly structures dominate. This appropriation of wealth from incumbents can take many forms such as, for example, creating deliberately additional offshore processing facilities to generate additional profit without, though, affecting necessarily the supply and demand for the final consumers. It is worth mentioning that processing also experiences strong economies of scale. In an industry with long-lived assets, like oil and gas, setting prices for deliveries in advance over the long period of an oil field's lifespan is challenging and it can possibly lead to ex-post adaptation problems. Essentially, the main issue formed by the presence of vertical integration is the fact that it allows the market power of a natural monopoly in transportation stage to extend to other stages of production which could have been potentially more competitive. Hence, because of vertical integration, a more competitive

in its core production stage may become monopolistic allowing, consequently, the incumbent to extend her monopolistic power to an originally competitive market.

However, even though vertical integration can lead to barriers to entry and excess profits on behalf of the monopolist, there may be efficiency gains arising since it can prevent double marginalisation. For instance, in offshore oil and gas transportation market, it is not rare two different monopolists to often co-exist in the same geographical area; one controlling the pipeline and the other the offshore processing charging different prices for each service, or, controlling two different but interlinked pipelines.

Figure 2.4: Offshore Transportation Schematic



Two different firms with respective market powers can apply their own mark-ups (which is the difference between the cost of service and its selling price) in tariffs for third party access. However, since individually charged monopolistic prices are above marginal cost, a deadweight loss is induced twice. As a result, the fields using the tieback pipeline and the main pipeline owned by the two monopolies pay a tariff higher than the marginal cost twice. For example, in the schematic above (Figure 2.4), if Field A has the monopoly for the main pipeline leading onshore and Field B controls the tie-back pipelines as well as offshore processing, then the Field C will end up paying a monopolistic tariff twice. Specifically, Field B pays to Field A the monopolistic tariff price for the transportation of hydrocarbons produced to the onshore terminal which is above the marginal cost of Field A. As a result, Field C will pay to Field B a price which will essentially include not only the costs of Field B but also the monopoly price of Field A. Vertical integration prevents the problem of double marginalisation as it is considered economically more desirable for one monopoly to exist (charging just one monopolistic price for all services) instead of two (charging two separate tariffs higher than the marginal cost).

E. The Case for Government Intervention

Although under conditions of natural monopoly the market can be best served by one single firm, monopolistic industries, such as oil and gas, are often subject to various types of regulation. Public interest theory provides several explanations for government intervention aiming to correct market imperfections and inefficiencies. As mentioned in previous section of this chapter, looking closely at the history of infrastructure, most infrastructure sectors including oil and gas are originally designed by the government which has established a public company and enforced the appropriate regulation to open some segments of the industry to all market participants. Nowadays, this model of industrial organisation still applies in several segments of the transportation infrastructure, such as roads and airports. The government apply strict regulation on private enterprises is the dominant form of organisational structure in telecommunications and energy, especially electricity and gas.

Public intervention in the operation of transport utilities has been justified based on the government's motivation to repair market failures created by monopolistic private companies. Inefficient operation due to the opportunistic behaviour of dominant enterprises along with the importance of oil and gas as an energy source, environmental issues, reduced dependency on imports, rent distribution and concerns over the economic activity, were some of the justifications for government intervention. As a result, we often observe governments to implement entry, price and supporting-related regulation to improve the performance of the industry that would otherwise be associated with unregulated market allocations (Joskow, 2007).

The phenomenon of 'Domino Effect' and the decreased exploration rates have been identified as the main economic inefficiencies which arise due to the strong presence of natural monopoly and high pricing in third party access tariffs. In this section of the chapter, these two market inefficiencies are critically discussed and evaluated as whether they could act as a reason for the government to intervene. In addition, the 'common carrier' regulation is presented along with a comparison between the inefficiencies in a discriminatory and a non-discriminatory monopoly. Finally, the three core reasons calling for regulation in oil and gas transportation networks which are linked with social and political concerns are analysed; the cost to the overall economy, the effect to the supply chain and the safety of supplies.

E.1. Economic inefficiencies due to natural monopoly and high pricing in pipeline networks

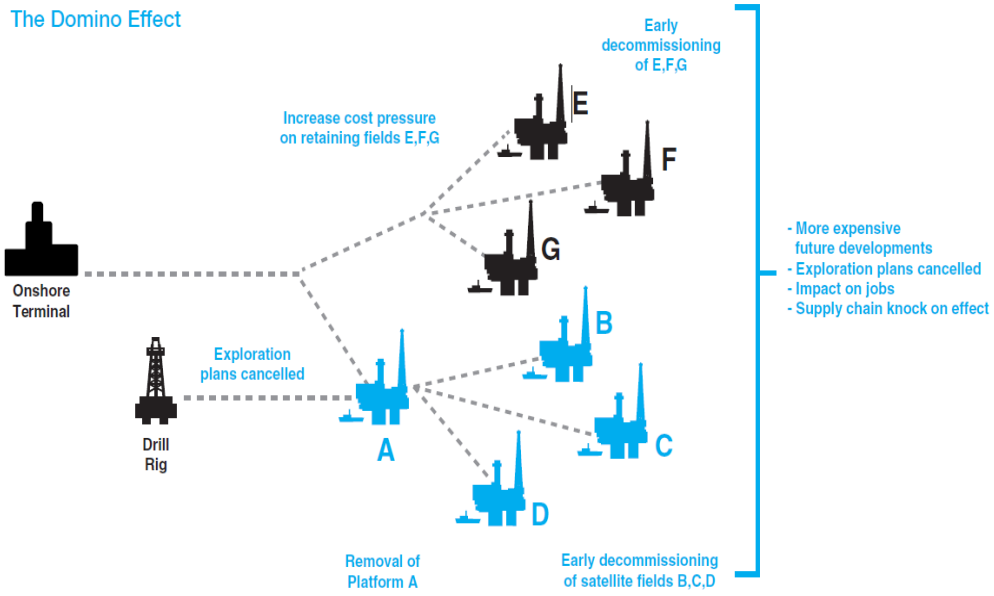
In the oil and gas industry, natural monopoly along with unregulated procedures may substantially allow firms to exploit market power and raise prices. The two main economic inefficiencies created due to the presence of natural monopoly and the high prices set by the incumbent in the third-party access tariffs are the Domino Effect and the decreased exploration rates.

The premature decommissioning of critical infrastructure and related hubs forces key fields to prematurely shut down as shared infrastructure costs are allocated across fewer platforms increasing, thus, the unit operating costs (Oil&Gas UK, 2016a). This phenomenon is called 'Domino Effect'. The scenario of Domino Effect is related mainly with the offshore upstream transportation sector and indicates that the negative profitability in some fields could lead to the early decommissioning of critical infrastructure with the potential consequence of the shutdown of whole areas in a basin leaving significant recoverable resources unexploited. Due to the high degree of interconnection on the infrastructure facilities in the offshore oil and gas upstream sector, many companies (especially the smaller ones) rely heavily on shared infrastructure to transport hydrocarbons from fields to the onshore terminal. If major pipeline systems are decommissioned, the owners of user-fields are left with some economically challenging options. Even if the infrastructure is not decommissioned, given the fact that several pipelines operate under sharing agreement status (where all parties share the fixed costs of the asset), the cessation of one or more fields in the area will leave the rest of the parties sharing all the operational costs for both the pipelines and the processing facilities. When it comes to small size accumulations with high operating production costs, the increased transportation cost pressure will shorten their economic lives and force them to shut down.

Specifically, as Figure 2.5 represents, a potential early decommissioning of Field A will cause a premature decommissioning of Fields B, C and D given the fact that these fields are connected through a tieback to Field A which enables them to reach the main pipeline system and transport the hydrocarbons produced onshore. At the same time, the early

decommissioning of Platform A and its satellite Fields (B, C and D) will increase the cost pressure to the retaining Fields E, F and G, which share the same main pipeline system leading to the terminal. As a result, these fields might be also forced to be early decommissioned while, under these conditions, any exploration plans in the area will be cancelled due to the lack of operating infrastructure facilities. Hence, the consequences of the Domino Effect can spread to the fields that are both directly, as well as indirectly, linked to the prematurely decommissioned field (Field A).

Figure 2.5: The Domino Effect- Schematic



Source: OGA, pg. 9 (September 2014)

Nevertheless, from an efficiency point of view, if the operating costs of a pipeline is not, at least marginally, covered for a long period of time by the field's production revenue, it is anticipated by a profit maximising firm to cease production and abandon the development. Firms, as economic agents with a clear profit-maximisation orientation, cannot be expected to maintain assets, which are occurring losses, or they are not as profitable as they used to be. Consequently, one could argue that the Domino Effect is not essentially an economic consideration from a business perspective, as it is common that the no-profitable fields and related infrastructure facilities will shut down and eventually be decommissioned. Business efficiency rational would not allow sustaining fields and infrastructure assets which are economically non-feasible and unable to cover their costs.

A government, nonetheless, might have alternative motives linked to the overall economy to intervene and prevent an extensive Domino Effect from occurring. The oil and gas industry and its infrastructure are directly associated, and often considered a prerequisite, to economic development. At the same time, regulatory innovation could be equally desired and useful as technological innovation. Low investment rates (incapability of attracting new entrants to the market) and reduced tax revenues (including royalties) can have a great negative impact in the State's budget- a situation which will motivate the government to introduce regulatory measures to enable the industry reaching its maximum potential.

The distinct economic market features of oil and gas upstream transportation stage also contribute to the arising issue (especially in mature basins around the globe) of uncertainty in the exploration phase and decreasing exploration activity. Due to the low global oil price, the major oil and gas companies appear to be generally risk averse especially when it comes to exploration activity. As a result, they tend to prefer conducting exploration activities in regions with proven potential and low operating costs avoiding older basins or areas with complex regulatory and/or transportation infrastructure regime. Wood Mackenzie's recent research reveals that majors are cutting investment in exploration activities more drastically than other sectors (Wood Mackenzie, 2016). In general, the decision-making process during and after any exploration activity is quite complex involving several cost factors that should be taking into consideration.

Potential new field owners are reluctant to be bind to transportation, storage or processing contracts ex ante without knowing first the exact production that can be brought on-stream. From the other hand, the infrastructure owners, having made big sunk investments in long-lived assets, are looking to extract as much profit as possible, especially given the monopoly power they hold in their respective geographical areas. If there is no clear regulatory framework in place to set the conditions of the negotiation process (or even set the tariffs) between third parties seeking access to transportation and infrastructure owners, it is not rare that negotiations fail. Various contracting issues, essentially related to transaction costs, arise ex-post exploration activities and the frictions created in the negotiations due to the conflicted interests of the parties involved often lead to malfunctions, delays in operations or even breakdown of exploration contracts.

The complex multi-party negotiations for transportation tariffs and uncertainty regarding the exploration outcome make the creation of full contingent contracts in the oil and gas industry unfeasible. As a result, 'market contracts' tend to be incomplete revealing several ex-post performance problems and enhance the opportunistic behaviour of incumbents in an industry where natural monopoly structures dominate. This appropriation of wealth from incumbents can take many forms, such as overcharging the access to the pipeline. Potential new entrants, or even existing market participants, are reluctant to undertake exploration activities as they anticipate that they will pay high transportation prices due to the monopolistic nature of the market. Because of the high prices (anticipated or actual), exploration activities are lacking efficiency given the fact that the exploration costs are expected to exceed the exploration revenues. In an industry with long-lived assets, like oil and gas, setting prices for deliveries in advance over the long period of an oil field's lifespan is challenging and it can possibly lead to ex-post adaptation problems. Potential new entrants and existing market participants have little, or no, incentives to initiate exploration activities resulting the lack of utilisation of the remaining oil and gas resources. The uncertainty in the exploration phase regarding the quantity and quality of future discoveries does not allow field owners to commit at the present for the future prices especially in the case that they anticipate higher pricing due to the presence of natural monopoly in the market.

As one of the main considerations for new potential entrants is the high transportation prices, access rights and tariff pricing under the presence of a strong regional natural monopoly often discourages new participants to proceed with exploration operations to enter the market. Consequently, and in combination with other factors, such as high capital costs, the market is no longer attractive to new entries resulting to low exploration and investment rates. The low incentive to invest in exploration activities and the development of new accumulations may, thus, cause the early decommissioning of older fields due to reduced revenues following the decreased business activity. Therefore, high pricing can be inefficient especially for older basins that need a boost to the economic activity to survive longer and reach their maximum potential. The government might want to intervene to regulate the pricing in access to critical infrastructure and improve exploration activity rates, attract new entrants and maintain the significant revenue stream coming from oil and gas industry to the state budget.

E.2. Price discrimination as justification for government intervention

Considering the high investment and capital costs of replicating existing infrastructure, the carriers (or owners of infrastructure facilities) often find themselves gaining the bargaining advantage in the negotiations with the shippers (owners of fields seeking access to infrastructure) which allowed them to charge disproportionately high fees. According to classic economic theory on production efficiency, local natural monopoly in industries with high fixed investment costs and low marginal cost, such as infrastructure, are more efficient given the fact that it is more economically viable for one single producer to provide the product or services rather than several competitive firms (Kemp & Phimister, July 2010). However, price discrimination in access to infrastructure networks can create economic inefficiencies in a completely unregulated market. The efficiency of market outcomes and the pricing of access to infrastructure can become even more complicated in the case where there is, even at least partial, vertical integration (e.g., where the infrastructure owner is also one of the potential users of this infrastructure).

Higher prices for the use of infrastructure facilities increase the cost pressure to the retaining fields, especially in smaller accumulations with limited production capacity and for which building their own transportation or processing facilities is economically non-viable. In case the owners of these fields feel that they are discriminated, they might be forced to enter a long negotiation process resulting delays in field development which often lead to significant loss of value. In some instances, price discrimination to third party access to infrastructure is directly linked with the issue of negative profitability of smaller new fields which causes early decommissioning as well as decreased exploration rates.

There are, thus, regulatory approaches which support a non-discriminatory monopoly where the infrastructure owners charge the same price for third party access to pipelines and processing facilities to each and every field in their respective geographical area. The most well-known regulatory approach is the ‘common carrier’. The common carrier concept has its roots on the English common law concept of ‘public callings’ that was developed during medieval times. The concept has been refined over the years and used as a basis for determining when the government regulatory intervention is justifiable. In the medieval times, courts classified enterprises as ‘public callings’ when they were virtual monopolies

(Jamison & Hauge, 2014). A characteristic example would be the local inns which were used to fall under the 'public calling' status given the fact that each village had but one, and if the enterprise refused someone service, the person would have to travel several additional miles in dangerous sometimes conditions in order to seek another accommodation facility. Likewise, and similarly to the contemporary use of this regulatory status, enterprises which carried goods between villages were 'public callings', called 'common carriers', and were obligated to provide service and charge a standard price in order not to exploit their local monopolistic power (Jamison & Hauge, 2014). These principles became embedded in the U.S law regarding 'common carriers' on railroad in the 1800s and, more recently, to the oil and gas industry for pipelines transporting crude oil, carbon dioxide, hydrogen and coal[24].

Governments use this type of regulation in situations where the abuse of monopolistic power by a firm is considered to be related with social goals having an effect to the public. The 'common carrier' gives to the Regulator the right to control the degree of price or service discrimination while service quality is also regulated. The regulation of prices under 'common carrier' usually includes mechanisms of ensuring that utilities have the opportunity to recover costs. However, in certain occasions, network access prices were regulated to be below the economic cost with the justification of social benefit advancement or promotion of universal access (Jamison & Hauge, 2014). 'Common carrier' regulation was developed under the justification of overall economic performance and in an effort to prevent firms engaging in extensive market discrimination.

Nonetheless, when it comes to oil and gas transportation sector, price discrimination could improve the economic efficiency of a basin. Specifically, slightly higher tariff prices can enhance the revenue stream of fields which operate on the margin and own at the same time the hosting facilities. Higher tariffs applied in selected neighbouring fields for the use of transportation and processing facilities will enable bigger fields with marginal revenues to stay in business longer as, otherwise, they would have made a loss. Keeping fields that own host facilities in business implies that premature decommissioning can be postponed enabling smaller fields to continue with production. Additionally, considering the distinguished technical characteristics of the individual fields (different production volumes, capital costs,

[24] Further discussion on the U.S 'common carrier' status in section F.1.1.

operating costs, etc.), it is disputable if one unified transportation tariff for the whole basin would be desirable and beneficial for the industry. In the case of discriminatory monopoly, the owners of transportation and processing facilities can charge tariffs based on their knowledge regarding the unique conditions and features of each field in their geographical area. Consequently, they may charge higher tariffs than they would charge in a perfectly competitive market, however, the price never exceeds the expected production revenues of each field. A unified tariff, from the other hand, would be more advantageous for some fields with high revenues and robust production, not enabling though other smaller fields to operate.

E.3. Social and political concerns related to natural monopoly in transportation networks

In the case of upstream oil and gas transportation production stage, one could argue that there is no need for regulation in order to protect consuming public as the price of the utility for the end-users is not directly affected by the monopolistic nature of the industry. The inefficiencies arising in the market may harm production rates but without having a direct effect to the end-users, or in other words, the consumers. Therefore, regulatory intervention in the upstream oil and gas transportation market does not constitute a direct consumer-protection statute. In addition, competition in the market might not be desirable as the cost is lower with a single supplier. The government intervention may be deemed unnecessary as, under a privatised and not heavily regulated environment, the industry operates efficiently achieving a certain market equilibrium. Nevertheless, when an industry critical for a country's economy, like oil and gas, exhibits poor economic performance, the government may want to intervene in order to correct potential inefficiencies in the production and exploration phase for three main reasons; the cost to the overall economy, the effect to supply chain (including employability) and the safety of the supplies.

Despite the fact that regulatory intervention may not constitute a direct consumer-protection statute per se, it could be justified based on the economic importance of the industry, as measured not only by its own share in total national output but also on the size and growth of the entire economy. Oil and gas industry and its infrastructure are directly linked and often

considered a prerequisite to economic development. Decreased investment rates (incapability of attracting new entrants to the market) and tax revenues (including royalties) may have a great negative impact in the State budget which may motivate the government to proceed in regulatory changes in order to 'fix' market inefficiencies and assist the industry to reach its maximum potential. For example, the Norwegian government's total net cash flow in 2016, including the dividend from state-owned petroleum company Statoil, is estimated to NOK 128 billion[25] or, to put it differently, the oil tax revenues are about 13 % of total government revenues in the National Budget (Norsk Petroleum, 2016a). The Canadian oil sands are expected to contribute $4 billion to the Canadian economy and pay another $1.2 trillion in provincial and federal taxes (including royalties) over the next 20 years (CERI, 2015). In the U.S, just the Oklahoma state (the second largest oil and gas hub in the U.S. trailing only Texas) pays total direct state taxes of $2 billion or, to put it differently, 22% of all state taxes (State Chamber of Oklahoma, Sept. 2016). In the UK, since 1970, oil and gas industry has paid more than £300 billion in production tax, which is the equivalent of more than three years of NHS bills while the tax amount for 2014/15 was £2.2 billion (Oil&Gas UK, 2016a). Consequently, when the industry exhibits poor economic performance and, as a result, the market is considerably shrinking, the negative effect on the profits generated by the State will affect adversely the overall economy.

Furthermore, oil and gas industry has great influence as a supplier of essential inputs to other business sectors taking into consideration the overall supply chain. Specifically, in the UK, the oil and gas supply chain generates £30 billion revenue per year (Oil&Gas UK, 2016a) while more than 330,000 jobs are directly supported by oil and gas production sector and another 200,000 people are employed by the supply chain on UK oil and gas projects (Oil & Gas UK, 2016b). In Canada, direct employment as a result of solely oil sands investment is expected to grow from 151,000 jobs in 2015 to over 350,000 jobs in 2035 (CERI, 2015) while, according to the U.S Bureau of National Statistics (2017), all employees working just in oil and gas extraction stage reach the 178 thousands. Finally, in 2016, 185,300 people were directly or indirectly employed in the Norwegian petroleum industry and the Norwegian oil and gas supply chain had a revenue totalling NOK 461 billion in 2012, which made it country's second largest industry, after oil and gas sales (Norsk Petroleum , 2016b). The

[25] Approximately £12 billion.

significance of the industry for the public interest expands, thus, in several other sectors of the economy which may be affected from a potential extensive shrinking of the oil and gas upstream market. Regulating the industry in order to provide the maximum possible input back to the economy can be justified based on concerns related to negative impacts on the supply chain and the employability of a great number of people.

Last but not least, a common justification for governments to enforce regulation in the energy industry is the security of supplies as hydrocarbons are considered a 'strategic' good that is essential for the functioning of the society. It is argued that overdependence on overseas resources is unwise, as they can be proved unreliable and disturb the operations in both society and other industries. Therefore, governments usually favour indigenous production given the fact that they are inherently more secure and more easily controlled. For instance, political debate on the need for energy regulation is central in the UK, as the country is still heavily dependent on hydrocarbons with 60% of the UK's energy coming from abroad (OGA, February 2016). Since mid-1980s, there is a global trend of liberalising the oil and gas transportation networks through deregulation policies regarding the access to pipelines networks which were under the control of national or regional monopolies. However, several countries have recently introduced various pricing schemes for access to oil and gas pipeline networks aiming to achieve a higher level of 'fairness' and improve economic efficiency.

The multistage program of reforms launched by the EU, for instance, was based on a light-handed regulatory approach that would facilitate the progressive opening of the national pipeline networks of natural gas to third parties, especially in regions heavily dependent on imports. The Gas Directive of 1998 facilitates the liberalisation of the European gas industry through establishing rules on market shares and imports. Additionally, the provision of third-party access (TAP Code) to the pipeline networks promotes reforms for the minimal opening of the market. As H. Cremer et al. (2003) highlight, the European Gas Directive focuses on four principles that would foster competition and eventually decrease the prices for consumers; (i) the pipeline network is an essential facility and access must be provided to authorised operators, (ii) separation is required between operators' integrated activities (transportation, storage and distribution), (iii) 'eligible' customers are allowed to form contracts with authorised operators of their choice within the regulatory framework set by TAP Code, and, (iv) regulation of access to the pipeline network is under the responsibility of

an independent regulatory authority which would design the structure as well as set the tariffs aiming to encourage economic efficiency and control monopoly rents. The European gas market is expected to reach an import dependency of 60% over the next decade (Cremer et al., 2003). Thus, there is an urgent need for European countries to secure sufficient supplies and their transportation routes into the market to tackle any security of supplies issues. As Cremer et al. (2003) highlight in their work, the fact that the EU relies on a small number of countries for the gas supply (namely Algeria, Norway and Russia) causes concerns regarding a potential exercise of producers' market power which could offset the benefits the consumers are enjoying due to the opening of the market. These factors make the continental Europe a unique case in comparison to other countries which have also opened and regulated their gas markets in relation to third-party access and highlights the importance of the security of supplies as justification for government intervention.

F. Regulatory Tools and Access to Pipelines in International Markets

The oil and gas industry has several distinguishing characteristics depending on both the technical features (like the maturity of the basin, water depth of discoveries, etc.) as well as the regulatory regime of the country in which the sector had been developed (light regulatory regimes versus tight ones). Therefore, any analysis is usually conducted on a case-by-case basis. Nevertheless, considering the oil and gas business in other countries as well as other industries can lead to a fruitful comparison which allows the researcher to identify similarities and, most importantly, differences which may lead to useful lessons learned. In this section, potential regulatory strategies, such as access regulation, vertical disintegration and government ownership, are explored in an effort to identify appropriate regulation for the key features of the oil and gas pipeline networks which may call for government intervention.

The study of regulation, though, cannot limit to theory, as it must be instead the interpretative key for the real-world cases. Therefore, this section of Chapter 2 presents the business and regulatory framework regarding the access to oil and gas pipeline networks in offshore Norway and Gulf of Mexico. While in the previous sections the oil and gas industry structures and reasons for government intervention were brought into light, this part of the work aims to observe potential lessons learned from the way the Norwegian and American (offshore Gulf of Mexico) oil and gas industry operates. These cases could provide valuable examples in terms of ownership patterns and regulation for possible structural changes that can be applied in the oil and gas industry elsewhere. A deep dive into these practices provide an excellent illustration for the application of various regulatory tools.

F.1 Access regulation to infrastructure

Policy makers have used access regulation in order to promote effective competition as it creates a regulatory environment which guarantees that the competitors have access to infrastructure facilities too costly to duplicate. In general, regulation covering fair access and access pricing to these facilities was formed to improve economic efficiency by easing

competition in the market. When it comes to oil and gas infrastructure, access regulation is characterised by three main components.

Firstly, under this type of regulation, access to infrastructure facilities is compulsory, meaning that it cannot be denied to the market participants. As a result, existing third-party users as well as potential entrants are not dealing with the uncertainty that they might not get access to pipeline facilities as the right of entry is guaranteed. Secondly, it is common that the allocation of the usage percentage on the pipeline is based on a first-come-first-serve basis or, alternatively, it is granted to the highest bidder. However, in access regulation, the available space in the pipeline is allocated in a non-discriminatory manner and on a pro rata basis.

Finally, pricing in access to infrastructure is a core theme in this type of regulation and the tariffs are usually cost-based. Nonetheless, even though traditional cost-based rates are generally applying on natural gas pipelines, tariffs charged by oil pipelines are set according to several approaches, such as negotiations, settlements and market-based rates (AOPL, 2014). Traditional cost-of-service ratemaking is being employed only in limited circumstances often seen in the Gulf of Mexico, as access pricing is part of the antitrust concerns covered by U.S legislation.

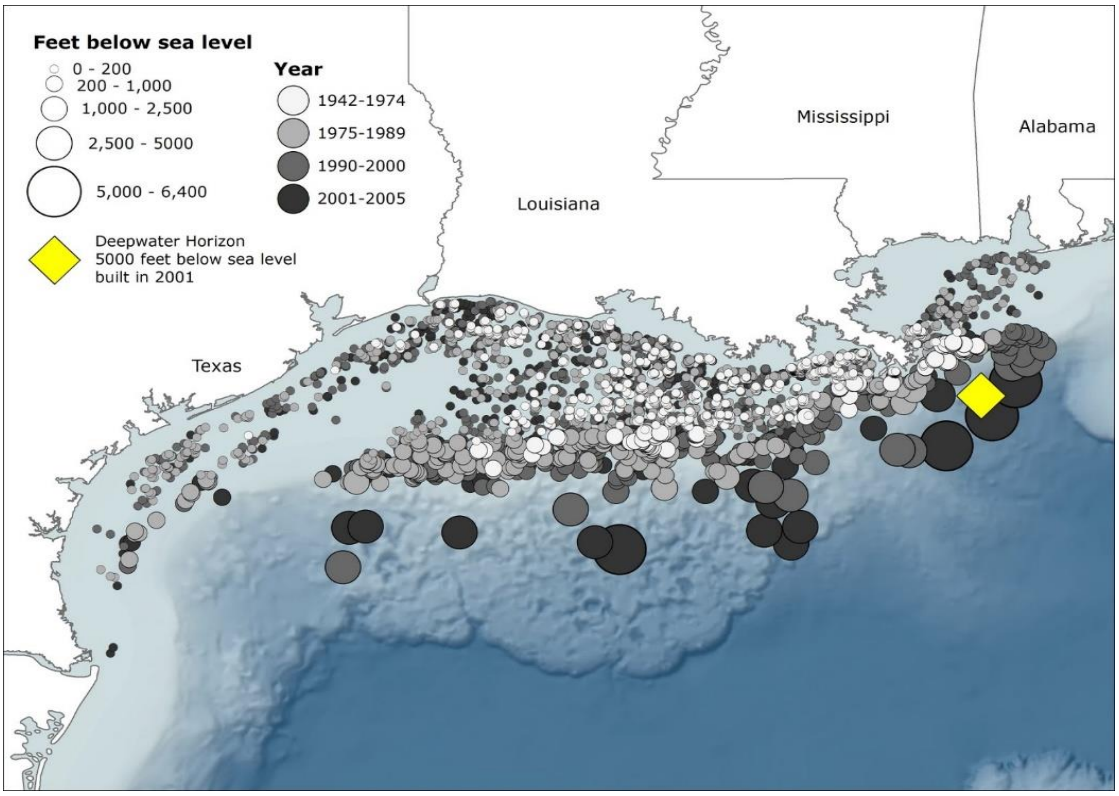
F.1.1. Gulf of Mexico (GoM) Outer Continental Shelf (OCS) - Transportation regime

The Gulf of Mexico (GoM) is the largest supply area of the U.S among the Petroleum Administration for Defence Districts (PADDs)[26] as the oil produced in the basin accounts for 55% of the nation's total crude oil production and 47% of its refined product output (AOP & APIPC, Dec 2001). In the U.S, the responsibility for authorising the siting, construction and operations in oil and gas pipelines lies with the Federal Energy Regulatory Commission (FERC). The safe operation of oil pipelines (for the entire life of the pipeline) along with the

[26] The oil producing areas in the U.S are divided in five regions referred to as "Petroleum Administration for Defence Districts" (PADDs) and are the following: the East Coast (PADD 1), the Midwest (PADD 2), the Gulf Coast (PADD 3), the Rocky Mountain Region (PADD 4), and, the West Coast (PADD 5) (AOP & APIPC, Dec 2001).

issue of the acquirement of a safety certification prior to the beginning of any operation is controlled by the Office of Pipeline Safety (OPS). The pipelines are owned by individual companies (usually solely specialised in transportation) and the FERC requires that the access to their transportation facilities should be provided on a non-discriminatory basis and be fair to all parties. For inter-state transportation services, the owner of the pipelines negotiates the individual tariff contracts with the customers which are, though, subject to a FERC-approved tariff (Thomson Reuters Legal Solution, 2015).

Figure 2.6: Gulf of Mexico basin fields and technical characteristics



Source: WordPress (2010)

The regulatory processes and jurisdictional authority concerning pipelines on the Outer Continental Shelf (OCS) and in coastal areas are shared between several Federal agencies[27]. In GoM, there are two ways of transporting the hydrocarbons produced offshore to the onshore refineries, storage facilities and processing plants; via sub-sea pipeline or with

[27] Department of the Interior (DOI), Department of Transportation (DOT), U.S Army Corps of Engineers (USCOE), the Federal Energy Regulatory Commission (FERC), and the U.S Coast Guard (USCG) (Booz Allen Hamilton , 2010).

marine tankers (which can also be used as offshore short-term storage facilities). While the marine tankers are usually owned by global shipping companies, the offshore pipelines are operated and owned by well operators (Booz Allen Hamilton , 2010). It is important to highlight the fact that the oil transportation by pipelines does not fall under a single federal regulating authority, but it is regulated on a state-by-state basis.

In general, although oil pipelines and their respective facilities can provide transportation, or even logistics services and temporary storage, they do not own the product they transport. In the U.S, most of both offshore and onshore oil pipelines are ‘‘common carriers’’ under the Interstate Commerce Act. The shippers who are wishing to use the pipeline network need to contract for space (AOP & APIPC, Dec 2001). In case the requests for space on a pipeline exceed its capacity, the available space is allocated among shippers in a non-discriminatory manner on a *pro rata* basis, and it is not based on a first-come-first-serve basis or the highest bidder (AOP & APIPC, Dec 2001).

For example, on Texas, a “common carrier” includes one who “*owns, operates, or manages a pipeline or any part of a pipeline in the State of Texas for the transportation of crude petroleum to or for the public for hire, or engages in the business of transporting crude petroleum by pipeline*’’ (LSU, 2016). The common carrier status in the States is limited to pipelines transporting crude oil, carbon dioxide, hydrogen and coal. Common carriers have the right and power of eminent domain having, thus, the liberty to enter on and occupy the land, rights-of-way and property of any person or corporation required for the construction, operation, or, maintenance of the common carrier pipeline (LSU, 2016).

Table 2.1: Contract Oil and Gas Pipeline Regulation- Key Features

Oil Pipelines	**Gas Pipelines**
Common Carrier (or Carriage)	Public Utilities
Unregulated entry and exit	Approval required for construction and abandonment
Highly competitive	Natural Monopoly model
Unique regulatory model	

Source: Reed (2009)

Historically, the common carrier regulation implies the lack of any firm's exclusive capacity as all interested parties and qualified shippers are entitled to some reasonable percentage of usage (usually allocated in a pro rata basis) (Morgan, 2012). As we can see in Table 2.1, in the U.S, natural gas pipelines are viewed as public utilities under a natural monopoly model and approval is required for their construction and abandonment (Reed, 2009). On the contrary, oil pipelines are operated under the status of common carrier (or carriage) with unregulated entry and exit within a highly competitive market environment (Reed, 2009).

If an upstream producer needs to transfer the produced oil through a transportation pipeline controlled by a third party, he pays a fee based on the volume of oil. The tariff pricing can vary as it is governed mostly by individual contracts (EIA, 2016). According to the EIA (2016), upstream operators who need to transport oil for long distances to reach a refinery tend to pay tariffs ranging from $2.20 to $13.00 per bbl. As mentioned above, FERC regulates oil pipelines including the rates as well as the terms and conditions of service offered by their owners who engage in interstate commerce. The FERC Commission requires pipeline owners to publish tariffs and controls the auditing process of the collected information (Klass & Meinhardt, 2015). Unlike natural gas pipelines, oil pipelines that do not cross federal lands, they do not require approval from FERC for their construction and/or operation (Klass & Meinhardt, 2015). However, despite the fact that oil pipelines are free to enter and exit the market, once they start their operation, FERC has exclusive authority over their rates and tariffs.

F.2. Vertical disintegration

C.v. Hirschhausen et al. (2004) highlight that vertical disintegration regulation was mainly established in order to deal with discrimination issues and it was used widely in the U.S to organise some electricity markets, especially in California, as well as in the UK for electricity as well as railways. In vertical disintegration regulation, the network company can be either directly regulated or part of the public sector while different structures can be used on the market; from unregulated enterprises (e.g. California electricity generation) to regulated monopolies (e.g. UK railways franchisees system) (C.v. Hirschhausen et al., 2004).

Vertical disintegration regulation could solve the problem of bundling which often exists in oil and gas industry with infrastructure owners to charge extra fees for additional services other than transportation, like offshore processing. Adding services for the third-party users increases the cost of their operations and discourages new entrants affecting, thus, potentially the rates of exploration. Disintegrating a vertically integrated monopoly through regulation can decrease the costs of operators and offer incentives to new participants to enter the market and undertake exploration of new wells.

Similarly to access regulation, the vertical disintegration regulation can work towards the liberalisation of service provision by facilitating equal and fair access to infrastructure facilities as well as dealing with bundling issues that the industry often faces. As consequence, any concerns arising from the monopolistic nature of the industry and the vertical integration of the market can be tackled through two practices; by either 'forcing' the monopolist to provide equal and fair access under reasonable tariffs, or alternatively, by 'breaking' the vertical integration structures (bundling) separating the company which owns the pipelines network with the one owning the processing facilities not allowing, thus, a single firm to control both.

F.3. Government ownership

Government ownership represents a significant turning point in the development of oil and gas policy. A clarification needs to be made at this point that the term 'government ownership' is referring to a situation where the government of a country owns and operates one, or more, stages of oil and gas production. A government might decide to own and develop itself the resources found in its territory since the very first discovery of hydrocarbons, or, in a later stage with the agreement of private sector (i.e. Norway). Furthermore, government ownership does not correspond necessarily to absolute absence of foreign investments in the oil and gas industry or the obliteration of any private business activity. Government ownership can be applied in one stage of oil and gas production (i.e. transportation) with other stages being open to private operators. In rare cases, like Norway, a

mixed model of state ownership and private interests can be found. For the purpose of this chapter, the term ‘government ownership’ does not represent any instances of nationalisation of oil supplies which correspond to the process of confiscation of oil assets and any type of private property with the violation of contract law.

State-owned and state-operated energy companies were initially founded in order to keep the revenue from natural resource development in-country as well as maintain control over production and reserves. In the case of oil and gas infrastructure facilities, government ownership holds two important merits. Firstly, if the infrastructure is owned by the government, any uncertainty regarding the terms and conditions of third party access are eliminated along with any concerns over monopoly. As a result, exploration rates can be boosted, as new entrants are able to commit ex ante to transportation contracts since the access to critical infrastructure and tariff pricing are predefined by the government and communicated to the interested parties. Secondly, in government ownership, tariffs are not only predefined, but also unified for all transportation activity regardless of the distance to the terminal or, in the case of offshore fields, to the shore. Specifically, the same tariff applies for both fields located close to the onshore terminal as well as fields located further offshore. Consequently, considering the fact that in many basins around the globe new fields are discovered farther way from shore in higher depth, this tariff system can be considered advantageous for isolated new discoveries providing more incentives for exploration activity.

F.3.1. The Norwegian regulatory framework on access to pipeline networks

The history of the Norwegian oil and gas sector began in October 1962 when Phillips Petroleum requested from Norwegian authorities to be granted the right for exploration in the North Sea. The company offered $160,000 per month to the Norwegian state for the right to hold a licence for territories in the Norwegian sector of the basin. The Norwegian state viewed this offer as an attempt on behalf of Phillips Petroleum to get the exclusive right. Therefore, the State declined the offer supporting the idea that exploration should be opened to competition with several companies participating.

The year after, Einar Gerhardsen's government proclaimed sovereignty over the Norwegian Continental Shelf (NCS) putting forward a new regulation which made the State the owner of any natural resources on the NCS while it also stated that only the King (government) has the right to award licences for exploration and production (Norwegian Government, 2013). During the same period, the country entered into agreements with Denmark and Great Britain in order to divide the continental shelf of the North Sea. The first Norwegian licencing round took place on 13 April 1965 with 22 production licences for exploring, drilling and production that were awarded to oil companies or group of companies for the total of 78 blocks (Norwegian Government, 2013).

During the first years of life of the Norwegian oil and gas sector, foreign companies were dominating the exploration and production of the country's first oil and gas fields. However, in 1972, the state-owned company, Statoil, was created along with the principle of 50% state participation in each production licence. A few years later, that rule changed so the Norwegian parliament (Storting) could evaluate the level of state participation (lower or higher than 50%) in each individual acreage depending on the circumstances (Norwegian Government, 2013).

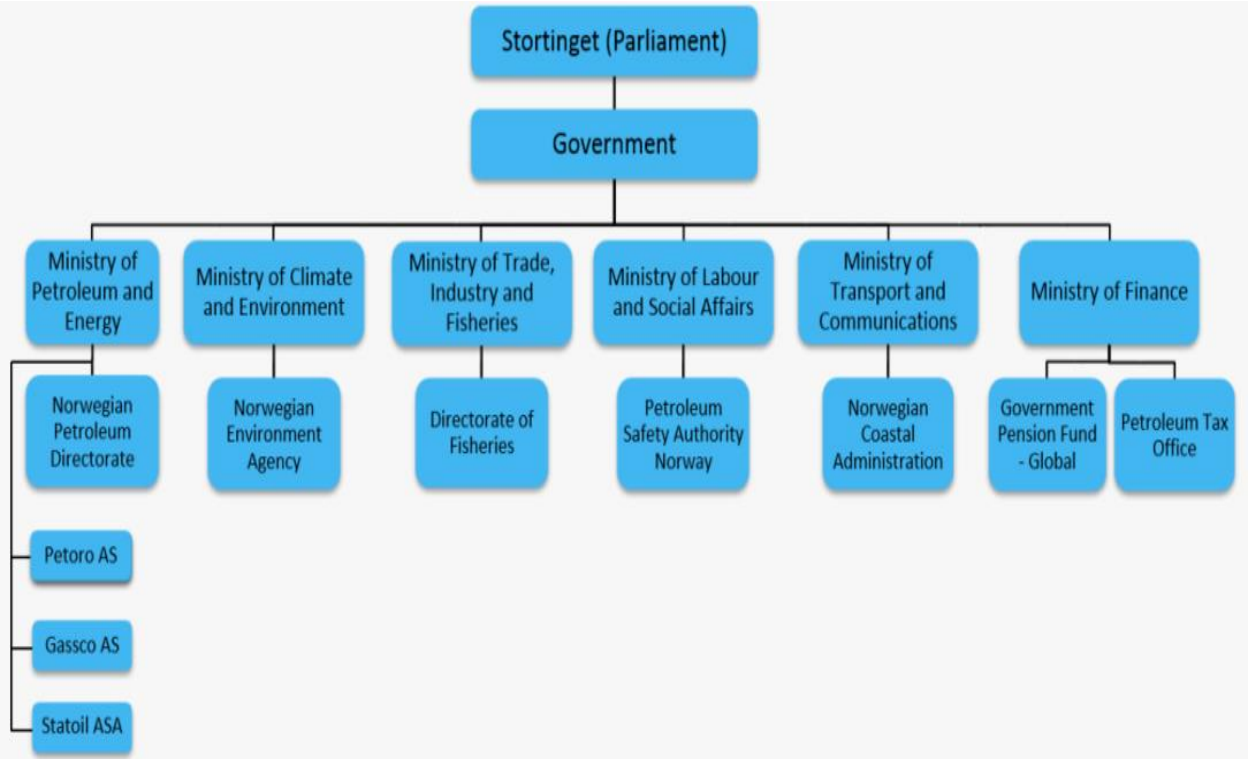
From 1 January 1985, the State participation was reorganised and split in two; one becoming part of the State's Direct Financial Interest (SDFI) in petroleum operations, and the other linked to the company (Norwegian Government, 2013). The SDFI is essentially an arrangement through which the State owns interest in several oil and gas onshore facilities, pipelines as well as fields and each government take is determined during the award process of production licences while the state participation share varies depending of factors such as the size of the field. Given the fact that the State is an owner, it participates in both the investment and operational costs as well as the revenues by receiving a share of the income from the production licence.

In 2001, the Norwegian parliament decided that 21,5% of the SDFI's assets would be sold with 6,5% traded to several licensees and 15% to Statoil- a fact that enhanced the process of listing and privatisation of the state-owned company (Norwegian Government, 2013). Statoil was listed in June of the same year, and, since then, the company operates on the same terms as every other market participant in the NCS. It is important to highlight the fact that the

company is the operator of the 70% of all oil and gas production in the NCS while Norwegian State owns 67% of Statoil's shares (Norwegian Petroleum, 2016a).

In May 2001, the State established Petoro which manages the commercial aspects of the SDFI as a wholly state-owned limited company. Petoro is essentially the licensee for both the State's share on the production licences as well as the owner of fields, pipelines and associated onshore facilities in the NCS (Norwegian Petroleum, 2016a). The main objective of Petoro is to maximise State's revenues from the portfolio of assets.

Figure 2.8: Organisation structure of the Norwegian oil and gas regulatory agents



Source: The Ministry of Petroleum and Energy through the Norwegian Petroleum (2016a)

Prior to 2006, access to infrastructure facilities in the NCS was regulated by a voluntary framework created by the major oil companies at the request of the Norwegian Ministry of Petroleum and Energy (MPE)[28] (Memery Crystal LLP, 2012). This regulatory approach could not be lessening the monopolistic behaviour of several infrastructure owners driving, thus, MEP to adopt a series of regulatory measures on negotiating behaviour. Under the

[28] For the organisational structure of the Norwegian oil and gas regulatory agents, see Figure 2.8.

Norwegian regulatory model, the potential users of infrastructure are seeking information regarding the available capacity of the facility from the asset owners through a 'request overview capacity' and expect reply within 15 working days, initiating the beginning of the negotiation process. In her reply, the owner is obliged to provide information about the services, priority, liabilities, responsibilities and an indicative tariff.

During the negotiations, an agreement should be reached within a time limit and then be submitted to the appropriate authorities. Thereafter, the infrastructure owner will grant access to the user to all existing agreements concerning the use of the facility with the negotiations to be finalised no later than 4 months since the initiation of the process (Memery Crystal LLP, 2012). If requested by the user, the owner shall offer terms and conditions (including tariffs) separately for each one of the services. According to the Norwegian regulatory framework, when determining the terms and conditions (including tariffs), the following should be adhered to (Memery Crystal LLP, 2012):

i. terms shall be determined on the basis of the services provided and independently of the profitability of the field to which the services relate;
ii. each user shall pay its share of operating costs incremental to the existing owners;
iii. the user shall pay for any new investment required for the use of the facility but where the user utilises capacity in which the owner has made a pre-investment for the purpose of third -party use the tariff may include payment for the use of such capacity including a reasonable payment for the risk that the investments would not be fully utilised;
iv. tariffs shall not include any repayment of investments that have already generated or, with the planned use, must be expected to generate a reasonable return for the owner;
v. the user shall compensate the owner for any loss of profits, including the loss or postponement of production, as a consequence of the user's use of the facility.
vi. compensation for such losses shall be determined on the basis of the profit that could have been obtained in respect to the lost or postponed production;
vii. the owner may charge a reasonable profit, allowing for the risk assumed by the owner in connection with the third-party use of the facility.

When negotiations are completed, the agreement should be submitted for the approval to the relevant authority.

In 2001, and in response to the First Gas Directive issues by the EU, the MPE founded the new operator Gassco and, through a voluntary agreement, the joint venture (JV) Gassled to implement the Directive. Gassled consists of a JV between the oil and gas companies operating in the NCS and has no employees as it is organised through various committees with specific assignments. Gassled is a partnership which owns the Norwegian gas transport infrastructure while Gassco serves as the system operator, responsible for initiating and coordinating any development process in the gas pipeline network and facilities (Norwegian Government, 2016). Petroleum Regulations control Gassled's activities while the tariffs for individual services are stipulated by the MPE.

Gassco is the neutral and independent operator of the gas transport system safeguarding that all users are treated equally, and its operatorship is split in two; the special and the normal operatorship. The Petroleum Act regulates the special operatorship which includes issues such as the management of gas transport system's capacity, the coordination of the gas stream through the network to the markets, and, the development of any new infrastructure. The normal operatorship refers more to the management of a facility based on the Health, Safety & Environmental (HSE) legislation. In collaboration with the industry, an annual transport plan has been developed by Gassco for all relevant information to be continuously gathered and for all participants to act in accordance with the agreed procedures. Gassco's costs occurring by the operating of the transport system are paid by its users through tariff whereby operating costs are paid to the operator on a 'no gain no loss' basis. Capital investment is recovered with a 7% return on capital invested by each system owner with some variation between different parts of the system (Memery Crystal LLP, 2012). Following the establishment of this JV, all companies sold their interests to non-industry institutional investors enabling them to redeploy their capital to exploration and production activities.

In the NCS, the total tax rate for oil and gas companies is 78% with only firms being taxed and not directly the fields (Norwegian Petroleum, 2016b). To prevent the willingness of companies to invest to be reduced by the high tax rate, the operators are entitled to deduct investment-related costs from the tax base. For example, an effective system has been put in

place which allows companies to claim reimbursement for exploration expenses (especially if exploration phase does not bare any positive results) as an alternative to deducting them from the tax base (Norwegian Petroleum, 2016b).

Overall, in Norway, the pipeline transportation system is essentially a natural monopoly where the access to the network and the tariffs are regulated by the authorities. Specifically, the tariffs are set such as that the returns from oil and gas production are derived from the fields providing at the same time a reasonable return on investment for the infrastructure owners (Norwegian Government, 2016). All operators have equal access to the capacity of the transportation network based on their needs while transport rights can be transferred between users, when their capacity changes. The main argument for this system of joint ownership is that of a higher efficiency in transportation in terms of generated value and the avoidance of conflicts of interests. The overall objective of Norway's petroleum policy has always been to ensure that a large share of the value creation from any oil and gas operation will accrue to the State and redistributed to the society. The regulated authorities have managed to create a predictable and clear framework which balances the companies' and State's interests.

F.4. Discussion on the different regulatory tools and their application to the oil and gas upstream transportation

In the western world, the trend of liberalising the market was present in both the oil industry and the gas industry, especially in countries with large reserves such as the U.S, aiming to develop a competitive nationwide market. However, due to market uncertainty and the rise of monopolistic behaviour, it was deemed necessary the establishment of, even a light-handed, regulation for the transportation of hydrocarbons.

The transition from a light-handed to a stricter regulatory environment can be observed in the case of Norway where the monopolistic behaviour of some players in the NCS increased mainly because of the existence of a voluntary regulatory environment prior to 2006. This

behaviour drove MEP to adopt a series of regulatory measures on negotiating tariffs and access to the pipeline network. Nowadays, the national company has a participation share in the NCS fields (the percentage depends on the circumstances) while Gascoo is the established system operator for gas networks with Gassled JV owning the gas transportation infrastructure and MEP stipulating the tariff prices. The Norwegian system is considered highly efficient from an economic perspective. The Norwegian offshore oil and gas industry combines the presence of a monopoly with the access to infrastructure and tariffs, though, to be highly regulated by the authorities in an effort to balance corporate and State interests.

In Gulf of Mexico, there is a distinction between the status of oil pipelines and the gas infrastructure network. The gas pipeline network is treated as a public utility and, therefore, the owner of the pipeline can negotiate directly with the customer regarding the tariff contract which is, though, subject to a FERC-approved tariff. On the other hand, oil pipelines are under the status of 'common carrier', which implies that the pipeline capacity is allocated among shippers in a non-discriminatory manner on a pro rata basis.

One could argue that regulatory innovation in oil and gas transportation market is as important as technical innovation. The oil and gas transportation systems face different challenges in different countries, especially regarding to infrastructure development. The unique technical characteristics and market conditions of each basin greatly affect the established regulatory framework and do not facilitate the direct application of the same regulations everywhere in the world. The differences between the various regulatory tools extend from their historical justification to the approval process of new projects, and, from the terms and conditions of service to the allocation of capacity and the flexibility in negotiating third party tariffs. All the above-mentioned regulatory tools were developed and applied in different countries and under unique historical, political and economic context. Nevertheless, there are some lessons learned from their application that could facilitate other basins facing similar challenges and conditions.

More specifically, access regulation to transportation infrastructure is usually applied under the absence of strong natural monopoly and when certain geographical and technical conditions occur. For example, the U.S regulation, as it is known today, has its root to the strong monopoly of John D. Rockefeller's company, Standard Oil, which soon after its

creation controlled 90% of all oil refining and 80% of all oil onshore transportation market in the country (Reed, 2009). President Theodore Roosevelt brought oil pipelines under the Interstate Commerce Act of 1887 (originally applied only to railroads) in order to break Standard Oil's monopoly which was already threatened by new competitors (Gulf, Sun, Texaco, Phillips, etc.). The same regulation had been later applied in the offshore transportation market as well. The implementation of the 'common carrier' status in the Gulf of Mexico was facilitated by the fact that many of the fields are located in relatively proximity to the shore, in low/medium water depth, and, their development is taking place under good weather conditions. As a result, companies operating in the basin are dealing with, on average, lower fixed and operational costs while the construction of a pipeline is not highly capital intensive in comparison with other regions.

Vertical disintegration of the market works undoubtedly towards the liberalisation of the market and can solve the issue of bundling which is especially challenging as it can increase the cost of service for current and new participants. The oil and gas transportation markets share some common characteristics, such as the high capital cost, the long-lived and durable assets (associated with sunk cost) and the tendency towards monopolistic practices. As a result, vertical disintegration regulation could potentially be applied in basins that they face issues of bundling. Disintegrating the oil and gas transportation production stage could result to increased numbers of new entrants and, consequently, exploration activity, given the fact that potential participants would be dealing with lower costs. However, the application of this type of regulation in the oil and gas industry is questionable as competition cannot easily be promoted in all stages of oil and gas upstream sector. For example, due to the nature of hydrocarbons and the technical structure of the industry, competition in processing facilities (offshore or onshore), which is usually the additional service provided in bundling strategies, could be proved to be challenging.

When the Government is the owner and operator of assets (fields and/or transportation facilities) in one or more production stages, there are no concerns over natural monopoly and, in addition, no uncertainty over the third-party tariff pricing. This situation facilitates especially new entrants that can commit ex ante to transportation contracts as terms and conditions of access to critical infrastructure are predefined by the government. However, in basins with an already long-established oil and gas industry, the transition from a liberalised

market framework to a highly regulated environment, which stretch to State ownership of facilities, cannot always be applied. In the case of Norway, the transition was successful mainly because the Norwegian government created a worldwide unique business context by allowing private investors and companies to continue operations and participate actively in the formulation of the new regulatory framework. The political and social, though, mechanisms and conditions facilitating the application of the Norwegian regulatory model cannot be found easily in other basins. Nonetheless, a similar model could be considered by countries which are currently in the process of developing hydrocarbons and do not have an already established regulatory framework.

Finally, it is important to bear in mind that when considering the need for regulation, it is required to assess the balance between market failure and regulatory failure. To date, the debate in the economic literature has not yet concluded unanimously on the appropriate balance between these two types of failure. Utility industries are generally capital intensive with durable, immovable and long-lived assets and, as consequence, it is not unusual demands for regulation regarding access and 'fair', 'non-exploitative' prices to arise. Regulatory measures, though, can cause the investors to feel like they are limited in the prices they can charge after having made big sunk investments. Hence, the regulator needs to take into consideration the fact that expectations on future pricing policy can critically affect the incentive to invest. The interaction of the characteristics of an industry along with the type or regulation selected can result to significantly different outcomes in different circumstances.

G. Conclusion

The second chapter of this thesis consists of an analysis of pipeline networks focusing on the economics of regulation and the issue of third party access to infrastructure under conditions of natural monopoly in the oil and gas upstream transportation market. It aims to explore how the basic principles of regulation economics can be applied in the oil and gas transportation networks. The key economic and technical features of the oil and gas pipeline networks are presented as well as the market failures often arising in the upstream industry which may call for the appropriate regulatory tools. This chapter explores the peculiar characteristics of oil and gas transportation networks and discusses the advantages and disadvantages of the various regulatory tools employed to tackle economic inefficiencies arising in the upstream market. Special focus is given to the economic and business impact of a potential government intervention in a critical industry for the economy.

The oil and gas transportation sector has all the features of a natural monopoly; the presence of strong economies of scale, the high level of sunk cost and the structural barriers to entry. Unregulated procedures may substantially allow firms to exploit market power and raise prices. Consequently, and in combination with political and social pressures, a case may be made for government intervention in the market to protect public interest and ensure that high levels of output growth are achieved.

Classic economic theory of natural monopoly suggests that production efficiency can be better satisfied if a single firm supplies the market. However, the absence of competition might allow the incumbent firm to exploit its monopolistic power to achieve higher profit maximisation creating, thus, inefficiencies in the market. The presence of strong economies of scale is one of the main reasons why competition was deemed undesirable in the oil and gas industry. Furthermore, needless duplication of capital equipment is probably an additional argument which suggests that monopoly is the most efficient market structure. It would be inefficient for both the firms as well as the market, if two oil companies were constructing two different pipelines in the same geographical region to transport the hydrocarbons produced from the offshore platforms to the onshore facilities.

In addition, the effects of vertical integration in the oil and gas industry can become easily apparent partly since the production stages are straightforwardly differentiated. Vertical integration can lead to barriers of entry and excess profits on behalf of the monopolist. In combination with this fact, the complex ownership patterns and uncertainty regarding the exploration outcome make the creation of full contingent contracts in the oil and gas industry unfeasible. Essentially, the presence of vertical integration allows the market power of a natural monopoly in transportation stage to extend to other stages of production which, otherwise, might have been more competitive. Hence, because of vertical integration, a more competitive production stage can become monopolistic allowing the incumbent to extend her monopoly power to an originally competitive market. However, there may be efficiency gains arising from the presence of vertical integration as it can prevent double marginalisation. Vertical integration can avert the problem of double marginalisation as it is considered economically more desirable one monopoly to exist (charging just one monopolistic price for all services) instead of two (charging two separate tariffs higher than the marginal cost).

The two main economic inefficiencies arising due to the presence of natural monopoly and the high prices set by the incumbent in the third-party access tariffs are considered to be the Domino Effect and decreased exploration rates. Regarding the Domino Effect, from an efficiency point of view, if the operating costs of a pipeline is not, at least marginally, covered for a long period of time by the field's production revenue, it is anticipated by a profit maximising firm to cease production and abandon the development. Consequently, one could argue that the Domino Effect is not essentially an economic consideration as, from a business perspective, it is expected that the no-profitable fields and related infrastructure facilities will shut down and eventually be decommissioned. A government, nonetheless, might have alternative motives linked to the overall economy in order to intervene and prevent an extensive Domino Effect from occurring. Decreased investment rates and reduced tax revenues may have a great negative impact in the State's budget- a situation which may motivate the government to proceed in regulatory changes to assist the industry to reach its maximum potential.

The distinct economic market features of oil and gas upstream transportation also contribute to the arising issue of decreasing exploration activity. Potential new entrants, or even existing market participants, are reluctant to undertake exploration activities as they anticipate that

they will pay high transportation prices due to the monopolistic nature of the market. As a consequence of high pricing (anticipated or actual), exploration activities are lacking efficiency as the exploration costs are expected to exceed the exploration revenues. The government might want to intervene in order to regulate the pricing in access to critical infrastructure and improve exploration activity as well as attract new entrants to maintain the significant revenue stream coming from the oil and gas industry to the State budget.

The issue of pricing for the use of infrastructure facilities can increase the cost pressure to the retaining fields, especially in smaller accumulations with limited production capacity and for which it is economically non-viable to build their own transportation and/or processing facilities. In case the owners of these fields feel that they are discriminated, they might be forced to enter a long negotiation process resulting delays in field development which often lead to significant loss of value. In some cases, price discrimination to third party access to infrastructure is directly linked with the issue of negative profitability of smaller new fields, which can cause their early decommissioning as well as decreased exploration rates in the whole basin. There are, thus, regulatory approaches (i.e. U.S 'common carrier' regime) which support a non-discriminatory monopoly where the infrastructure owners charge the same price for third party access to pipelines and processing facilities to each and every field in their respective geographical area. Nevertheless, when it comes to oil and gas transportation sector, price discrimination could improve the economic efficiency for a basin. Slightly higher tariff prices enhance the revenue stream of fields which operate on the margin and own at the same time the hosting facilities. Additionally, considering the distinguished technical characteristics of the individual fields (different production volumes, capital costs, operating costs etc.), it is disputable if one unified transportation tariff for the whole basin would be desirable and beneficial for the industry.

In the case of upstream oil and gas transportation production, one could argue that there is no need for regulation to protect consuming public as the price of the utility for the end-users is not directly affected by the monopolistic nature of the industry. The inefficiencies arising in the market may harm production rates without, though, having a direct effect to the end-users, or in other words, the consumers. Therefore, regulatory intervention in the upstream oil and gas transportation market does not constitute a direct consumer-protection statute. Nevertheless, when an industry critical for the country's economy, like oil and gas, exhibits

poor economic performance, the government may want to intervene to correct potential inefficiencies in the market for three main reasons; the cost to the overall economy, the effect to the supply chain (including employability) and the security of the supplies.

The oil and gas industry has several distinct characteristics depending on both the technical features (like the maturity of the basin, water depth of discoveries etc.) as well as the regulatory regime of the country in which the sector had been developed (light regulatory regimes versus tight ones). Therefore, any analysis is usually conducted on a case-by-case basis. The study of regulation cannot limit to theory, as it must be instead the interpretative key for the real-world cases. Therefore, in this chapter, the business and regulatory framework as well as the ownership structures regarding the access to oil and gas pipeline networks in offshore international markets were under examination.

Access regulation has been used by policy makers in order to promote effective competition as it creates a regulatory environment which guarantees that the competitors have access to infrastructure facilities too costly to duplicate. Under this type of regulation, access to infrastructure facilities by the market participants cannot be denied. As a result, existing third-party users as well as potential entrants are not dealing with uncertainty as the available space in the pipeline is allocated in a non-discriminatory manner on a pro rata basis. Access regulation to transportation infrastructure is usually applied under the absence of strong natural monopoly and where certain geographical and technical conditions occur. The implementation of the ‘common carrier’ status in the Gulf of Mexico was facilitated by the fact that most of the fields are located in relatively proximity to the shore, in low/medium water depth, and their development is taking place under good weather conditions. As a result, companies operating in the basin are dealing with, on average, low fixed and operational costs while the construction of a pipeline is not highly capital intensive in comparison with other regions.

Like access regulation, the vertical disintegration regulation can work towards the liberalisation of service provision by providing equal and fair access to infrastructure as well as dealing with bundling issues that the industry often faces. Disintegrating a vertically integrated monopoly through regulation can decrease the costs of operators and offer incentives to new participants to enter the market and undertake exploration of new wells.

Applying vertical disintegration regulation to all production stages of the oil and gas industry could be proved to be a perplexing task considering the nature of hydrocarbons and the technical structure of the sector as, for instance, achieving competition in processing facilities would be challenging.

Last but not least, government ownership does not always correspond necessarily to absolute absence of foreign investments, as usually the Government owns one stage of oil and gas production (i.e. transportation) with other stages to be open to private operators. In rare cases, like Norway, there is a combined mixed model of state ownership and private interests. Government ownership has two important merits; no uncertainty regarding the terms and conditions of third party access and elimination of any concerns over monopoly. As a result, exploration rates can be boosted, as new entrants are able to commit ex ante to transportation contracts since the access to critical infrastructure and tariff pricing are predefined by the government and communicated to the interested parties. Secondly, tariffs are not only predefined, but also unified for all transportation activity regardless of the distance to the terminal or, in the case of offshore fields, to the shore. However, in basins with an already long-established oil and gas industry, the transition from a liberalised market framework to a highly regulated environment, which stretches to State ownership of facilities, cannot always be applied. The political and social mechanisms and conditions facilitating the application of the Norwegian regulatory model cannot be found easily in other basins. Nonetheless, a model like the Norwegian arrangements could be more easily be considered by countries that are currently in the process of developing hydrocarbons and do not have an already established regulatory framework.

One could argue that regulatory innovation in oil and gas transportation market is as important as technical innovation. The oil and gas transportation systems face different challenges, especially as to infrastructure development, in different countries. The unique technical characteristics and market conditions of each basin greatly affect the established regulatory framework and do not facilitate the direct application of the same regulations everywhere in the world. The differences between the various regulatory tools extend from their historical justification to the approval process of new projects, and, from the terms and conditions of service to the allocation of capacity to the flexibility in negotiating third party tariffs. All the above-mentioned regulatory tools were developed and applied in different

countries and under unique historical, political and economic context. Nevertheless, there are some lessons learned from their application that could facilitate other basins facing similar challenges and conditions.

Chapter 3

The UKCS and the Case for Government Intervention

A. Introduction

Chapter 3 provides an analysis of current and future policy options for regulation of the oil and gas transportation networks in the United Kingdom Continental Shelf (UKCS). The arrangements around third-party access to infrastructure facilities in the UKCS are investigated along with the existing market conditions and regulatory framework. This chapter also analyses the monopolistic ownership structures of transportation facilities and the market inefficiencies arising in the market. Price discrimination, high pricing in access to infrastructure as well as the vertical structure of the market are examined in an effort to discuss various regulatory tools and their application in the UKCS. The chapter aims to also provide a discussion of the role and limitations of government ownership in the UKCS.
The business landscape and the investment dynamics in the UKCS oil and gas industry are constantly evolving. International super-majors were once dominating the basin as they were attracted by the prospects of indigenous hydrocarbon reserves. In the past decades, with their financial capacity and technical capability, they managed to proceed in major field developments, such as Forties and Brent fields, setting at the same time the foundations of current UKCS infrastructure routes and hubs. This infrastructure remains the spine of any oil and gas activity in the basin and requires continued investment to remain functional and economically viable. In the new diversified UKCS business environment, with independent oil and gas companies of many shapes and sizes, a wide range of business models is developing to both tackle the contemporary challenges as well as exploit the opportunities of the current North Sea oil and gas industry.

The UK offshore oil and gas industry provided, and can keep providing for many years to come, significant benefits to the country in terms of security of energy supplies, taxation,

exports and employment. Specifically, the oil and gas sector support the, direct or indirect, employment of 450,000 people across the country and delivers approximately £7 billion worth of international exports of related goods and services (Wood, 2014). Furthermore, in 2014, the industry contributed £2.8 billion in direct taxes with the overall oil and gas production contribution to reach £271 billion (2008 money) in tax revenues over the last forty years (UN, 2016). Even though both the UK along with the rest of the world are moving towards a less carbon-intensive future, the Government recognises that oil and gas remain a vital part of country's energy system. To maximise the economic recovery[29] of the estimated 11 to 21 billion economically recoverable boe[30], new investment and technological innovation in the North Sea need to be encouraged (Treasury, July 2014).

Both Prof Alex Kemp (Kemp & Phimister, July 2010) and the Wood Review[31] have identified some key factors impacting upon reduced investment in field development, declined production and decreased production efficiency levels. These factors include the lack of investment in new facilities, the need to maintain existing assets in an appropriate condition and, of course, access terms to infrastructure. Government's possible measures to maximise the economic recovery of reserves from the UKCS will determine substantially the size of oil and gas industry's future contribution to the UK's economy. Initiatives such as Sir Ian Wood's review, the establishment of Oil and Gas Authority (OGA) as the new regulator (following the recommendation included in the Wood Report) and the expanded allowances are some examples of the willingness of the Government to safeguard the future of the oil and gas industry and maximise the sector's contribution to the economy.

The first section of the chapter consists of a description of the UKCS oil and gas industry including the current business environment as well as the distinct characteristics of the transportation and processing facilities operating in the basin with a special attention to the key issues the industry faces. The second part provides a comprehensive analysis of the

[29] The so-called MER-UK strategy (Maximisation of Economic Recovery-UK).

[30] Barrels of Oil Equivalent.

[31] In June 2013, the Secretary of State for Energy and Climate Change requested Sir Ian Wood to conduct an independently led review of the UKCS oil and gas recovery. Specifically, the so-called Wood Review investigates ways of maximisation of the economic recovery of the UKCS. The Government is committed to fully implementing all the Review's recommendations (Wood, 2014).

vertical structure of the UKCS industry, the regional monopolies dominating the basin as well as the degree of market concertation. The third section presents the current regulatory landscape focusing especially on the terms and conditions to third party access to critical infrastructure as well as the advantages and disadvantages of a self-regulatory regime. The fourth part develops a critical discussion on the regulatory challenges in the UKCS; the Domino Effect, the price discrimination, the high pricing of third party transportation tariffs and the effect on exploration. Potential regulatory tools, some of them presented previously in Chapter 2, and their application in the case of the UKCS are analysed in the last section. z

B. The UKCS Business Environment; Overview of the Key Issues- Dealing with a Mature Basin

In 2015, fifty-one years have passed since the first licencing round in the UKCS and, although the basin is moving towards the second half of its lifetime, experts conclude that there are still 40 to 60 years of active resource extraction ahead (EIA U. E., 2016). The maturity of the basin, the declining production as well as production efficiency, the relatively small average size of new fields, the low levels of exploration activity and the high capital and operational costs per barrel are some of the characteristics of the UKCS business environment.

While in the past North Sea operations were dominated by the major oil companies, today's UKCS upstream environment is much more diverse as there are currently 125 groups of companies involved as licensees in offshore exploration and production- the majority of them middle or small size companies (OGUK, October 2014). The commercially and technically demanding assets in the West of Shetlands (WoS), the high pressure/ high temperature opportunities in the Central North Sea (CNS) and the enhanced oil recovery projects (EOR)[32] and brownfield investment in mature oil and gas fields across the basin, shape the current business and investment climate in the UKCS.

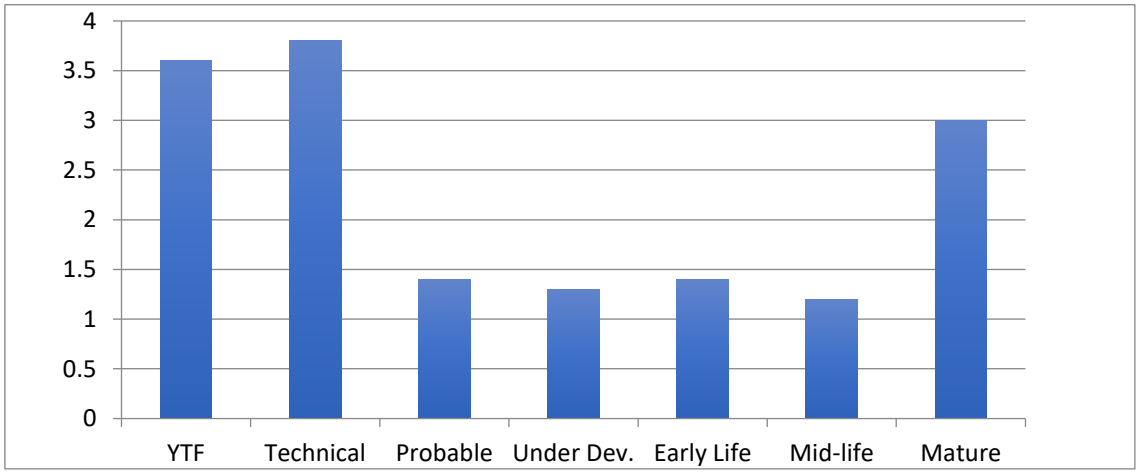
B.1. The maturity of the basin

Given the maturity of the basin (see Figure 3.1), the extraction and development of the remaining reserves are becoming increasingly challenging and more expensive. Maintaining high levels of production in the fields close to the end of their lives is costly and requires significant investment in order to both preserve but also extend the life of their existing infrastructure.

[32] Oil production is separated into three phases: primary, secondary and tertiary, which is also known as Enhanced Oil Recovery (EOR). Primary oil recovery is limited to hydrocarbons that naturally rise to the surface (recovery of the 10% of reservoir's original oil in place) while secondary recovery employs water and gas injection to displace the oil and driving it to the surface (recovery of the 20-40% of the original oil). EOR is the way to further increase oil production and extract what is left (prospects for ultimately producing 30-60%, or more, of the reservoir's original oil). Given the fact that it has higher cost, it is closely associated with the price of oil and overall economics of the field (Kokal & Al-Kaabi, 2010).

Despite the £14.8 billion investment record in 2014 (Treasury, July 2014), the maturity of the basin is making the recovery of the remaining oil and gas reserves both technically and economically challenging. As a result, companies struggle to sustain high levels of production which, as shown in Figure 3.2, has fallen by approximately 35% since 2010 and it is expected to keep falling during the next years.

Figure 3.1: Maturity of UK Remaining Reserves (billions of boe)

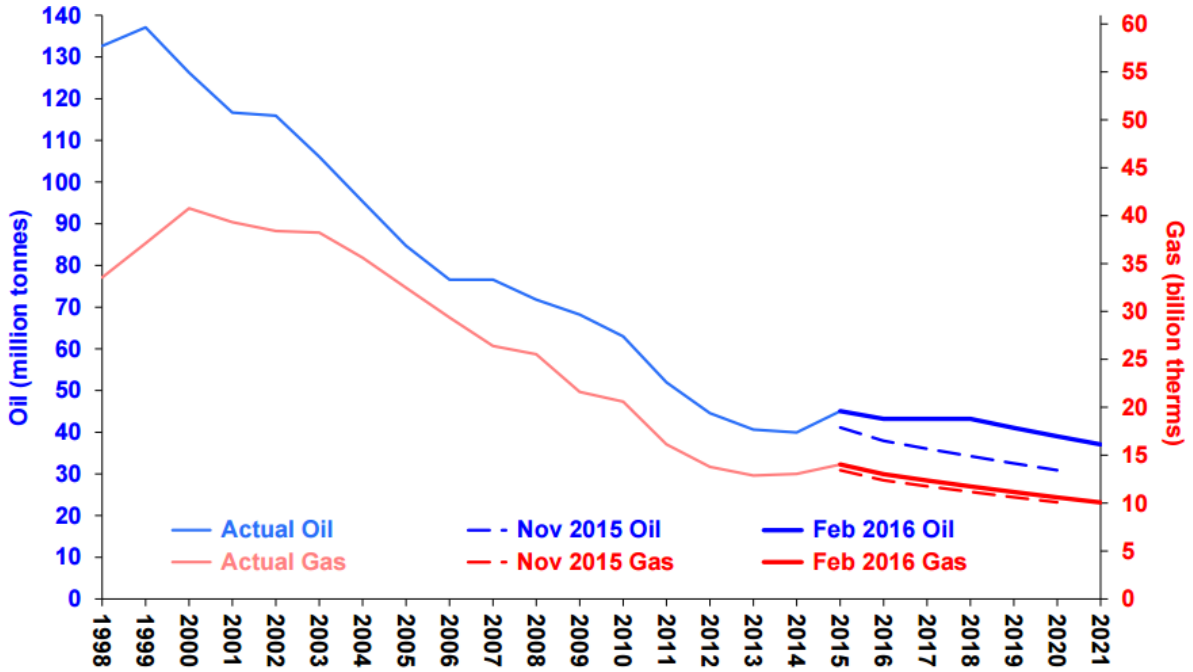


Source: Wood Mackenzie (2015a)

For example, the northern North Sea (NNS) rejuvenation project reveals the challenges mature regions are facing. According to the Oil and Gas UK report in October 2014, the mature assets of NNS struggle to compete for funds necessary to improve their production rates (OGUK, October 2014). Unless further, near -field, exploration is taking place, these assets face an uncertain future. Uncertainty, though, regarding the lifespan of critical infrastructure assets also hinders new exploration activity, therefore creating a vicious circle.

The capital intensity of developing large fields along with the costs of incremental projects discourage many companies from expanding their activities in the UKCS. In addition, maintaining and enhancing the existing production and infrastructure is substantially challenging for asset owners. There is the urgent need to attract more investment in producing fields, such as those in the NNS, for these developments to avoid imminent shutdown and premature decommissioning; this would lead to the loss of critical infrastructure depriving consequently a significant part of the UKCS from future development. The OGA is working closely with the operators to ensure that late-life asset management supports the maximisation of the economic recovery of the UKCS.

Figure 3.2: Actual/Projected UKCS Oil and Gas Production

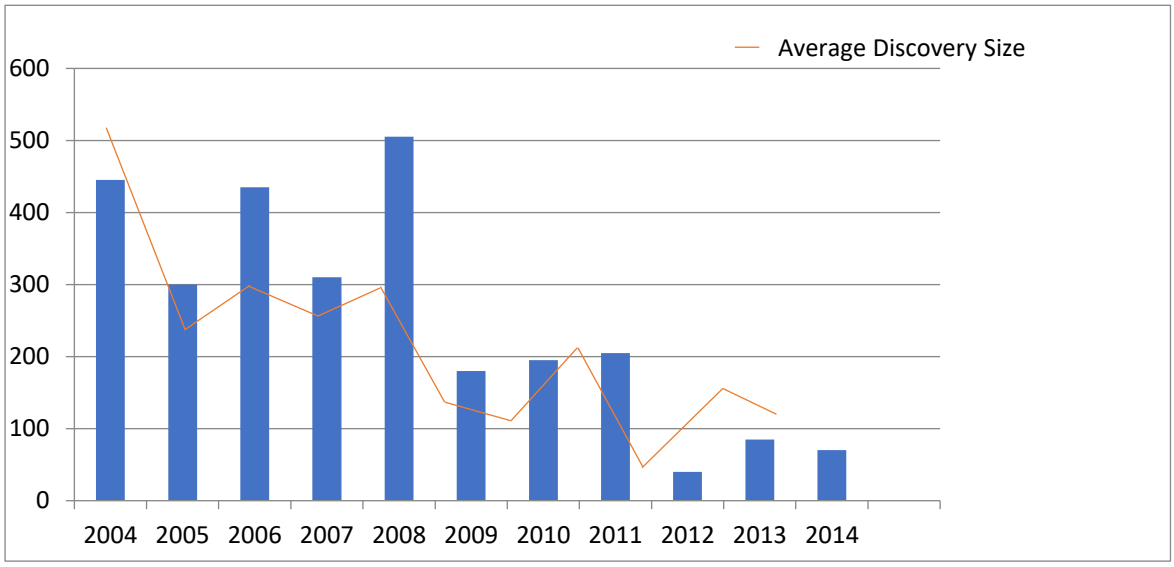


Source: OGA (February 2016)

B.2. Smaller less commercially viable new discoveries

Exploration rates have been relatively low since 2009 as the exploration and exploitation of new fields are more technically challenging. In addition, new discoveries tend to be smaller making the benefits from the development of such fields less attractive. As Figure 3.3 indicates, most of the newly discovered fields are either small in size or rather technically difficult to be developed, or both. Considering the fact that in this type of new fields a stand-alone infrastructure development would often be deemed uneconomic, access to the UKCS existing infrastructure is vital.

Figure 3.3: Volumes (mmboe) and Average Discovery Size



Source: Wood Mackenzie (2015a)

In addition to the fact that maintaining the existing ageing infrastructure entails high costs, the production from the fields for which the infrastructure was originally developed is declining. Incentivising the owners of such infrastructure to prolong the life of their assets is key so that the small field developments can gain access to critical pipeline systems and hubs. This downward trend of the average size of discoveries can be mitigated through improving the exploration outlook which remains at an all-time low.

In recent years, production in smaller fields is adversely affected by the inadequate levels of infrastructure maintenance in the UKCS. A significant factor contributing to the decline in production efficiency levels is the insufficient investment in inspection, maintenance and repairs by operators (Scotland's Independent Expert Commission on Oil and Gas, July 2014). Sustaining the existing key facilities to high standards is of paramount importance as it will both facilitate the extension of assets' life prior to decommissioning and it will enable further exploration activities and field development.

According to the Oil & Gas UK 2016 production data (measured in barrels per day), 170 offshore fields, out of the 223 in total, produce oil volumes lower than the average 4391.6 bpd and, therefore, they can be classified as 'small' developments (Oil & Gas UK, 2016c). Out of the total of 942,095.45 bpd daily on average production on 2016, the 214

(approximately 924 bpd) are coming from smaller fields or, to put it differently, the 22,8% of total daily oil production for the same period[33].

B.3. The global oil price and industry profitability

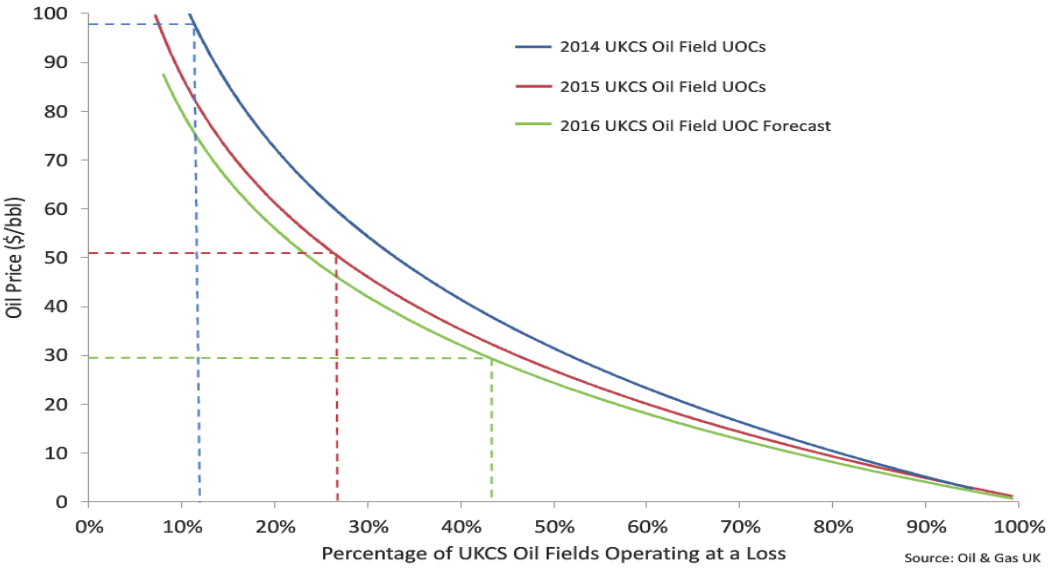
In addition to the high-cost environment of the UKCS, investors are concerned regarding the downside price risk. Although Brent crude had been stable for several years in a range of $110- 115/bbl, since summer 2014, the price has fallen drastically by $20 to approximately $95/bbl in early October 2014 (OGUK, October 2014). It has averaged around $52.78/bbl throughout 2015, only to experience a new fall in 2016 and stabilise on average to approximately $43/bbl (Nasdaq, 2016). The increased exposure to downside risk in oil price causes the UK to be at a competitive disadvantage as further development of new fields, or infrastructure, is expected to cease partly because of the low global oil price environment. The lower oil price affected adversely both the economic viability of some assets as well as the economic contribution of the oil and gas industry to the UK economy. However, according to OPEC, the long-term oil price to 2040 is predicted to reach $100 per barrel reflecting the global rise in costs of production and the simultaneously increased demand coming from the rapidly developing economies of Asia (US Energy Information Administration , July 2013).

Figure 3.4 presents the cost of operating an asset in the UKCS showing that over 40% of fields are operating at a unit cost which is higher than the prevailing oil price (around $30/bbl according to the OGUK Activity Survey 2016). According to the same source, this percentage of fields represents more than the 15% of the total production in the basin. Even the fields that have positive cash flows are not generating adequate margins to support reinvestment (Oil & Gas UK, 2016c). The low global oil price, thus, has a negative effect in the funding of new projects as the main source of investment in the oil and gas industry is the returns of existing assets which have been plummeted due to the low prices. Moreover, the fall of the oil price from $99/bbl in 2014 to a little more than $50.00/bbl in 2015 contributed to a £4.2 billion cash flow deficit across the oil and gas sector despite the significant £5 billion reduction in total expenditure (see Figure 3.5). Therefore, despite industry's relatively

[33] For detailed data, see Appendix II on data for oilfield size in the UKCS.

successful progress on cost reduction, the Oil and Gas UK foresees the cash flows to be worsen during the next years unless there is a sharp recovery in the global oil price (Oil & Gas UK, 2016c).

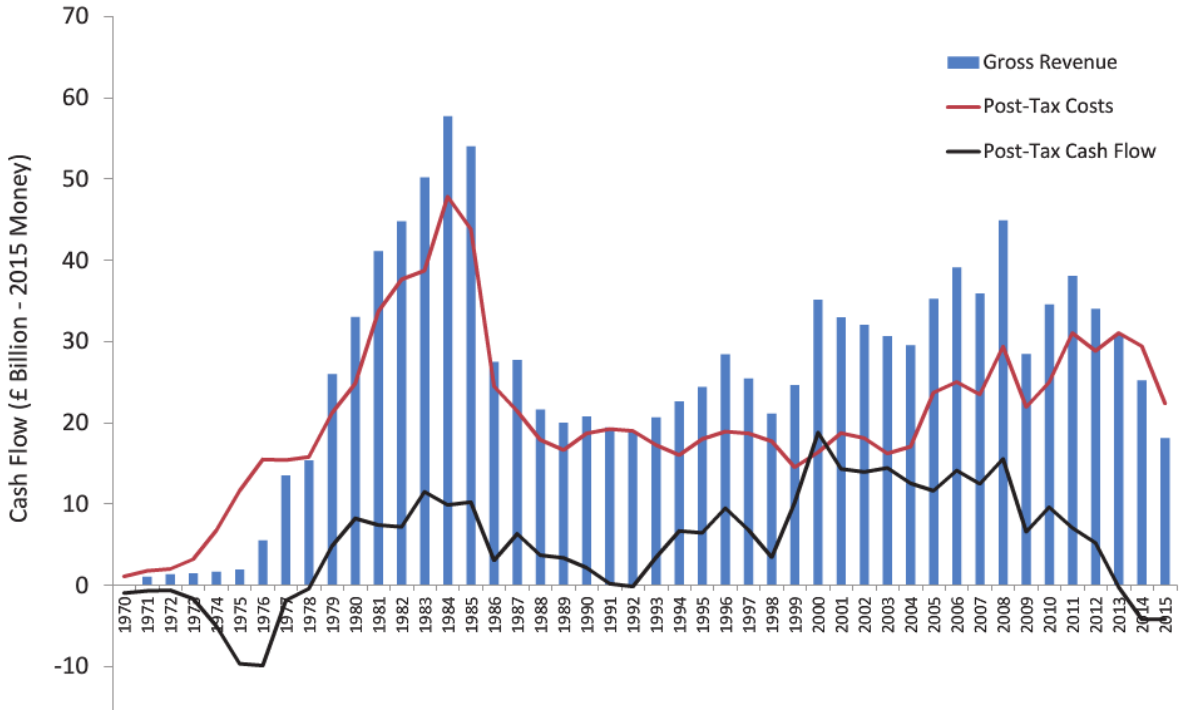
Figure 3.4: Proportion of Oil Fields Operating at Loss



Source: Oil & Gas UK Activity Survey 2016 (2016c)

Despite the substantially falling investment rates in combination with the escalating exploration costs, there are several positive indicators representing a major opportunity for future activity in the UKCS. More specifically, the Oil and Gas UK estimates that the remaining potential in the UKCS ranges between 15 and 24 billion boe in addition to DECC's assessment that the remaining recoverable reserves will reach 11.1-21 billion boe. The growth in exports of oil and gas services, the potential exploration and extraction from offshore shale as well as the continuous conventional exploration and production are only some of the opportunities present in the British oil and gas sector. This positive potential contains high economic and technical risks which should be tackled in order to achieve the maximisation of the economic recovery of the remaining reserves and enable the UKCS to deliver its full potential.

Figure 3.5: Revenues, Costs and Cash Flow on the UKCS



Source: Oil & Gas UK Activity Survey 2016 (2016c)

B.4. Taxation and the benefits to the society[34]

Traditionally, the oil and gas profits retrieved from extraction activities in the UKCS fall within two distinct fiscal regimes: Petroleum Revenue Tax (PRT) and two Corporate Taxes (CT); the Ring Fence Corporation Tax (RFCT) and the Supplementary Charge (SC). The overall tax regime should aim to ensure a fair return for the nation keeping the system cost-effective. During the last decade, the tax burden has doubled affecting, thus, adversely the competitiveness of the UKCS. Investors expressed concerns regarding UK's fiscal stability, increasing complexity and lack of compatibility with the current issues of basin's maturity. For instance, in the UK sector of the southern North Sea (SNS), the headline tax rates are between 50-70% while in the Dutch sector of SNS, the same taxes reach only up to 50% (OGUK, October 2014).

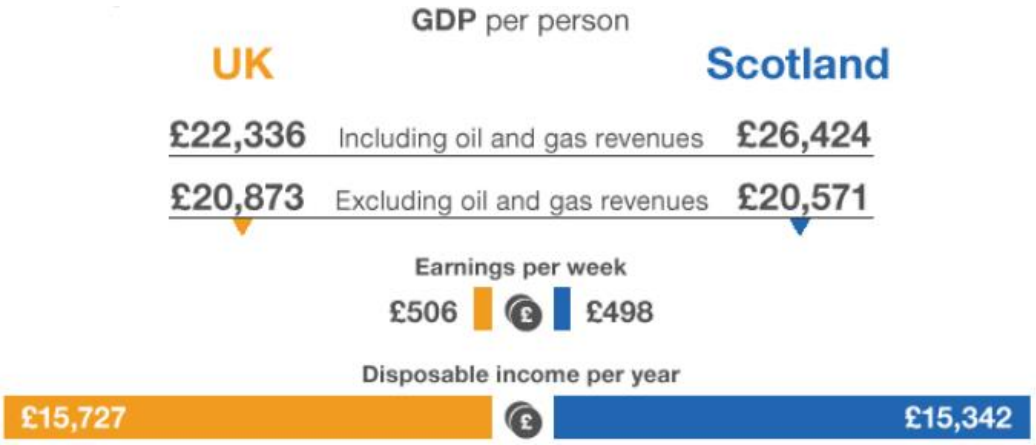
[34] For more information on fiscal regime, see Appendix III.

One of the main considerations is the trade-off of a more simplistic fiscal regime. More specifically, although a simpler regime would be more easily understood by investors, it entails the danger of not considering the commercial challenges of individual fields. From the other hand, a fiscal regime that seeks to balance tax levels and field profitability comes often with the cost of greater complexity. Another major concern regarding the fiscal regime in the UKCS is the degree to which lower effective tax rate could attract more investment in the more economically and technically challenging fields to increase future production. Nevertheless, potential benefits from lower taxes should be balanced against the risk of incurring deadweight costs by reducing the return for the nation from less economically challenging fields which would have still been commercially attractive at a higher tax rate (OGUK, October 2014).

Considering the increasing development costs in the mature basin of the UKCS and the depressed global oil price, the UK government introduced some significant tax cuts in the Budget 2016 to support the UK oil and gas industry. Specifically, the PRT was abolished, the SC was reduced effectively from 20% to 10%, and, the oil and gas companies acquired access to decommissioning tax relief allowances and other tax allowances which aim to encourage investment in infrastructure (UK Government , 2016). The Budget 2016 followed the recommendations firstly introduced in the Wood Review towards the maximisation of the UKCS economic recovery to create a more efficiently operating and attracted to new investments business environment.

Despite any issues related to the fiscal environment in the North Sea, the oil and gas industry is without a doubt a major contributor to the UK's State budget as the tax revenues are expected to reach the £57billion by 2018 (Scottish Government, 2016). In 2015-16, the sales value of oil and gas produced in the North Sea is estimated by the same source to be approximately £13.4 billion despite the low profitability and the increasing decommissioning expenditure. It is worth mentioning that over £330 billion has been paid in corporate taxes since production on the UKCS began (Oil&Gas UK, 2016a). Furthermore, the industry employs approximately 450,000 people across the UK and, since 2012, oil and gas companies have paid £6.5 billion in taxes yearly on average to the UK government.

Figure 3.6: Relative Living Standards



Source: ONS (Scottish Government, 2016)

In 2014, North Sea supplied 67% of the country's oil demand and 53% of the UK's gas requirements providing a major boost to the overall economy (UK Government , 2016). Figure 3.6 represents oil revenues included in GDP figures. According to the Office of National Statistics (ONS), Scotland is shown to generate more per head of population than the UK as a whole, while the GDP per capita is substantially reduced when oil and gas revenues are excluded, highlighting the significance of the industry for the society (Scottish Government, 2016).

C. The UKCS and the Vertical Structure of the industry

As presented previously in Chapter 2, the various oil and gas facilities and systems are broadly defined into five categories based on their utilisation in the oil and gas production stream; exploration (takes place prior to the decision for field development), production (for production and stabilisation of oil and gas), upstream transportation (transportation of hydrocarbons onshore, initial offshore processing), refining (condensates' transformation into marketable products), and, distribution (distribution of hydrocarbons and petrochemicals to end-consumers) (Devold, 2013). In the UKCS, some of these stages are heavily interlinked and often vertically integrated. Several companies are involved in most, if not all, stages of production by conducting exploration activities, developing fields, operating pipelines and running processing facilities. There are very few examples of companies operating in the North Sea which are specialised in facility management or decommissioning activities without any vertical link to upstream operations. These examples, although they challenge the traditional models of ownership existing in the UKCS for decades, are hardly sufficient at the moment to transform the current business environment in the basin.

C.1. Vertical Integration in the different Production Stages

C.1.1. Exploration & Production (E&P)

Even though smaller companies specialised in exploration activities are growing fast in the North Sea, the majors and integrated firms still have the strongest presence when it comes to exploration and development of new wells. Even though a limited number of independent companies, like Hurricane Energy, specialise in exploration, most of the overall exploration activity in the UKCS is still conducted by majors or, alternatively, smaller integrated companies seeking to expand their portfolio of operating assets in the area. Even firms traditionally focussing on exploration, such as Perenco UK, have moved towards a more vertically integrated model by including development and operatorship of assets in their business activities. Furthermore, it is worth mentioning that the low oil price environment took a toll in the independent exploration companies. For example, on February 2016, First Oil Expro, a company specialising solely in exploration activities, after a long financially

distressed period, had sold its two main subsidiaries to the vertically integrated Zennor Petrolem (FT, 2016). As a result, it is becoming obvious that the exploration sector in the UKCS is highly integrated considering the fact that the vast majority of companies undertaking exploration drilling own and, also, operate production platforms, transportation facilities and processing stations.

Similar to exploration, production in the UKCS is a highly integrated stage of the oil and gas upstream sector. The literature along with any additional information found in various research sources related to the structure of the market do not provide a single example of a company undertaking solely production activities[35]. It is safe to assume that all production companies currently operating in the North Sea are following a vertically integrated business model, as they are involved in exploration, transportation and refinery activities as well.

C.1.2. Transportation & Offshore Processing

From 1975 to 2013, almost over two thirds (approximately up to 86%) of oil produced was exported via three pipeline systems: Forties, Brent and Piper (GCA, 2015). As it appears in Figure 3.7, there are five main pipeline networks in the UKCS- Shuttle, Piper, Brent, Forties and Ninian-, which in combination control almost 90% of the total hydrocarbons' transportation in the basin (GCA, 2015). This highly concentrated system of transportation and export routes can easily be explained through the challenge of the economic viability of new discoveries; it had always been much cheaper to tie up a newly developed field to existing infrastructure and pay transit tariffs to an existing pipeline/hub owner, instead of investing in an alternative method, such as a standalone infrastructure facility. As consequence, North Sea production is heavily dependent on these pipeline systems. It is worth mentioning that the existing pipeline network is currently operating in decreased capacity, as a large part of it remains unutilised. It is also expected that these pipelines will experience further decline in throughput volumes in the medium term- a possibility that might marginalise their lifespan (OGJ, 2000).

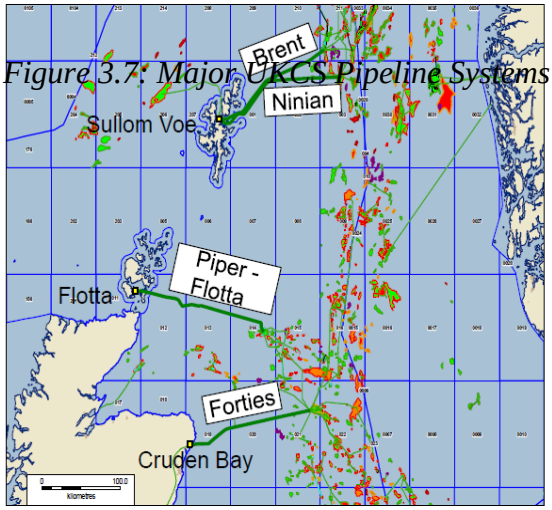
[35] Service companies providing specific technical services, such as drilling, are not be considered for this work.

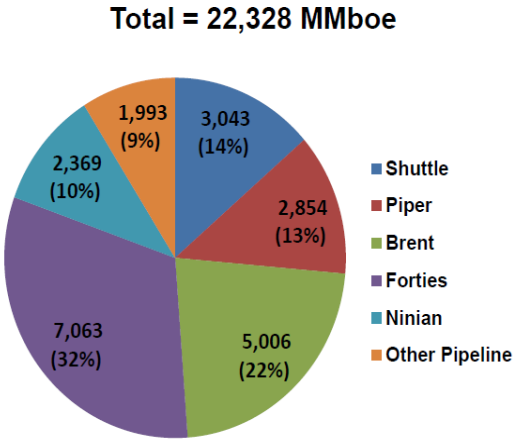
When it comes to processing facilities, there are close to 20 major processing hubs in the UKCS, usually attached to the main platform controlling the pipeline system. Considering the interconnectedness of the North Sea infrastructure network, regenerating critical facilities within prominent hubs is becoming one of the top priorities. Considering the increasingly interconnected system, most fields and especially the new discoveries are heavily relying on third party access for commercial field development plan (FDP) options.

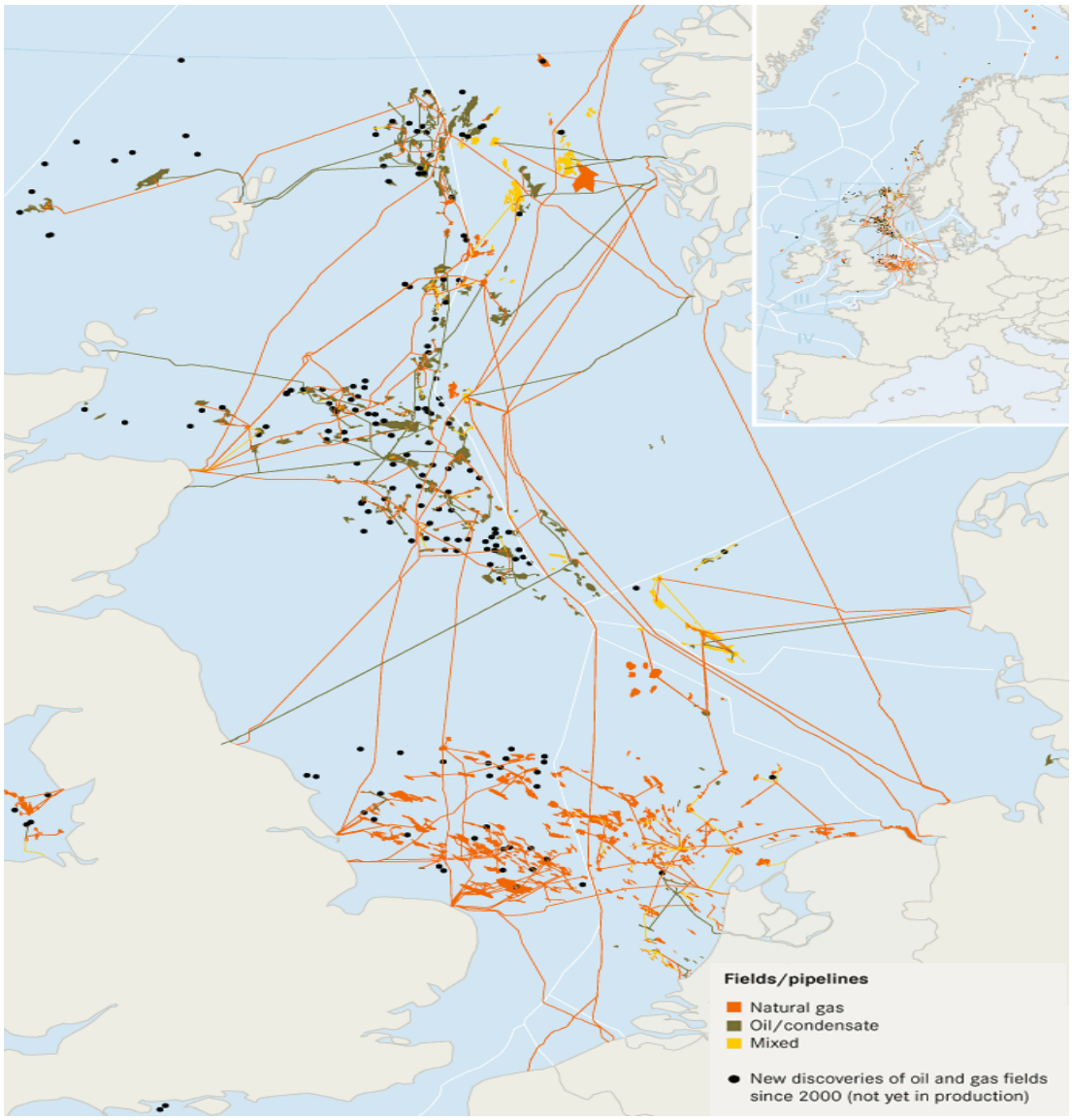
As an example, North Sea Midstream Partners Ltd. (NSMP) has agreed to acquire 67% operated interest in the Shetland Island regional gas export system (SIRGE), 100% interest in the Frigg UK gas pipeline (FUKA), and 100% interest in the St. Fergus gas terminal from Total SA for $905 million (OGJ, 2015). FUKA is connected to the Frigg field on the UK-Norway median line and to the St. Fergus gas terminal in Scotland.

Production from the Frigg field ceased in 2003, therefore, the field is fully abandoned, but Frigg UK pipeline system bypasses the field structures. Around 20 fields in the UKCS and Norway currently utilise the Frigg UK pipeline. The FUKA pipeline is delivering gas from some 20 fields in the NNS to the terminal at St. Fergus. Following completion of the deal, the systems will be operated on behalf of NSMP by its long-term operating partner PX Ltd., which already operates NSMP's gas processing plant. The sale of Total's interests in FUKA and SIRGE follows the example provided by Antin's acquisition of Central Area Transmission System (CATS) from BP for approximately £324 million.

Figure 3.7: Major UKCS Pipeline Systems







Source: DECC and Deloitte PetroView (through (GCA, 2015))

C.1.3. Terminals & Refinery

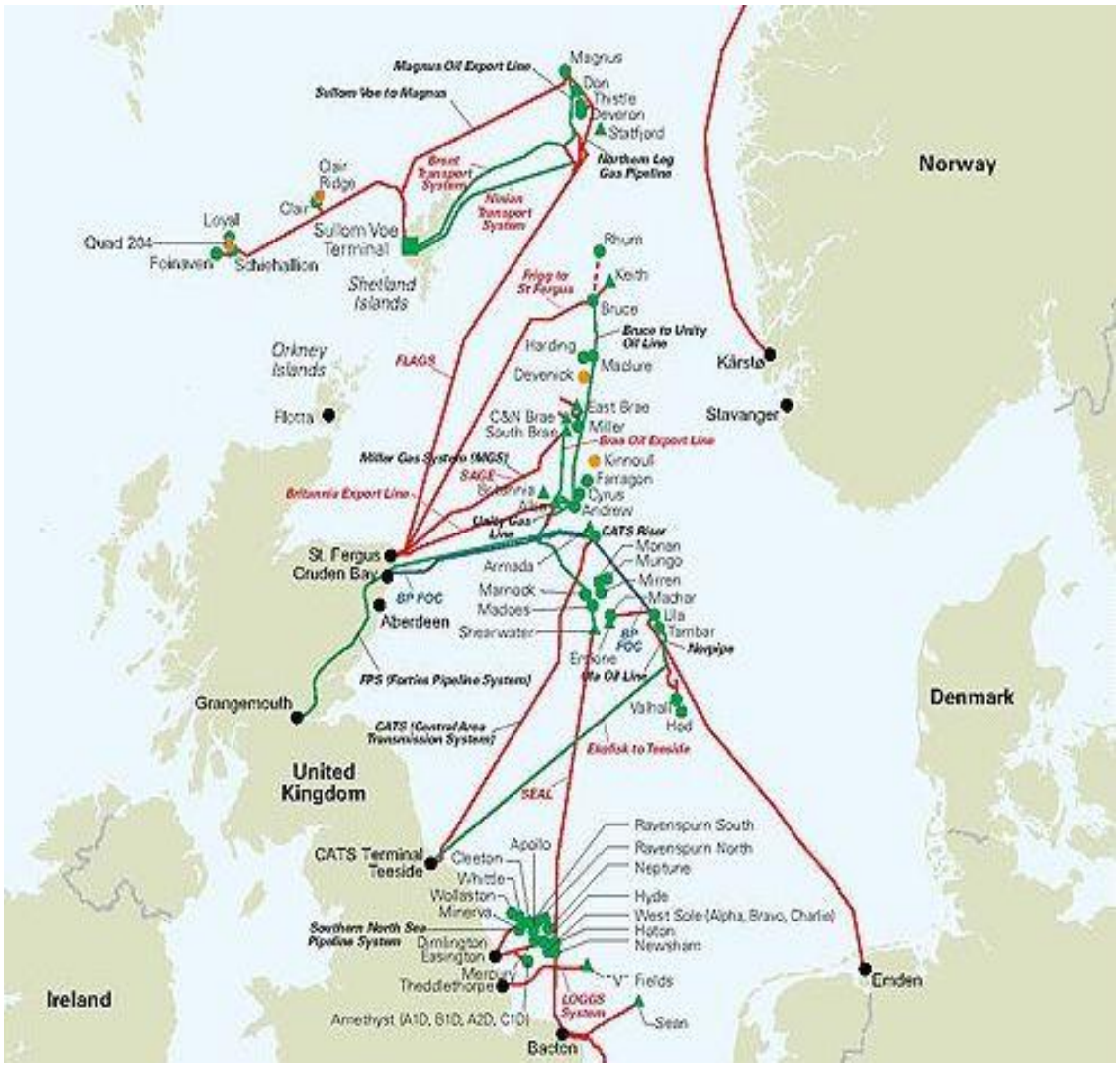
There are only three main oil terminals in the UKCS; Sullom Voe (Shetlands Islands), Flotta (Orkney Islands), and, Cruden Bay (Aberdeenshire). Sullom Voe terminal is by far the largest oil terminal in the North Sea handling approximately half of all oil produced in the UKCS. It has been owned since its construction by the Ninian and Brent Pipeline Systems partners (Talisman, Canadian Natural Resources and BP) and operated by BP plc. The terminal receives oil through the Brent (TAQA Bratani) and Ninian (BP) pipeline systems. The second largest major oil terminal serving the UK North Sea is Flotta, which provides the landing for the Piper pipeline network. Both the terminal and the pipeline are operated by Talisman Sinopec Energy UK. Cruden Bay is connected to Forties Pipeline operated by BP plc and in close proximity with St Fergus Gas terminal[36].

Regarding natural gas, there are two key terminals where the gas produced in the UKCS ends up; Teeside (gas) terminal which is connected to the Central Area Transmission system (CATS), and, St Fergus terminal that is connected with three highly important gas transporting pipelines- SAGE, SEGAL and FLAGS pipeline systems. Teeside facilities are owned and operated by NSMP. It is worth highlighting that NSMP is a company specialised in transportation and processing facilities without any links to upstream production and exploration activities. On the contrary, St Fergus terminal is a joint venture (JV) of seven vertically integrated firms, including some majors (Shell, BP, and Centrica) with Apache being the principal owner and operator.

In the UKCS, terminals and refineries are in general vertically integrated, especially regarding oil. Apart from the NSMP which recently acquired Teeside infrastructure, the rest of the companies operating in this production stage are also involved in all parts of upstream oil and gas production process.

[36] For a more detailed representation of the complex UKCS main Oil & Gas terminals and pipelines, see Figure 3.8.

Figure 3.8: Main Oil & Gas Terminals



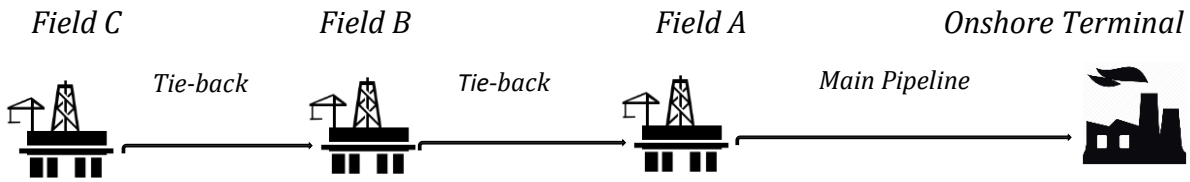
Source: Traimeca Pyro (2013)

C.2. The Vertical Integration in the UKCS

Observing the five main pipeline systems as well as the UKCS terminals, it is becoming clear that they create easily distinguished regional monopolies considering that they control large geographical regions in the basin. Brent and Ninian monopolise the transportation of hydrocarbons in the North, Piper has a great proportion of the Central North Sea (CNS) and Forties gets the lion's share in the South (see map on Figure 3.8). The key characteristic of these pipelines lies to the fact that they are the ones that connect the fields with the onshore

terminals. Smaller pipelines and hubs are running all over the basin creating tie-backs between the fields in order to feed the main pipeline systems which are the ones that essentially transport the oil and gas produced to the final destination- the onshore processing facilities and network.

Figure 3.9: Offshore Transportation Schematic



The above schematic represents in a simplified way the transportation structures existing in the UKCS. Field A is the first field developed in the area for which the original infrastructure and main pipeline were created to connect it with the onshore facility. Field B, which was developed later, is required to build a tie-back to Field A and pay third party access tariffs to Field A owners in order to access the main pipeline network and be connected to the shore. Field C, a possibly new and smaller accumulation, in order to transfer its hydrocarbons produced, it needs to pay a tariff not only to Field A which owns the main pipeline, but also to Field B for the tie-back pipeline connecting B to A and for access from C to B. Therefore, Field C is paying essentially a double tariff for the vital access to both Field B and Field A transportation infrastructure and facilities.

The majority of new fields in the basin are already operating in the margin due to the low volumes of production and high capital and operational costs. Increased transportation costs are pushing these fields to their limits making them often uneconomic and discouraging new entrants to the market. It is becoming more and more challenging for these fields to retain their commercial viability, as they are dependent on the existing pipeline network and hub facilities to have an economically viable transportation route. The infrastructure owners run two types of business as they have their upstream E&P activities and, at the same time, operate infrastructure facilities with other upstream operators as customers. As a result, several conflicted priorities can arise due to this dual business activity.

Table 3.1: The United Kingdom's top 10 producing oil fields- Connections & Ownership

Field	Production[37]	Field Operator	Field Owner[38]	Pipeline System	Pipeline Owner	Terminal	Terminal Owner
Buzzard	154	Nexen	Nexen	Forties	BP	Cruden Bay	BP
Forties	40	Apache	Apache	Forties	BP	Cruden Bay	BP
Jasmine	39	ConocoPhillips	ConocoPhillips	FPSO	ConocoPhillips	Flotta	Talisman Sinopec
Captain	21	Chevron	Chevron	FPSO	Chevron	Nigg Terminal	Ithaca
Wytch Farm[39]	-	-	-	-	-	-	-
Franklin	17	Total	Total	Forties	BP	Kineil	BP
Foinaven	17			Ninian	BP	Sullom Voe	BP
Alba	16	Endeavour	Chevron	Forties	BP	Cruden Bay	BP
Clair	16	BP	BP	West of Shetland (WOSP)	BP	Sullom Voe	BP
Gryphon	12	Maersk	Maersk	FPSO	Maersk	Sullom Voe	BP
Total top 10 Fields	*350*	*Total UK*	*787*	Sources: DECC Fields Database (2017)			

[37] Measured in thousand barrels per day.

[38] In the case of a Joint Venture (JV), the owner is the JV party holding the highest percentage of shares.

[39] Wytch Farm is an onshore oil field with corresponding processing facilities located in the district of Dorset, England. It is the largest onshore oil field in Western Europe and, although BP previously operated it, the facility was recently taken over by Perenco. However, since this work is dedicated to the upstream offshore sector, no details of the onshore developments are provided in Table 3.1 to maintain simplicity and consistency.

Most commonly, in the vast majority of the cases, vertically integrated companies control both the pipelines and the terminals. In terms of oil production, Nexen is the largest field operator in the UKCS as the company operates eight fields which combined account for about 24% of total UK production in 2014 (EIA U. E., 2016). The UKCS's largest producing field was the Nexen-operated Buzzard oil field even though production in 2014 was 15% lower than in 2013, mainly due to extensive maintenance-related outages (EIA U. E., 2016). When it comes to hydrocarbons final processing, the UK is a net exporter of fuel oil and gasoline as the British refineries produce more of the products that are demanded domestically. However, imports continue to grow, as the UK refineries cannot meet local demand for many other fuels, such as diesel (EIA U. E., 2016). In transportation, most of the UK infrastructure used to be operated by a relatively small group of companies, which also own the remaining UKCS undeveloped reserve potential.

Through observing the UK's top 10 producing fields (see Table 3.1) in combination with their connectivity to transportation facilities as well as the ownership patterns, it becomes apparent that there is no significant diversification in the companies owning the infrastructure facilities while the vast majority of them are operating vertically in the industry. Even in the case of JVs, usually there is one sole company controlling over 50% of the ownership stake of the facilities.

Nevertheless, new monopolies arise in several geographical areas of the UKCS. For example, the importance of the Forties field along with its extended pipeline system has made it a status symbol in the North Sea. In 2003, BP sold its 96% share in the field to Apache Corporation (Apache Corporation, 2015) making some traditionalists likened it to selling off the family silver and starting a discussion regarding the rise of a ''new area'' in the UKCS's market dynamics. After the re-evaluation of the field by Apache Corporation, it was revealed that the field's life could be extended for at least another 20 years. It is important to highlight the fact that even though BP lost the revenues coming directly from the production of the field's remaining reserves, the company retained full ownership of the Forties pipeline system. As a result, BP could still profit from Apache's exploration and development investment in Forties field through the third-party tariff charges and without needing to proceed to any development investments itself.

However, in April 2017, BP announced that an agreement had been reached for the transfer of ownership for all Forties pipeline system (FPS), including the main Forties offshore and onshore pipelines and other associated pipeline interests and facilities, to INEOS (FT, 2017). Subject to partner, regulatory and other third-party approvals, operatorship of the FPS assets and business were transferred to INEOS. However, the sale did not affect BP's existing rights to the capacity in the FPS, as the company continued to use the pipeline system and infrastructure facilities to transport the hydrocarbons produced from the neighbouring BP-owned fields (FT, 2017)[40].

The overall recent business activity of INEOS itself represents an interesting example of the changing market environment and monopolistic dynamics in the UKCS. INEOS is a characteristic case of a smaller company proceeding to mergers and acquisitions in the North Sea to move away from basic production operations to a more multi-dimensional vertically integrated portfolio. After the sale of Forties pipeline system is completed, INOES will be responsible for a strategic UK asset which delivers onshore almost 40% of the UKCS oil and gas (INEOS, 2017). The importance of INEOS new businesses can be reflected to numbers as the 20% of the oil which passes down the pipeline feeds the Cruden Bay refinery (part of the sold Forties pipeline facilities) providing approximately 80% of Scotland's fuel (INEOS, 2017). In addition to Forties, in May 2017, INEOS announced that it has agreed to acquire the DONG Oil & Gas Business from DONG Energy (INEOS, 2017). DONG's portfolio extends to several assets in the promising, in terms of potential reserves and exploration activity, West of Shetland area. The mix of newly discovered long-life assets along with great potential for exploration activities will provide the company with a production of an average of 100,000 bpd[41] and a further 570 million boe of commercial and potential oil and gas reserves not only in West of Shetland but also in Denmark and Norway (INEOS, 2017).

It appears, thus, that smaller companies, which were involved only in exploration and production activities until recently, choose to move to a more integrated portfolio by including transportation and processing to their business. Major companies, which dominated

[40] In Table 3.1, it appears that BP has the ownership of the Forties Pipeline System because, at the moment this work is written, the BP-INEOS deal has been announced but not yet completed.

[41] Barrels of Oil Equivalent per Day.

the basin for decades, leave the market shifting consequently their regional monopolistic power to new players. Despite the change in the traditional monopolies in the UKCS, the vertically integrated structure of the market is still strong with some very few exemptions, such as midstream-specialised firms like Nord Sea Midstream Partners Ltd and Antin.

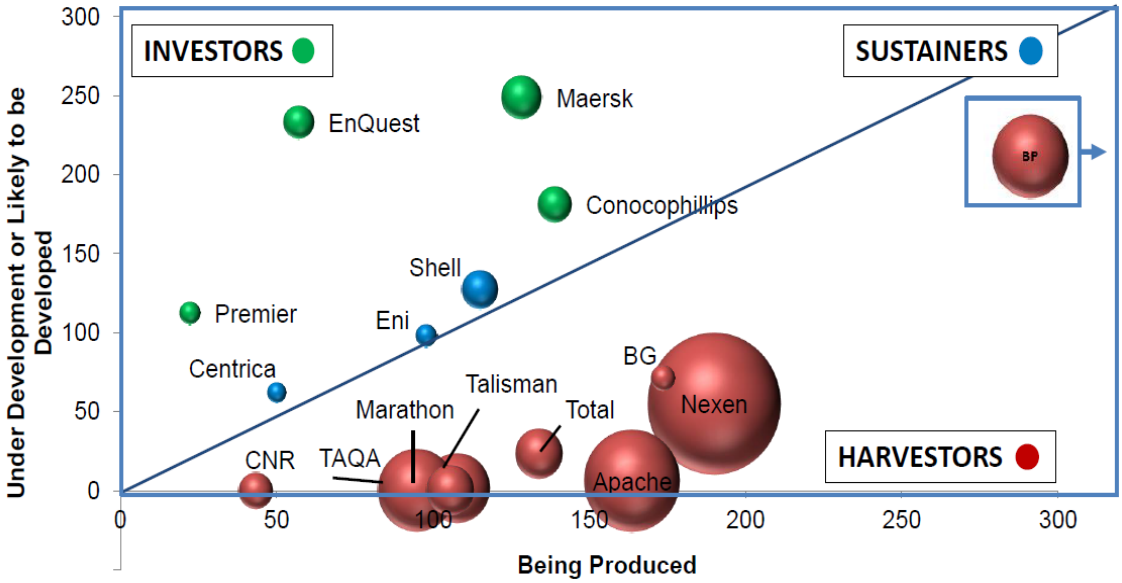
When it comes to transportation, a concerning trend is that indirect hubs and dependants[42] appear to be significantly less efficient than direct hubs, with the gap widening since 2000 (McKinsey & Company, April 2014). This is likely to be the case partly due to the operational impacts from an increasingly interconnected system. For example, in early 2013, the operator of the Brent crude oil pipeline in the northern North Sea (NNS), Abu Dhabi National Energy Co. (TAQA), had to close down the system due to a hydrocarbon leak which was discovered at the Cormorant Alpha platform; a decision which affected another 27 fields. Cormorant Alpha platform handles approximately 90,000 bpd of crude oil feeding the Brent system pipeline including 10,000 bpd from Cormorant field (OGJ, 2013). The Brent system transports crude oil from more than 20 North Sea fields to an export terminal at Sullom Voe in the Shetlands Islands, operated by BP PLC. In general, prolonged outages like the example above can widely affect adversely production and asset production efficiency.

Figure 3.10 represents a 'harvestor/investor' plot for the pipeline export hub operators with the bubble size to be proportional to the volume of hydrocarbons exported via the respective hub (GCA, 2015). According to Figure 3.10, a pattern appears to emerge as the operators of the biggest hubs (bigger bubbles) are 'harvestors', meaning that they do not easily invest in new developments but prefer to exploit existing operating fields. At the same time, exploration activities and field development are initiated mainly by smaller (mainly in terms of volumes of hydrocarbons share) investors. The new dynamics arising in the North Sea business environment may see a divergence in business models – with upstream operators focusing solely on E&P activities, while companies specialised on midstream activities focusing on managing hub facilities. Despite, though, these arising trends, the industry remains in the largest part vertically integrated with companies operating in all stages of the upstream production process. It is possible that this new business models will play a greater

[42] The term "dependent" refers to fields which are tied to and rely on third-party hubs for export.

role in industry's market structure in the future. However, they currently appear more as the exemption rather than the general rule.

Figure 3.10: UKCS Hub Operators (Bubble Size = 2013 Volume through Operated Hubs)



Source: Wood Makenzie and DECC (through (GCA, 2015))

With the production stages easily differentiated, the UKCS do not constitute an exception from the general rule of the frequent appearance of vertical integration in the oil and gas industry. In several cases, vertical integration can lead to barriers of entry and excess profits on behalf of the monopolist controlling a specific geographic area given the fact that the incumbent can increase the capital requirements for new entrants by integrating into an additional stage of production. However, if double marginalisation appears, vertical integration could actually be desirable.

More specifically, in double marginalisation, two different firms have their respective market powers applying their own mark-ups[43] in tariffs. In the UKCS, it is not rare two different monopolists to exist in the same geographical area; one controlling the pipeline transportation network and the other the offshore processing infrastructure charging different prices for each service, or, controlling two different but interlinked pipelines. Due to the individually charged monopolistic prices, often set above the marginal cost, a deadweight loss is induced

[43] Mark-up is the difference between the cost of service and the selling price.

twice making it worse off for the whole industry (Hamilton & Mqasqas, 1996). As a result of the existence of double marginalisation, the fields using both pipeline networks (tieback pipeline and main pipeline), owned by the two monopolies, pay a tariff higher than the marginal cost not just once but twice. One way to eliminate the double marginalisation inefficiency from the market is by integrating the two monopolists vertically and, hence, decreasing at least one of the deadweight losses through lower tariffs. Having a unified transportation tariff charged by one monopolistic firm for the whole route to the onshore facilities would be more desirable as the existence of two monopolies forces third-party field users to be overcharged twice. It is a classic example of the maxim that a single monopoly is better than a chain of monopolies (Joskow, 1985).

D. Current Regulatory Environment

When the British National Oil Corporation (BNOC) was still active, the regulatory framework was capable to empower the role of the Government, but after BNOC was rendered inefficient, a more light-handed regulatory approach was adopted which was based on voluntary commitments from the industry. An internationally competitive, sustainable and responsive to the market forces regulatory framework deemed necessary in order to secure the required investment in the UKCS and maximise basin's economic recovery. Scotland's independent expert commission on oil and gas, in its 2014 report, suggested that the emphasis of the future regulation should be on high quality proactive stewardship (Wood, 2014). The Wood Review also highlighted the need for a more proactive stewardship model that would be a better fit to the more complex commercial environment of the UKCS[44].

Until recently, the Regulator (mainly the Department of Energy & Climate Change, DECC[45]) had a limited role in shaping fiscal policy and, as a result, was viewed as detached from critical decisions related to tax regime, development of new allowances and other fiscal mechanisms. The increasing diversity of operators and the development of smaller, more marginal fields should be taking into account by the regulatory regime removing any obstacles to collaborative industry approaches. The Wood Review supports that the existing 'light touch' regulatory framework is not sufficient to manage the future of the North Sea basin and that operating companies should agree to shared infrastructure while, at the same time, being supported by regulatory principles which encourage collaboration. The Review provides the business and regulatory framework of the UKCS in an attempt to confront the major challenges including lower exploration activity, declining production and increasing costs.

Having as an ultimate goal to maximise recovery from the UKCS, the UK Government made a fundamental change to the regulatory framework with the establishment of the new Oil and

[44] For more information on improved stewardship regulatory actions, see Appendix IV.

[45] On April 2017, it was announced that the responsibilities of the Department of Energy and Climate Change (DECC) are to be merged into the newly established Department for Business, Energy and Industrial Strategy (BEIS). However, since this chapter was written prior to April 2017 and, since all the policies correspond to DECC's activity before the merge with BEIS, the name "DECC" is going to be used for this work.

Gas Authority (OGA) which holds the responsibility for the licensing of all exploration and production (E&P) activity and works closely with both HM Treasury and the industry. The OGA is looking to improve economic recovery, promote stewardship and tackle the non-fiscal issues that restrict development and investment across the North Sea basin. All energy and climate change mitigation policies are held within the responsibility of DECC. From the 1st of April 2015, the OGA replaced DECC as the regulatory entity accountable for petroleum licensing and regulation of the upstream oil and gas sector, including decommissioning of offshore infrastructure installations and enforcement of environmental legislation. The OGA also took over several responsibilities which were exercised until recently from the Secretary of State for Energy and Climate Change (Secretary of State). Since the creation of OGA, fundamental change to the e regulatory regime is underway. The OGA was created as an Executive Agency which is now responsible for onshore and offshore regulation. Under this new regulatory model, on the 9th of July 2015, the Energy Bill was introduced to the House of Lords. The Bill formally established the OGA as the new independent regulatory body for the oil and gas industry in the UKCS providing the new regulator with the ability to attend meetings with the operators, have access to data, offer dispute resolution and introduce sanctions (like improvement notices and fines up to £1 million) (OGUK, October 2014).

D.1. Terms & Conditions to Third Party Access to Infrastructure

Given the fact that most of the approximately remaining 20 billion boe are located in small accumulations that can only have the economic viability to be developed by connecting to nearby existing pipelines and hubs, third party access to critical infrastructure is vital. A new field investor can require access to infrastructure by one of two mechanisms; either pursuing an equity share in the facility, or, obtaining access to infrastructure '*as consequence*', meaning to pay tariffs to the asset-owner. Private negotiations between the field owners ('shippers') and the infrastructure owners ('carriers') determine the terms and conditions of access to infrastructure. The owners of new smaller discoveries need to employ the additional capacity in nearby existing host facilities to commence exploration and appraisal operations as developing their own facilities is uneconomic. The host facilities provide not only operator services for transportation, but they can often also conduct the initial blending, separation processes and delivery of the outcome stream into an integrated pipeline system that leads to

onshore facilities for further treatment before ending up to the market (Memery Crystal LLP, 2012).

For several decades, the negotiations for access between 'shippers' and 'carriers' set the foundations for all the terms related to third party infrastructure usage in the UKCS. After the dissolvent of the BNOC, government intervention passed to a laissez-faire approach that consequently led to the development of monopoly practices by some infrastructure owners. Since the imposing of Petroleum Tax Revenue (PRT) on tariff receipts during the seventies and eighties, third-party business lost its high profitability. As a result, it is speculated that most of the major pipeline systems have operated for years under an integrated E&P business model. They were providing services to the original fields that initiated their development as well as several larger customers without, though, pursuing actively new clientele (Memery Crystal LLP, 2012). In the case of integrated pipelines with the tie-in point located to a host facility already connected to the pipeline, a template of Transportation and Processing Agreement (TPA) sets the standard terms for all shippers- a method which is considered legally, commercially and technically less challenging (Memery Crystal LLP, 2012). After the agreement of the basic terms of the access to the facilities, the Transportation, Processing and Operator services agreements (TPOSAs) regulate the extraction services provided by the host facility while processing and downstream transportation are arranged by the pipeline owners through TPAs.

The complexity of the negotiation process for the transportation contracts lies partly to the fact that they take place simultaneously with both the owners of smaller pipelines and hub facilities. The first are looking to connect their fields to the main pipeline systems while the second need to transport also their own production and are, in most cases, natural monopolies within their geographical market. These negotiations are taking place under voluntary commitments based on industry's Infrastructure Code of Practice (ICoP). The Secretary of State has the right to interfere and set the terms only in the case that an agreement cannot be reached and one of the involved parties requests formally Secretary's involvement[46].

[46] For more information on dispute resolution regulation, see Appendix IV.

More specifically, in 1994, Government's concerns regarding regional monopoly issues of disproportionately high tariff for carrier services resulted in the agreement (1996) of the non-statutory Infrastructure Code of Practice (ICoP) which establishes the principles and procedures for all stakeholders involved in negotiating third party access to oil and gas infrastructure in the UKCS. The main goal was to facilitate the optimal development of the remaining oil and gas reserves through the utilisation of infrastructure through access agreements with reasonable and fair terms. The ICoP has been developed by the UK Offshore Operators Association (predecessor of Oil and Gas UK) in consultation with the UK Department of Trade and Industry (predecessor of DECC) and a wide range of other stakeholders.

In the UKCS, it is common that new developments are often being delayed partly because of the inability of third parties to negotiate commercial and technical terms with the owners/operators of existing infrastructure. Consequently, new field developments are dealing with delays that might end up transforming the project to economically sub-optimal. This issue exists primarily because of the misalignment of commercial and technical interests between the owner of the hub platform and that of the third party seeking access to processing facilities and transport infrastructure. In the case of no equity interest sharing, the hub owner typically views third party business as a low value opportunity and, therefore, has little incentive to enable this kind of 'trade' which could add risks to his own operations through the use up of his facilities' capacity. The field developer seeking access to the facilities has usually little bargaining power being often subjected to repetitive delays during the negotiation process.

Mainly due to the delays in concluding the terms of agreement for third party access, a revised Infrastructure Code of Practice (ICOP) published in September 2004 under the umbrella of PILOT[47], the joint Government-industry consultative body. The new ICOP contains a number of principles which state, among other, that the parties will follow a Commercial Code of Conduct; they will provide meaningful information to each other during negotiations as well as publish key commercial provisions. Additionally, the infrastructure

[47] PILOT (formerly the Oil and Gas Taskforce) facilitate the partnership between the UK oil and gas industry and government.

owners need to provide transparent and non-discriminatory access with tariffs and terms for unbundled services and the negotiations should be treated with a timely manner. According to the new ICOP, a user shall have the right to use a facility on objective and non-discriminatory terms[48] without granting one or more companies an unfair advantage. Preferential rights provided to a user due to their ownership interest in the infrastructure is also prohibited.

The ICOP constitutes of a generally self-regulatory regime. Self-regulation is defined as "*a regulatory process whereby an industry-level organization (such as a trade association or a professional society), as opposed to a governmental- or firm-level, organization sets and enforces rules and standards relating to the conduct of firms in the industry*." (Gupta & Lad, 1983, p. 417). It is worth mentioning that the voluntary code of conduct existing in the North Sea oil and gas market falls under the category of a more 'co-operative' self-regulatory regime, where there is co-operation between the regulator and the regulated on the operation of statutory regulation (Bartle & Vass, 2005)[49]. Even though there is a long history of self-regulation in Britain stretching back to the early 19th century, the global shift towards various forms of statutory regulation during the 20th century affected the developments in the UK (Bartle & Vass, 2005). The issue of market's liberalisation versus tighter regulatory frame is not new in the UK oil and gas industry. The first years of the UKCS industry were set in the political context of a Labour government which supported in a big majority the maximum possible direct control over the newly-found resources. However, the market-led Thatcher government oversaw the major outburst of the oil and gas sector during the 1980s. By the early 1980s, with a liberalised oil and gas sector, Great Britain managed to become a net exporter of oil while it was in the mid-1990s that the country transformed into a net exporter of gas as well.

[48] '*Non-discriminatory'* relates to both the terms and the rates included in the agreements. As the name suggests, this commitment requires that licensors treat each individual licensee in a similar manner. This does not mean that the rates and payment terms cannot change. This obligation enables to maintain respect to existing competitors and to ensure that potential new entrants are free to enter the market on the same basis.

[49] Despite various efforts in the literature to categorise self-regulation regimes, a clear distinction has been deemed significantly challenging forcing researchers to evaluate each regulatory regime in a case-by-case approach. Therefore, although the UKCS regulatory framework seems to fit in the category of 'co-operative' self-regulation, as it was defined in the work of Bartle & Vass (2005), there are some diversifications which were taken into consideration for the analysis.

A self-regulatory, or semi-self-regulatory, regime can, in many cases, be considered superior to government regulation as industry participants benefit from their extended knowledge to design practical rules, increased efficiency in the rule-making process, and, the enhanced flexibility they gain to adapt rules to changing circumstances (Williams , 2004). It is often the case that an industry might choose self-regulation instead of excessive government regulation partly due to the fact that inefficient, or even unnecessary, centrally designed regulatory measures increase production costs for businesses (Kammel, 2010). This type of regulation can enable the knowledge and expertise of all parties to be utilised more effectively (Bartle & Vass, 2005). Self-regulation can be beneficial for both the market participants as well as the overall economy as it creates a more flexible and responsive to the market conditions regulatory environment (Castro, 2011). Self-regulatory guidelines created by industry experts usually continue to evolve over time in response to feedback from the industry providing, thus, a more flexible regulatory environment which may allow market participants to operate more efficiently minimising the compliance costs. The State also experiences decreased costs for the enforcement of such regulation (Castro, 2011).

The advantages of self-regulation were the principles for which a self-regulatory regime was selected for the North Sea oil and gas industry. The state deemed necessary to put companies in the core of the design of regulation hoping that their expertise will assist to the creation of an effective and flexible voluntary code of conduct with minimised costs for both the operating firms and the State. However, it is disputable if this inherited flexibility of self-regulation was taken fully into advantage in the case of the UKCS as, considering the issues the UK petroleum industry faces, the ICOP's effectiveness has been questioned since its introduction with the original ICoP.

Self-regulation regimes often experience economic as well as legal limitations which might affect adversely its effectiveness. For instance, self-regulation guidelines have been manipulated by firms in cases where there were strong economic incentives, such as in the case of production quotas and barriers to market entry which restrict competition and allow the monopolists to increase prices (Williams , 2004). Therefore, anti-trust concerns have been raised in the past due to anticompetitive activities. A typical economic limitation of self-regulation is considered the free-rider problem as this regulatory system to be effective needs to set the rules for the whole industry, including firms which do not participate in the self-

regulatory guidelines (Castro, 2011). As a result, these firms benefit from the self-regulation regime without paying any of the costs. The free-rider problem, though, cannot be taking into consideration in the case of the UKCS, as participation in the ICOP is mandatory for all market players. Two of the limitations of self-regulation can be found in the North Sea case; firstly, the self-regulatory sanctions tend to be either too harsh or too lenient, and, secondly, the regulatory framework represents more of a 'response' rather than an 'action' regulatory approach.

The ICOP was designed solely with the purpose to guide bilateral negotiations between infrastructure owners and potential third-party users without providing, though, a mandatory set of rules. Several UKCS stakeholders view the existing system governing access to infrastructure as 'skewed' in favour of the infrastructure owners who usually have the local monopoly power in their respective geographical area and, therefore, can influence greatly the final terms of the agreements. The lack of specific set of actions from the Regulator and the lenient, voluntary, regulatory approach contributed to the continuation for decades of the relatively high cost of accessing the UKCS infrastructure facilities- a situation which does not facilitate marginal field development and the initiation of exploration activities. Tariffs and terms of access are determined mainly by the asset owners resulting often to protracted negotiations and even failures to reach agreements increasing, thus, the costs and in some cases prohibiting activity from taking place. One of the main concerns regarding the regulatory regime for the UKCS infrastructure is the effectiveness of the voluntary ICOP which has been questioned in the basis that it does not contain sufficient disclosure requirements to address information asymmetry issues and that it is not sufficiently supported by the Office of Fair Trading (OFT).

The presence of strong local natural monopolies is considered the main economic challenge that can undermine the success of this voluntary regime of regulating the use of facilities and third-party access to infrastructure. The OGA is currently working to reform and improve regulatory processes to overcome these barriers. This is especially important in the mature areas of the UKCS where rapid exploration of the near-field potential is required before existing infrastructure facilities are decommissioned. It is widely accepted that in a light-touch regulatory system, robust competition laws and rigorous disclosure requirements are essential for the smooth operation capability of the offshore market of transportation,

processing and operator services by host facilities and pipelines. A proactive regulatory approach to ensure third party access to infrastructure as well as the maintenance of existing facilities to an appropriate standard which would enable the extension of assets' life prior to decommissioning has been deemed essential by the Government to overcome any barriers to new investment and increase the recovery and value generation in the basin.

E. Challenges for the Regulator

The offshore oil and gas industry has undoubtedly a great impact both economically and socially as it consists of a major contributor to the UK economy for decades. Almost £330 billion has been invested to exploration and production of more than 43 billion boe (OGUK, October 2014). The more of £316 billion of direct production taxes contribution, £15 billion in the export of related goods and services and the support of 450,000 jobs across the UK, with half of those in Scotland (OGUK, October 2014), are only a part of the input of the sector to the UK balance of payments and employment.

The tax receipts to the UK Exchequer reveal that oil and gas industry pays more in corporation tax than any other industry and, at the same time, it comprises the largest industrial sector in the economy in terms of both the contribution to the GDP as well as industrial investment (Oil&Gas UK, 2016a). The North Sea industry generated a highly sophisticated supply chain to service the offshore operations resulting to a cluster of world-class companies based in the UK with in depth expertise in oil and gas facilities, subsea technologies, project management, well-management and training services. On top of that, the industry enables the UK to safeguard its security of supply given the fact that North Sea oil and gas sector produces approximately 67% of all UK oil demand and 53% of all gas demand. In addition, despite the efforts for the transition to a low carbon economy, it is predicted that in 2030, the 70% of the UK's primary energy requirements will come from oil and gas (HM Revenue & Customs, 2014).

Considering the new challenges arising in the UKCS, the government has been taking action to maximise economic recovery ensuring that the existing regulatory framework enables companies to be involved in new developments while improving their assets stewardship. The UKCS entered a transition period from an upcoming province, which attracted high levels of investment, to one where the ageing fields and more technically challenging new discoveries increased the costs lowering, as consequence, the investment levels. The main challenge for the government is to adapt quickly and effectively to this transition securing a reasonable rate of return for both the industry and for the nation.

The introduction of the ICOP and the adoption of a 'light-touch' regulatory regime by the government has been reckoned insufficient. The Regulator and Wood Review have been identified two main issues related to the access to critical infrastructure which need to be tackled by the Government; the premature decommissioning infrastructure assets (so called, in its extreme form, 'Domino Effect') and the price discrimination regarding the third party tariffs in pipelines and processing facilities. In this section, these two main challenges, along with the high pricing in third party tariffs and the negative effect on exploration, are analysed to identify their effect to the economic efficiency of the oil and gas business in the basin.

E.1. The 'Domino Effect'

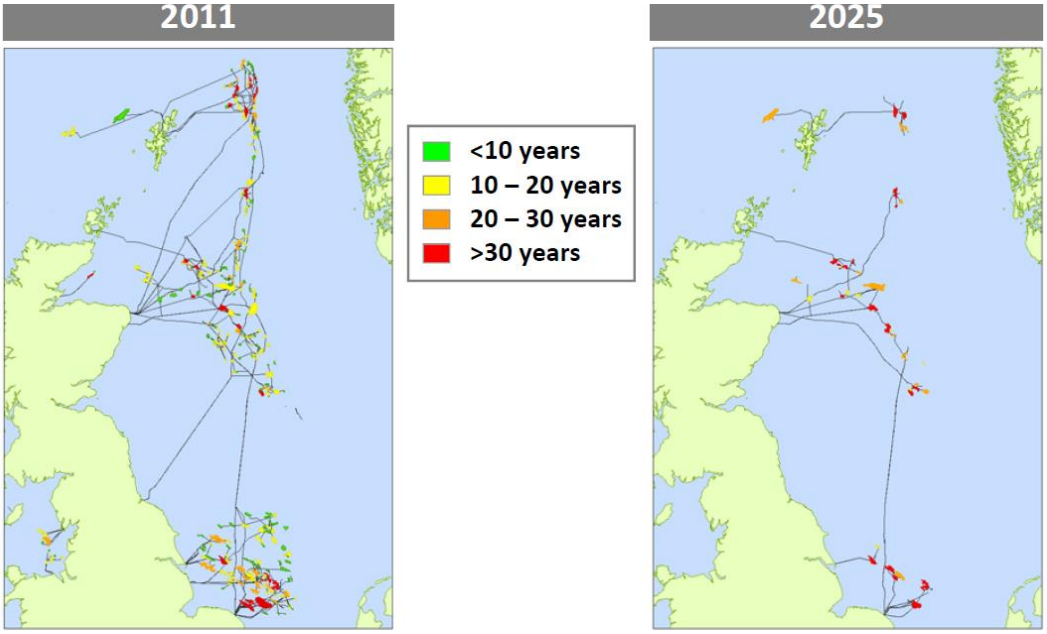
The scenario of 'Domino Effect' indicates that the negative profitability in existing fields could lead to the premature decommissioning of critical infrastructure in the UKCS with the potential consequence of the shutdown of whole areas in the basin leaving significant recoverable resources unexploited. The possibility of an extensive Domino Effect in the UKCS could result to subsequent significant decrease in taxation revenues, job losses and deprived energy security leading to greater dependency on oil and gas imports. The Figure 3.11 displays the decreasing number of the UKCS infrastructure facilities over the next 30 years[50]. The maturity of the existing infrastructure and the maintaining costs to sustain its integrity is a systematic challenge in the UKCS. The new developments via tie-ins could provide the appropriate incentives to expand the life of existing facilities whose original fields face a declining production.

Wood Mackenzie estimates that, within the next 5 years, 142 fields will cease production and more than £55 billion will be spent on decommissioning (OGJ, 2016). According to the same source, 340 platforms will be removed while several fields, although may not be shut down permanently, will be entering 'lighthouse mode'[51] to save the eminent decommissioning expenditure. Extensive decommissioning activity in the UKCS was prevented so far mainly

[50] Oil & Gas UK 'Breakfast Briefing', Aberdeen, 25 October 2011, through Memery Crystal LLP (2012, p. 11)
[51] In 'lighthouse mode', the wells shut in, production facilities cleaned, platforms decommissioned but navigational aids remain intact (Talberth & Branosky, 2013).

due to the high global oil prices during the period 2011-14 which allowed some mature high-cost fields to keep operating efficiently. However, the extensively low oil price environment after 2014, in combination with the maturity of the basin, has made the production on several fields economically non-viable. As a result, especially if the global oil price does not experience a significant increase, companies cannot continue operating at loss and the decommissioning of their assets will no longer be prolonged.

Figure 3.11: Premature Decommissioning of Infrastructure Assets Projection



Source: Wood Mackenzie (2015a)

During 2016, the oil price was on average slightly above US$40 per barrel and most companies were financially sound at US$60 (OGJ, 2016). Therefore, early decommissioning was considered an inevitable reality for several assets. - From a business and economic perspective, it is rational for a firm to shut down a field and its respective facilities (including pipelines), if the surplus from the production is not higher than the costs of maintenance and the overall fixed cost of the development. However, from the Government's perspective, the OGA has warned that premature decommissioning or, in its extensive form a Domino Effect, occurring in the UKCS would have a negative impact to the overall oil and gas industry affecting the country's economy in terms of tax returns, employment, supply chain, technological innovation and security of supplies.

The Government has already started to take some measures to protect the critical oil and gas infrastructure. The OGA has initiated the Regional Development Plans (RDP)[52] for several challenging regions of the basin and complete economic assessments of key production hubs. The Regulator also required from the top 20 production operators by volume to present stewardship improvement plans to rise gradually the production efficiency in the UKCS. In addition, the UK Budget 2016 introduced several tax changes to improve companies' cash flows with little effect however in assets present value (PVs) (FT, 2015). The recent tax changes were designed to encourage loss-making fields to continue production in the short term avoiding early cessation of operations but without eliminating the possibility of extended decommissioning of infrastructure in the foreseeable future. If no further investment in both existing developments but also exploration activities materialises, the firms will start exiting the North Sea upstream industry not being able to maintain their assets.

As presented in previous section of this chapter, due to the high degree of interconnectedness on the infrastructure facilities in the UKCS, a great number of companies, especially smaller ones, rely heavily on shared infrastructure in order to transport hydrocarbons from fields to terminals. If major pipeline systems are decommissioned, the owners of user-fields are left behind to face some economically challenging options. Even if the infrastructure is not decommissioned, given the fact that several pipelines operate under sharing agreement status (where all parties share the fixed costs of the asset), the cessation of one or more fields in the area will leave the rest of the parties sharing all the fixed costs for both the pipelines as well as the processing facilities. Considering the small size of most new accumulations and their high operating costs, the increased cost pressured will shorten the economic lives of the remaining fields causing at least one user-field to become uneconomic and shut down. It becomes obvious that the high interconnectedness of the pipeline network in the UKCS increases even further the severity of a possible Domino Effect occurring in the basin.

Nevertheless, from an efficiency point of view, if the cost of maintaining and operating a pipeline is not covered, or is at least marginally covered, for a long period by the field's production revenues, the company will choose to shut down the development. Firms as economic agents with a clear profit-maximisation orientation cannot be expected to maintain

[52] For more information on Regional Development Plans (RDP) on ageing infrastructure facilities, see Appendix VI.

assets that are occurring losses or are not as profitable as they used to be. Consequently, the Domino Effect does not essentially consist of an economic consideration from a business perspective. No-profitable fields will shut down and infrastructure, which does not fulfil its full capacity, will eventually be decommissioned. Conserving fields and infrastructure assets, which are economically incapable to cover their costs, would be against any business efficiency rational.

The government, though, might have different motives linked to the overall UK economy in order to intervene and prevent an extensive Domino Effect from occurring in the North Sea. Since 1970, the oil and gas industry has paid more than £300 billion in production tax, which is the equivalent of more than three years of NHS bills while the tax amount for 2014/15 was £2.2 billion (Oil&Gas UK, 2016a). Furthermore, taking into consideration the overall supply chain, the industry has great influence as a supplier of essential inputs to other business sectors as well as employability. Specifically, in the UK, the oil and gas supply chain generates £30 billion revenue per year from both domestic sales and export of goods and services overseas while the nationwide supply chain grid stretches from north of Scotland to southern England (Oil&Gas UK, 2016a).

Additionally, according to the Oil & Gas UK (2016a), more than 330,000 jobs are supported by oil and gas production sector and an additional 200,000 people are employed by the supply chain on UK oil and gas projects (including all the exporting oilfield goods and services). It is worth mentioning that the 45% of total jobs offered by the oil and gas sector are located in Scotland (Oil & Gas UK, 2016b). Consequently, the oil and gas industry and its infrastructure are directly linked, and often considered a prerequisite, to economic development for several UK regions. Decreased investment rates (incapability of attracting new entrants to the market) and reduced tax revenues (including royalties) may have a significant negative impact in the State's budget which may motivate the Government to proceed in regulatory changes in order to assist the industry to reach its maximum potential.

The OGA has warned that a Domino Effect would have a negative impact on all areas of the industry, from employment and supply chain to technological innovation. The fact that new field development might start relying more on floating production and storage vessels (FPSOs) in order to transport the hydrocarbons produced could complicate further the market

landscape in the basin. If offshore transportation through the existing pipeline network is considered uneconomic, more fields will start using FPSOs. However, for FPSOs to work, a certain flow rate is required. As a result, older and/or smaller wells are less likely to be developed and several fields are expected to be prematurely decommissioned. It is important to highlight at this point the fact that there is a Government regulation designed to prevent early decommissioning. Specifically, all owners looking to decommission assets should apply for a Cessation of Production (COP) certificate, and, to be approved, they are obliged to take into consideration the knock-on effects of closure. To date, the Government has not denied a COP certificate resulting the regulation to exist in theory with no practical application.

The 'Domino Effect' is a term that has been widely used by politicians, journalists, academic researchers and industry experts to highlight the importance of the negative effects of premature decommissioning in basin's critical infrastructure. However, it is important to draw attention to the fact that the 'Domino Effect' has not been used in any official governmental documentation so far, such as the Wood Review. In this particular document, although the possibility and effects of early decommissioning are analysed, the term 'Domino Effect' does not appear. Although becoming, in many cases, a synonym to early decommissioning, there are still doubts regarding the real possibility of a 'Domino Effect' occurring. With the evolving dynamics in the North Sea and the presence of new players specialised in infrastructure ownership and operatorship, the 'Domino Effect' might constitute more to an extreme scenario than an inevitable reality. Even though early decommissioning is without a doubt a problematic reality that the basin is called to face in the near future, the term 'Domino Effect', which implies a complete shutdown of the whole industry, might not constitute to an actual possible scenario. The likelihood of the phenomenon occurring needs to be taken into consideration for any theoretical analysis of UKCS business landscape while maintaining the premise that economic rationale and business dynamics cannot be overlooked.

E.2. Price Discrimination & High Pricing in Access to Infrastructure

Considering the high investment and capital cost of replicating existing infrastructure, the 'carriers' (owners of infrastructure) often find themselves gaining the bargaining advantage in the negotiations which allowed them to charge disproportionately high fees. Acknowledging this substantial local bargaining power, the Petroleum and Submarine Pipelines Act 1975 (PSPA) empowered the Secretary of State to regulate the third-party tariffs, but only if requested to do so by one of the parties involved. Currently, the regulation of this negotiation process and agreements is based on the ICOP with the Secretary having the right to interfere only in case that an agreement cannot be reached. As mentioned in previous section of the chapter, the new ICOP contains a number of principles which state, among other, that the infrastructure owners will provide transparent, non-discriminatory access with tariffs and terms for unbundled services.

In practice, reaching an agreement regarding the transportation terms can become a highly complex process involving several parties, the majority of which is often monopolies within their geographical market. As a result, field owners often face extensive postponements in project development mainly due to the fact that the agreement of the terms of agreement for third party access are delayed. In some areas of the North Sea with especially harsh weather conditions, like the West of Shetland, delays in the negotiations may cause the overall postponement of the project for a whole year, as operations cannot take place during some seasons of the year. Consequently, investors may be hesitant to initiate project developments since they are aware of the challenges which may arise during the bargaining process with the facilities' owners.

In addition, limitations in the pipeline throughput create further issues in the tariff negotiations given the fact that infrastructure owners are interested to carry also their own production onshore. However, limitations in the pipeline throughput is not the only point of friction in the tariff negotiations as the Serica incident shows (see Table 3.2). More specifically, the limited spare processing capacity at the platform forced Serica into multiple-party negotiations which made the development of Columbus field especially challenging.

Table 3.2: The Serica Incident- *An example of Multiparty Negotiations & Conflicted Interests*

Considering basin's maturity, all parties can benefit, if new fields are developed by utilising existing infrastructure. However, while owners of infrastructure are seeking to maximise the return of their assets, the field developers are looking to pay the lower possible tariff. It is only natural, thus, that conflicted interests create tensions between the parties hindering the negotiations which can often become protracted or even problematic.

In the case of Serica Energy's development of the Columbus field, the confirmation of access to processing at neighbouring BG's Lomond facility was vital for the development of the field (Edison Investment Research, March 2011). In addition, confirming this project was a major step forward for Serica to establish its North Sea production base. Although there were no limitations in the Lomond's pipeline throughput (so tariff negotiations were not an issue), there was limited spare processing capacity at the Lomond platform which was essential for processing the gas condensate from Columbus field. Therefore, the original project planning included the installation of additional processing facilities which would be linked by a bridge to Lomond.

These new facilities would also take production from the Arran field, operated by Dana/KNOC, with BG insisting of maintaining significant capacity for future production coming onstream by its own nearby exploration prospects. Therefore, Serica had to deal with several different partners with conflicted interests to reach an agreement.

The participation of Dana/KNOC in the negotiations and the indirect competition with BG's exploration portfolio plans forced Serica into multiple-party negotiations which made the development of Columbus field especially perplexing causing severe delays to the project.

In addition, mainly due to the maturity of the UKCS, infrastructure owners are seeking either to produce additional profit through overcharging the access to infrastructure. These delays in field development often lead to significant loss of value, developments that select the less economic option resulting on decreased revenue and, finally, in some cases, the indefinite

halt of any investment activity. If existing assets and associated facilities are decommissioned, nearby smaller accumulations may directly face negative profitability.

The Endeavour vs. Nexen Dispute (see Table 3.3) is a noteworthy example of a dispute on high pricing in tariff agreements which reached the Regulator to be resolved. However, when problems occur during the negotiations, by the time the user will recognise that there is no option but to involve the Secretary, it is usually too late as the procedure of addressing a request to the Secretary requires a month of submissions and responses followed by at least 10 weeks to reach a decision. Contrariwise, if the user decides to involve the Secretary too early in the process, then the risk is that the infrastructure owner will consider this an 'aggressive move' and may put barriers in the way of an early settlement of fast track decision. Given the fact that the regulation does not establish any penalties for such behaviour, the 'shy applicant' syndrome prevails with the Secretary being rarely involved. As consequence, the field owners may end up accepting hosts' demands under the pressure of time constraints or, alternatively, continuing the negotiations causing further delays in project development and risking its economic viability.

Nonetheless, we cannot overlook the fact that slightly higher prices enhance the revenue stream of marginal fields which own hosting facilities. Higher tariffs for the use of transportation and processing facilities can enable bigger and older fields to stay in business, even with marginal production revenues, which otherwise would have made a loss. Keeping fields that own host facilities in business can postpone premature decommissioning enabling smaller fields to continue production. In the UKCS, slightly higher prices cannot be deemed necessarily undesirable given that the tariff price allows both parties to operate with a revenue and infrastructure owners of marginal fields to turn loss into marginal profit.

Table 3.3: Endeavour vs. Nexen Dispute- *Facing the 'shy applicant' syndrome*

Endeavour was the first company which requested the Secretary of State to rule on a dispute. Endeavour argued that Nexen charged an unreasonably high tariff for the transportation of gas from Endeavour's Rochelle field through Nexen's Scott platform (FT, 2010). Endeavour disagreed on the tolling rates imposed to connect Rochelle to the Nexen-operated Scott platform. It is worth mentioning that Nexen was also a partner in the Rochelle development.

Endeavour's application was filled in 2010 in relation to the Scott platform and the respective gas pipeline, which connected Scott to the Southern Area Gas Evacuation (SAGE) pipeline. The dispute was ultimately elevated to DECC and East Rochelle has received the Field Development Plan (FDP) approval a year later and after the tolling arrangements had finally being resolved.

However, Greater Rochelle development has been significantly affected by these commercial negotiations around infrastructure access. Specifically, due to the issues arising during the negotiations, the development was delayed for a year which resulted to both a reduction of the net present value (NPV) of the Rochelle's project by the investor annual cost of capital and, also, to the loss of one year-worth of tariff revenues on behalf of the Scott owners.

Both parties were affected adversely by the long delay, however, not equally. More specifically, the main economic consideration of a pipeline carrier is to ship new production volumes, while an Exploration & Production (E&P) company is solely concerned in the case that its own production is at stake. In April 2011, the commercial terms have been agreed for the transport and processing of Rochelle gas production. Nevertheless, the details of the agreement were not appeared in Endeavour's statement.

Even though the regulation covering the access to the UK's offshore transportation system was set more than 35 years ago, the Endeavour vs Nexen dispute was the first incident in which the government has been requested to intervene. In the past, smaller companies had not elevated similar disputes to the Secretary of State to avoid creating further tensions between independent explorers and the multinational operators.

Therefore, the Endeavour vs Nexen dispute is considered noteworthy for the future trends on third party access to infrastructure and dispute resolution incidents in the North Sea. Small companies have always been reluctant to be characterised as 'too aggressive', experiencing often an unequal relationship with the major companies- a phenomenon called 'shy applicant' syndrome.

Nevertheless, despite the issues price discrimination can create, from an efficiency point of view, a discriminatory monopoly could be considered more desirable than a non-discriminating one. Considering the distinguished technical characteristics (different production volumes, capital costs, operating costs etc.) of the individual fields in the different geographical areas of the North Sea (North, South, Central North Sea, Irish Sea and West of Shetlands), it is disputable if one unified for the whole basin transportation tariff would be desirable and beneficial for the industry. As analysed previously in Chapter 2, in the case of discriminatory monopoly, the owners of transportation and processing facilities can charge tariffs based on their knowledge regarding the unique conditions and features of each field in their geographical area. Consequently, they may charge higher tariffs than they would charge in a perfectly competitive market, however, the price never exceeds the expected production revenues of each field. A unified tariff would be more advantageous for fields with high revenues and robust production not enabling, though, smaller marginal fields to maintain their operations onstream.

Another issue linked with price discrimination is information asymmetries. Specifically, information asymmetry can significantly undermine competitive pricing, especially in cases where tariffs and terms of transportation agreements are determined by private negotiations between parties, like in the UKCS. All the technical and financial information related to the service provided by the host of the processing and/or transportation facility, such as maintenance period, availability of bed spaces etc., is critical to cost properly the service and apply a fair tariff. In theory, there are two different situations where information asymmetries appear as market failure; when lack of information on behalf of some market agents causes inefficient allocation of resources, and/or, when inequality of access to information enables one party to make profit at the expense of the other. Under the presence of information asymmetries, the market can become severely distorted as the 'buyer' and 'seller' do not necessarily base their business decisions at the same set of information. Hence, market

inefficiencies often occur in situations where one party has access to information that other parties do not have.

Charging a different transportation tariff in each individual field could be considered an extreme form of group pricing as each separate group is comprised of a single customer due to the intense market segmentation (Belleflamme & Peitz, 2015). Infrastructure owners, being often the older players in the basin, can accurately predict and estimate the expected capital and operational costs of nearby future developments. Their local business experience allows them to make a specific and unique price offer to each separate field. According to economic theory on price discrimination, the better the information about consumers, the finer the separation of consumers into groups or individual parties, and, the bigger the possibilities for incumbents to extract consumer's surplus (Belleflamme & Peitz, 2015). Therefore, it is anticipated that the discriminating monopolist's profit will increase in relation to the quality of information she has about the willingness to pay of her consumers (Belleflamme & Peitz, 2015). In the UKCS, the infrastructure owners being for a long time in the area and aware of the costs and technical characteristics of new developments can predict with high accuracy the willingness to pay of the third parties seeking access to their facilities. The obtainable information regarding new field developments in combination with the lack of alternatives in transportation give the undisputable advantage to the infrastructure owners to charge effectively a different price to each field. Since the information on the field owner's reservation price on tariffs can be fairly precise, the monopolist can personalise the prices and capture the entire consumer surplus decreasing greatly at the same time the deadweight loss (Belleflamme & Peitz, 2015).

Personalised pricing in a monopoly can be equivalent to perfect competition given the fact that it implements the principle of 'first-best' as the last unit is sold at marginal cost (Belleflamme & Peitz, 2015).Considering that the infrastructure owners have a monopoly position on their respective local markets, price discrimination can be considered a profit-maximisation conduct. The infrastructure owners have no incentive to decrease the price below the monopoly price due to one main characteristic of the oil and gas transportation industry; infrastructure owners do not sell a product, but they rent capacity to their existing facilities. Therefore, the current tariff cut would apply not only to existing third party users but also to future ones. The existing third-party users are usually able to renegotiate tariff

contracts after a certain period and, as consequence, guarantee to face the same conditions as later users. As it was mentioned before, each field might have individual technical and economic characteristic based on which the infrastructure owners charge a tariff, however, fields located in close proximity can be treated in a similar way.

From an economic efficiency point of view, in the UKCS, infrastructure owners do not have a motive to overcharge tariffs to the point that transportation through their facilities would be deemed uneconomic by third parties. More specifically, if third party users decide not to proceed to the development of new fields, infrastructure owners will lose new clientele and the subsequent tariff revenues which might be essential for their own economic survival considering that older fields usually owing the transportation infrastructure generate nowadays lower production rates. Hence, one could argue that, in theory, the market finds a tariff pricing equilibrium as infrastructure owners charge a price which will maximise their revenue stream but, at the same time, will allow third party users to develop new fields. Nevertheless, in the business reality of the North Sea, there are several incidents indicating that access tariffs are often significantly high forcing, thus, new fields to operate in the margin and creating barriers for new entrants to commence exploration activities.

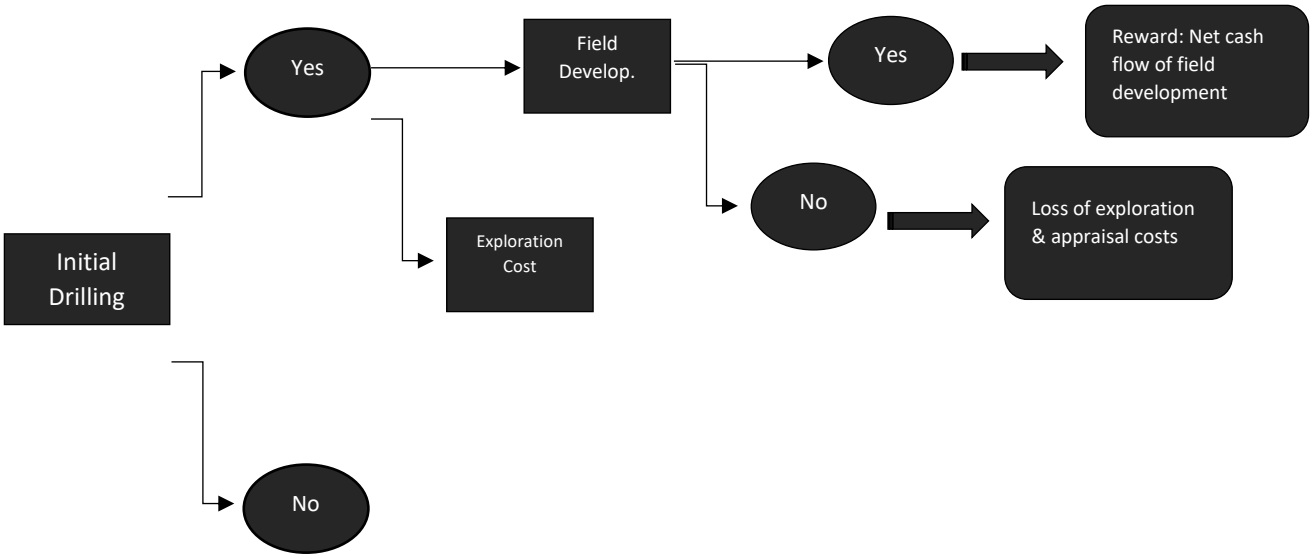
E.3. The effect on Exploration

Partly due to the low global oil price, the major oil and gas companies appear to be generally more risk-averse when it comes to exploration activity; a business trend which does not leave the UKCS market unaffected. Wood Mackenzie's research revealed that majors are cutting investment in exploration activities more drastically than other sectors (Wood Mackenzie, 2016). Even if a basin is rich in yet-to-find oil and gas resources, firms tend to invest in less-risky operations exploiting the existing fields. As a result, many promising discoveries are not commercialised due to the expectation of low returns after having undertaken capital-intensive exploration activities (Wood Mackenzie, 2016). However, when oil and gas companies decide to develop exploration activities, they focus on proven basins and on fields located near to existing infrastructure facilities. This business trend could imply an

opportunity for mature basins, such as the UKCS, where the infrastructure framework is already in place.

Looking at the schematic in Figure 3.12, one can observe that the decision-making process prior, during and after any exploration activity is complex and involves several cost factors. At an initial stage in the decision-making process, the company needs to decide if it will undergo or not with the initial drilling. In case the drilling fails and cannot produce any positive results, the company will lose all the initial exploration drilling-related costs. It is worth mentioning that in the UKCS, the exploration costs are significantly high and reach on average £28 million (Oil & Gas UK, 2016c).

Figure 3.12: Exploration Decision-making Schematic



If the initial drilling has been proved successful and has indicated the existence of hydrocarbon reserves in the area, the firm should decide if the newly founded reserves are economically and commercially viable. If the firm decides to develop the reserves, it can be rewarded with the net cash flow of the field which consists essentially from the Net Present Value (NPV) of the asset excluding any exploration and appraisal costs. However, in several cases, even though the initial drilling yields some positive results, the appraisal of the reserves could reveal that their commercial value is low (due to low volumes, high capital

costs etc.) and, therefore, force the firm to abandon any development plans. In that case, the firm will accrue the loss off all exploration and appraisal costs; an amount that can reach even more than £30 million in the UKCS (including the appraisal phase for the commercialisation or not of the reserves which follows the exploration stage).

Therefore, it becomes obvious that an oil and gas firm experiences uncertainty in all stages of the decision-making process from the initial drilling period, to the exploration stage and up to field development. In the short-term, transportation tariffs may not affect directly the production volumes as tariff payments will just extract a higher share of field's revenues. Nevertheless, when looking the long run, the business area mostly affected by tariffs being set above the cost-reflective levels is the exploration of new accumulations. Looking at the infrastructure facility profitability in the UKCS, it is not rare that a host facility, which provides standard operator and transportation services, might produce little, if any, revenue from the third-party business forcing the owner to recover the capital costs from his own development. Even under the assumption that all capital costs associated with the satellite field are covered by the field owner and indemnity terms have been introduced in the agreements in order to isolate the risk, the tariff payable may still be limited to the incremental operating costs incurred by the host facility owners. Incremental costs, though, can be minimal considering that operating costs of infrastructure facilities do not change dramatically after the introduction of new production.

As discussed previously in Chapter 2, the uncertainty in the exploration phase regarding the quantity and quality of future discoveries does not allow field owners to commit at the present for future prices. Field owners are reluctant to be bind to transportation, storage or processing contracts ex ante without knowing first the exact production that can be brought on-stream. From the other hand, the infrastructure owners, having made big sunk investments in long-lived assets, are looking to extract as much profit as possible, especially given the monopoly power they hold in their respective geographical areas. Consequently, various contracting issues (essentially related to transaction costs) arise ex-post and the frictions created lead often to breakdown of contracts, malfunctions or delays in operations. Considering these conditions, at least one of the parties needs to proceed to durable sunk investments on equipment, machinery and assets, such as pipelines, which have much lower value, or none, in alternative uses.

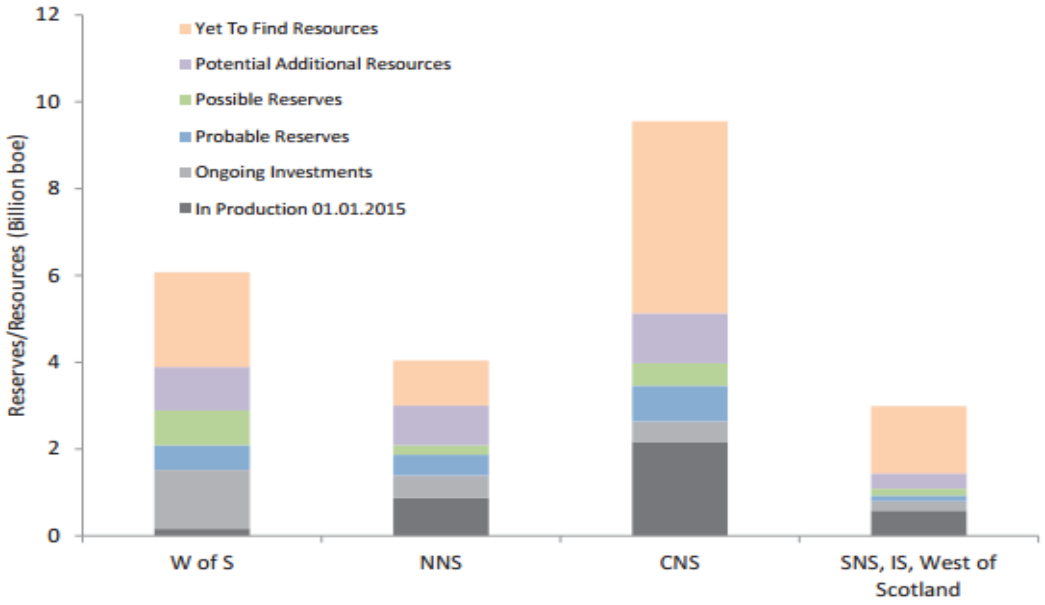
The high sunk costs in combination with the complexity of multi-party negotiations for transportation tariffs in the UKCS and the uncertainty regarding the exploration outcome make the creation of full contingent contracts in the offshore oil and gas industry uneconomic. As a result, 'market contracts' tend to be incomplete revealing several ex-post performance problems and enhance the opportunistic behaviour of incumbents in an industry where natural monopoly structures dominate.

E.3.1. The Effect on Exploration: the case of the West of Shetland (WoS)

Although the West of Shetland (WoS) along with the East of Shetland areas (EoS) are estimated to hold more than 2 billion boe yet-to-find resources (YTF) (Edison, 2016), this area of the basin is an immature area of exploration, especially if one considers its great potential. Although significant discoveries have been occurred in WoS almost 40 years ago, the area remains the least-developed comparing to the rest of the UKCS. Despite the fact that WoS holds the second largest YTF resources after the Central North Sea (CNS) (see Figure 3.14), as Figure 3.13 reveals, WoS is also one of the areas with the least resource growth.

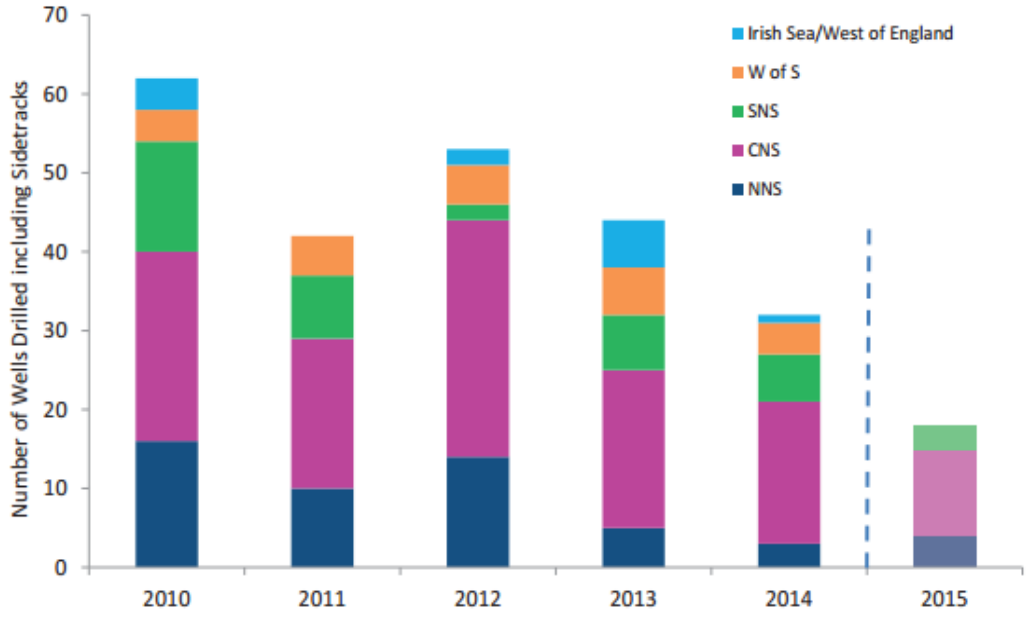
Several technical factors, such as the lack of infrastructure and the demanding deep-water drilling, create economic constraints for further development of projects in the WoS. The complicated ownership structures, the high costs of access to infrastructure facilities and the limited options for alternative shipping and transportation methods- especially comparing to other, less remote areas, such as the CNS- halt the development in WoS where approximately 95% of the resources located in the area are yet to be developed (Edison, 2016).

Figure 3.13: Reserves and Resources Growth by Region



Source: Oil & Gas UK, DECC (through Edison 2016 Exploration Watch)

Figure 3.14: Exploration and Appraisal Drilling by Region

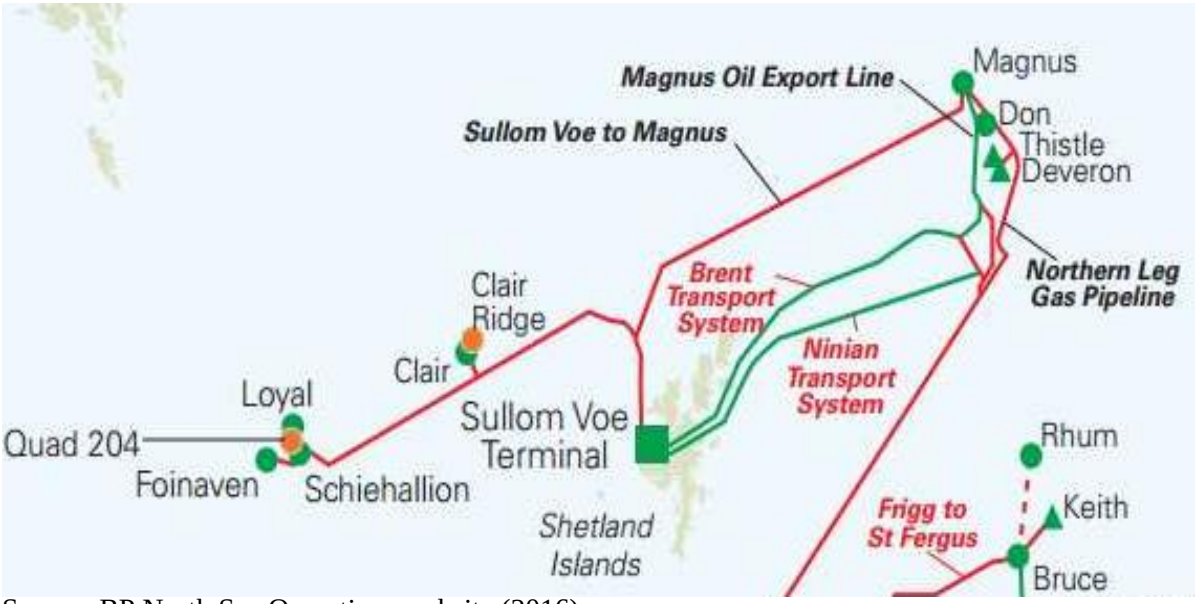


Source: Oil & Gas UK, DECC (through Edison 2016 Exploration Watch)

In the area, there are three main pipeline systems- the WoS pipeline system (gas), the Brent system (oil and gas) and the Ninian system (oil), as well as the Sullom Voe terminal (see Figure 3.15). Each pipeline transport system, along with the Sullom Voe terminal, has a

unique ownership and operatorship status. Therefore, any third parties interested to start a new development in the region need to negotiate with each relevant pipeline group and separately with the terminal partners. As consequence, the complexity of the negotiations is considerably high while the tariff charges are unstable. This highly complex business landscape often discourages potential investors. A noteworthy example is the case of the Schiehallion (Quad 204) field partners who decided to use the oil export route via Rotterdam as it was considered to consist of a more economically viable option comparing to the existing infrastructure system in the WoS area.

Figure 3.15: WoS Infrastructure Map



Source: BP North Sea Operations website (2016)

The WoS is the UKCS region where one can clearly observe the effect of oil and gas infrastructure to the economic decision-making of companies regarding the exploration and development of new fields. Without a doubt, the WoS is a technically challenging region due to the high depth of the seabed and the extreme metocean conditions which increase the operational and capital costs of all exploration and production (E&P) activities. However, the lack of appropriate infrastructure in combination with the highly complicated system of ownership, which affect adversely the tariff negotiations, have been identified as the main reasons for the low commercial success of the area so far (Edison, 2016).

Table 3.4: Summary of WoS Transportation & Processing Facilities

WoS Pipeline System (Gas)

- Collectively owned by owners of Schiehallion- namely Loyal, Foinaven, Clair
- Operator: BP

Brent Gas Transport System

- 50% Shell, 50% ExxonMobil (operator)
- Costs associated with 3rd. party access payed by the users in a production throughput basis

Brent Oil Transport System

- JV of 10 companies, TAQA (operator)

Ninian Transport System (Oil)

- JV of 8 companies, BP (operator)
- Fixed price for a stake (existing participants can offer part of their stake)

Sullom Voe Terminal

- Separate entity, multiparty JV
- Since 2000, a new equity holder in Brent or Ninian Systems does not

F. Regulatory Tools and their Application in the UKCS

In Chapter 2, potential regulatory strategies, such as access regulation, vertical disintegration and government ownership, were explored in an effort to identify regulatory measures which can tackle market inefficiencies arising in the oil and gas pipeline networks. Examples from various countries where these types of regulation are in place were also presented. This section of Chapter 3 analyses the possible effects the application of these regulatory tools could have in the case of the UKCS as well as the specific difficulties the regulator would face in a potential attempt to apply these regulations in the basin. Special focus is given to the scenario where government intervention extents to government ownership of fields and infrastructure assets in the UKCS.

F.1. High pricing in third party tariffs and Price Discrimination - access regulation and price cap

In upstream oil and gas markets, regulatory measures over tariff pricing and access rights can provide a solution on the issue of high pricing practices as increased transportation tariffs often discourage new participants to proceed with exploration operations in order to enter the market. Because one of the main costs for new potential entrants in the UKCS is the high third-party access tariffs that infrastructure owners charge for third party use of the pipelines, access regulation could be considered as a potentially appropriate regulatory tool for the basin. With access regulation in place, the industry would become more attractive for new entries boosting the currently low exploration rates. In the case of the UKCS, attention should be paid to the fitting form of regulation regarding the price of third party tariffs; very low prices can decrease the ex-ante pay-offs of infrastructure owners reducing consequently their incentive to invest in both the construction as well as the appropriate maintenance of large projects, such as pipelines or processing facilities with high sunk costs.

At least in theory, access regulation in the form of the U.S ‘common carrier’ approach could provide a solution to the issue of high pricing. However, it is disputable if regulation similar to the ‘common carrier’ approach could be applied in the UKCS. Traditional cost-of-service ratemaking has been employed only in limited cases worldwide, like in the Gulf of Mexico as

part of the antitrust concerns covered by U.S. legislation[53]. The successful implementation of this type of regulation in Gulf of Mexico was lying partly to the fact that the natural monopoly features in the area are not as strong as they are in the UKCS. Contrary to the UKCS, in Gulf of Mexico, there is absence of strong natural monopoly due mainly to the geography of the basin (most fields are located relatively close to the shore), the good weather conditions and the fact that most fields are located in low/medium water depth. All the above features create a low fixed and operational costs environment where the construction of a pipeline is not highly capital intensive. Thus, the conditions under which the oil and gas upstream sector operates in the Gulf of Mexico differ significantly comparing to the ones found in the UKCS. The absence of strong monopolistic market structures in the area facilitated the application of a type of cost-of-service regulation in the Gulf of Mexico basin. With the presence of strong regional natural monopoly in the UKCS and the unique business environment of the North Sea, it becomes disputable whether access regulation similar to the U.S 'common carrier' approach could be applied.

In general, though, the UK is highly familiar with price cap regulation as it was developed as an alternative to traditional rate of return regulation in the early 1980s in Britain and it could potentially provide a solution to the high pricing in third party access in the UKCS. Price cap regulation sets a cap on the price, which the utility provider is allowed to charge, and it is a form of economic regulation generally linked to the UK utility industry. Several economic factors, like inflation and the expected efficiency savings determines the cap. A vast part of the economic literature generally supports this type of regulation as it provides incentives and requires minimal regulatory effort ((Parker (1997), Berg (1998), Bernstein & Sappington (1999)).

With price capping, the monopolist is forced to charge a price below the profit-maximising price. In the UK, the RPI-'X' formula has been widely used to regulate the prices of privatised utilities. The Retail Price Index (RPI) reflects the current inflation rate while the 'X' factor is set at the expected efficiency gain that the Regulator believes would have existed had the firm operated in a competitive market (Bernstein & Sappington, 1999).

[53] For more information on Gulf of Mexico regulatory framework, see Chapter 2, subsection F.1.1.

However, excessive price controls might be harmful as lowering the prices could also deter potential entry into the market. Therefore, in industries which need high rates of capital investment, like the oil and gas, price capping should be more 'generous'. For example, in the case of water supply in the UK, the Water Services Regulation Authority (Ofwat) introduced a more relaxed price capping formula acknowledging the need for capital investment in infrastructure. Specifically, the price cap for water is identified by the formula RPI+K+U, where 'RPI' is the above explained Retail Price Index, 'K' is the price limit, and 'U' is any unused 'credit' from previous years allowing higher flexibility. Therefore, if 'K' is 5% in 2011, but the water company uses the 3%, then it can add the remaining unused 2% to 'K' of 2012 (Parker, 1997).

In the case of a price cap regulation applied in the offshore oil and gas UKCS infrastructure third party tariffs, several of the benefits resulting from this type of regulation could be observed. The infrastructure owners would have strong incentives to cut costs while the effect of information asymmetries has to the costs would be dampened. Additionally, a price capping regulatory environment could reduce the incentives to over-invest in capital or cross-subsidise. On the contrary, regarding cross-subsidisation, if cost-based regulation was in place, it could have created a distortion to the market due to potential cross-subsidisation with exploration activities.

Price regulation has been criticised for setting limits in the willingness to invest as regulatory measures, like price cap, can cause the investors to feel like they are limited in the prices they can charge after having made big sunk investments (Hausman, 1999). Hence, the Regulator needs to take into consideration the fact that expectations on future pricing policy can critically affect the incentive to invest. However, in the UKCS, investment activity in the existing mature fields (excluding any exploration activity) is not expected to be in any case substantial as the reserves are gradually depleting. In this mature basin, when it comes to the old and bigger fields, service quality and infrastructure maintenance is of great importance as it can add pressure to issues linked with the stewardship of pipelines. The proper maintenance of existing critical infrastructure is key to allow existing assets to prolong their life and, in addition, to assist any potential exploration activities in smaller accumulations that cannot support the construction of their own pipelines. The oil and gas infrastructure requires capital investment to remain functional and, at the same time, to meet the needs of the new entrants.

Hence, a more relaxed price capping regulation, like the one applied in the water industry, could be taken into consideration.

F.2. News Entrants, bundling and vertical disintegration

Vertical disintegration regulation could solve the problem of bundling which often exists in offshore oil and gas industry and it is also present in the UKCS with infrastructure owners charging extra for additional services (i.e. offshore processing) other than transportation. Adding services for the third-party users increases the cost of their operations and discourages new entrants affecting adversely the rates of exploration. Disintegrating a vertically integrated monopoly through regulation can decrease the costs of operators and offer incentives to new participants to enter the industry and undertake exploration of new wells. In general, vertical disintegration regulation works towards the liberalisation of service provision by providing equal and fair access.

Despite the benefits vertical disintegration regulation can have for the market, disintegrating the North Sea offshore oil and gas transportation sector could be perplexing as competition cannot be easily promoted in all stages of upstream sector. Due to the presence of natural monopoly in the transportation of hydrocarbons, vertical disintegration could be used only to protect, and/or promote, competition in other production stages in order, for example, to avoid unnecessary extra charges for offshore processing. Due to the nature of hydrocarbons and the technical structure of the industry, processing facilities (offshore or onshore) are usually the additional service provided in bundling strategies. Since, though, transportation and processing are two stages highly interlinked in the oil and gas production stream, disintegrating one stage without applying the regulation to the other could be deemed both challenging and inefficient.

F.3. The case for Government intervention- exploration activity and the Norwegian example

This section of chapter 3 discusses the role and limitations of government ownership as a policy option for the UKCS inspired by the Norwegian example. In the situation where the Government is the owner and operator of assets (fields and/or transportation facilities) in one or more production stages, there are no concerns over natural monopoly and, in addition, no uncertainty over the third-party tariff pricing. This situation facilitates especially new entrants that can commit ex ante to transportation contracts as terms and conditions to access to critical infrastructure are predefined by the Government. Successful government intervention can be found in the Norwegian system that is considered highly efficient from an economic perspective and it consists of a unique initiative worldwide, which combines the presence of a monopoly with the access to infrastructure and tariffs to be highly regulated by the authorities in an effort to balance corporate and State interests[54]. The issue of market's liberalisation versus a tighter regulatory frame is not new in the UK oil and gas market. The first years of the UKCS industry were set in the political context of a Labour government which supported the maximum possible direct control over the newly found resources. It was later in the 1980s that the regulatory policy moved towards a more liberalised approach.

The UKCS and the Norwegian basin share several common characteristics; technical difficulties in operations (deep water discoveries, challenging weather conditions, etc.), high capital and operational costs for both exploration and production activities, depleting resources due to the maturity of the North Sea and considerable undiscovered resources in certain remote-location acreages. Due to these common industry features, and in combination with the similar political and socio-economic background, Norwegian regulation can become an inspiration for the reformation of the British offshore upstream oil and gas industry. Norway had been a model for many countries in respect to its predictable and cautious management of natural resources through a globally unique model of government ownership and private sector participation. The country followed a predictable and consistent regulatory framework for both exploration and production activities managing the hydrocarbon resources and revenues in a competent and transparent manner. Norwegian regulatory

[54] For more information on the Norwegian regulatory framework, see Chapter 2, subsection F.3.1.

authorities contribute to maximisation of economic recovery of the remaining resources through the proficient access to data, consistent entry to attractive acreages and stable regulatory conditions. To maintain the profitability and competitiveness of the oil and gas industry, access to new acreage for exploration and production is considered essential to improve future production rates and tackle uncertainties regarding the security of supplies.

One of the main challenges for the UK Regulator highlighted in this chapter is the negative effect market inefficiencies have on exploration activity rates. Given the fact that exploration expenses can more easily be suspended or adjusted when oil companies need to improve cash flow, investments in exploration are usually impacted first. This trend is not unique solely to mature basins with high capex and opex, like UK or Norway, but it represents a rather global development which followed companies' adaptation to the lower oil prices. During the last decade, the Norwegian oil and gas offshore industry also experienced low exploration and production rates caused partly due to the low oil price global environment. Therefore, the Norwegian government attempted to encourage production and recovery activities through the implementation of innovative regulatory approaches to acreage management and stimulation of exploration activities in both frontier and mature areas.

More specifically, one of the key policy elements was the stimulation of exploration activities in frontier areas of the basin. Since the introduction of the new regulatory scheme, a licencing round is held yearly for mature exploration acreage while, every two years, a licensing round is taking place for frontier acreage to promote the exploitation of remote resources (IEA, 2017). On top of the licencing rounds, the Norwegian State is currently considering a joint co-operation with Russia through the national company, Statoil[55], in order to explore cross-border resources and share the costs of the infrastructure needed for the development of new projects in the area. In contrary to the UK bidding system, the Norwegian licencing system is discretionary; licences are awarded to companies that show the best understanding of the acreage to ensure that the full potential of each field will be maximised. Furthermore, the state gives licences to at least two companies for the same acreage uniting the companies in a joint venture for both exploration and production activities while, at the same time, the

[55] The Norwegian state owns 67% of the shares of Statoil ASA, the largest producer of oil and gas in the NCS (IEA, 2017).

government participates[56] directly to promising developments securing, thus, a higher government take from the field in comparison to traditional income taxes.

Another innovative approach the Norwegian government promotes, especially for frontiers exploration and development, is the transport of Liquefied Natural Gas (LNG) or compressed natural gas by ship as a more-viable alternative to the traditional pipelines (IEA, 2017). The pipeline network in Norway is a natural monopoly controlled by the State and regulated on the basis of non-discriminatory third-party access. Transportation tariffs are governed by special regulation and companies access the system based on their capacity needs (the state-owned Gassco AS is responsible for allocating capacity) while transportation rights might be transferred between users when needed (IEA, 2017). The Norwegian regulatory authorities seeking to decrease transportation costs and boost the recovery of the remaining reserves initiated an examination of alternative transportation methods, like shipping, in order to verify their economic viability in comparison to traditional transportation systems, such as pipeline networks. At the same time, the Norwegian Regulator ensures the efficient development and operatorship of any new transportation system.

In the case of UKCS, a potential transition from an already long-established liberalised market framework to a highly regulated environment, which stretch to State ownership of facilities, would be challenging. In the case of Norway, the transition was smooth mainly because the Norwegian government allowed private investors and companies to continue operations and participate in the new regulatory framework creating a worldwide unique business model. The corporate culture facilitating the application of the Norwegian regulatory model cannot be found easily in other basins. A system based purely on the Norwegian model with the creation of a state-owned company holding direct interests to fields and facilities might not be a feasible option for the current corporate and political culture in the UK. However, the incorporation of certain regulatory approaches used in Norway might hold the key for the maximization of the economic recovery of the UKCS remaining reserves.

[56] The state participation in licenses is purely commercially driven and managed by the state-owned company, Petoro (IEA, 2017).

Promoting exploration activities in frontier acreages through effective licensing in areas of the basin which hold high yet-to-find and probable reserves, like the West of Shetland, could boost exploration rates. The development of remote acreages in the UKCS has been challenging partly because of the lack of efficient and economically viable infrastructure facilities for both transportation and processing. The construction of such infrastructure to facilitate future exploration and production activities could be promoted through an active government participation. Several suggestions towards the direction of government ownership in the UKCS came recently to light from independent consultancy companies. For example, PwC suggested a national shared pool of critical infrastructure equipment (e.g. heavy lifters, drilling units etc.) owned and operated by a government backed entity (in PwC report this entity is called 'UK Offshore Equipment plc') and with tariffs that are competitive aiming to encourage their use (PwC, 2016). In addition, potential cooperation for oil and gas activities with neighboring countries in promising border regions of the exclusive economic zones, such as Norway (NNS) and Denmark (SNS), could result to additional funds and solutions in both the field of hydrocarbons development as well as transportation. The last years, suggestions regarding government ownership in the energy sector started becoming more popular indicating a possible turn in UK's current policy orientation towards liberalisation. For example, in October 2017, Scottish Prime Minister, Nicola Sturgeon, announced plans for the creation of a publicly owned, not-for-profit energy company, providing locally generated renewable energy.

It is also important for the UK Regulator to encourage the information and data sharing through, for instance, the development of a shared data pool between UKCS players which could tackle any information asymmetries and encourage new participants entering the market by creating a transparent business environment. Furthermore, given the importance of both technological but also regulatory innovation for the industry, the initiation of research programmes by the Government could be of high importance. Similar to Norway, the Regulator could conduct research on the economic and technical feasibility on alternative transport routes for the different areas of the UKCS and, in consultation with the private sector, present suggestions and implement the appropriate regulation for their promotion. Nevertheless, even though government intervention and potential government ownership of fields and assets could be considered economically efficient, the UKCS industry business culture might not allow easily an implementation of such approach. Regardless, government

leadership is required in the basin to take an active role in coordinating interests and policies encouraging the production and exploration of the last remaining hydrocarbon reserves.

In 2015, the newly established Oil and Gas Authority (OGA) was assigned with the role to regulate, influence and promote the UK oil and gas industry. As mentioned in previous section of this chapter, the OGA replaced DECC as the regulatory entity accountable for petroleum licensing and regulation of the upstream oil and gas sector, including decommissioning of offshore infrastructure installations and enforcement of environmental legislation. The importance of the creation of the OGA lies to the fact that the UK has now an independent Executive Agency which is responsible for onshore and offshore regulation. However, despite the increased responsibilities of the OGA which include meetings with the operators, access to data, dispute resolution and introduce sanctions, its role remains limited. The collectively known as the "OGA Powers" is a term that refers to dispute resolution and sanctions. Regarding disputes, OGA is responsible of considering a wide range of disputes and making non-binding recommendation to assist resolution while. When it comes to sanctions, any OGA recommendations are subject of a consultation process.

As mentioned above, a system based purely on the Norwegian model with the creation of a state-owned company holding direct interests to fields and facilities might not be a realistic option for the current corporate and political culture in the UK. However, creating a new authority or, alternatively, empowering the OGA to be able to expand its power, with increased regulatory duties might be essential. The UK is familiar with regulatory authorities holding an expanded role and power in the utilities industry with the most prominent examples to be Ofgem (Office of Gas and Electricity Markets) and Ofwat (Water Services Regulation Authority). Similarly to Ofgem and Ofwat, an empowered oil and gas authority would be able to apply access regulation, promote a more active government participation (by considering proposals like the previously mentioned PwC 'UK Offshore Equipment plc' entity), and, initiate greater collaboration with neighbouring countries to develop frontier resources. In addition, the new authority (or a reformed OGA) would be able to enforce the sanctions and provide final determination in disputes. Hence, potential dispute applicants would have the chance to avoid the current process, which requires the involvement of the Secretary of State, and being accused for both causing delays and stimulate the frequent

appearance of the “shy applicant syndrome”. Finally, like the Norwegian system, any proposals from the Regulator regarding alternative transportation methods following feasibility studies would be, due to the empowered regulatory framework, under immediate consideration and potential implementation after consultation with the industry.

G. Conclusion

The maturity of the UKCS basin in combination with the small size of new discoveries create a challenging business environment with high capital and operational costs, decreased production rates and lack of funds for the construction of new critical infrastructure facilities. Furthermore, the low global oil price affects adversely industry's profitability generating additional barriers for investment activities, especially in exploration. However, despite the substantially falling investment rates along with the escalating exploration costs, there are several positive indicators representing a major opportunity for future activity in the UKCS. The Oil and Gas UK estimates that the remaining potential in the UKCS ranges between 15 and 24 billion boe in addition to DECC's assessment that the remaining recoverable reserves will reach 11.1-21 billion boe. The growth in exports of oil and gas services, the potential exploration and extraction from offshore shale as well as the continuous conventional exploration and production are only some of the opportunities present in the British oil and gas sector.

In the UKCS, it appears that the oil and gas production stages are heavily interlinked and often vertically integrated. Several companies are involved in most, if not all, stages of production by conducting exploration activities, developing fields, operating pipelines and running processing facilities. Observing the five main pipeline systems (Shuttle, Piper, Brent, Forties and Ninian), it becomes clear that they create easily distinguished regional monopolies as they dominate and control the hydrocarbons' transportation for large geographical regions of the UKCS. However, there are new dynamics arising in the North Sea business environment creating gradually a divergence in the traditional business models – with upstream operators focusing solely on exploration and production activities, while companies specialised on midstream activities focus on managing hub facilities, such as Nord Sea Midstream Partners Ltd and Antin. Despite, though, these arising trends, the industry remains in its largest part vertically integrated with companies operating in all stages of the upstream production process.

Considering that the majority of the approximately remaining 20 billion boe are located in small accumulations which can only be developed by connecting to nearby existing pipelines and hubs, third party access to infrastructure facilities is critical. Private negotiations between

the field owners (‘shippers’) and the infrastructure owners (‘carriers’) determine the terms and conditions of access to infrastructure. For several decades, the negotiations for access between ‘shippers’ and ‘carriers’ set the foundations for all the terms and conditions related to third party infrastructure usage in the UKCS. However, the recent year with the increasing challenges the UKCS business landscape is facing, it is becoming obvious that the existing ‘light touch’ regulatory framework, based on the ICoP, is not sufficient to manage the future of the North Sea basin.

The reformed 2004 ICoP, namely ICOP, constitutes of a generally self-regulatory regime. A self-regulatory, or semi-self-regulatory, regime can, in many cases, be considered superior to government regulation as industry participants benefit from their extended knowledge to design practical rules, increased efficiency in the rule-making process, and the enhanced flexibility they gain to adapt rules to changing circumstances (Williams , 2004). These advantages of self-regulation were the principles in which the UKCS self-regulatory regime was based. However, several economic as well as legal limitations which might affect adversely the effectiveness of a self-regulatory regime. The ICOP is meant solely to guide bilateral negotiations between infrastructure owners and potential third-party users without providing a mandatory set of rules. One of the main concerns regarding the regulatory regime of the UKCS is the effectiveness of the voluntary ICOP. The ICOP has been questioned in the basis that it does not contain sufficient disclosure requirements to prevent the strengthening of regional monopolies and issues of both price discrimination and high pricing in third party transportation tariffs.

This chapter critically analyses the current main challenges for the Regulator; the Domino Effect, the price discrimination, the high pricing in third party transportation tariffs, and, the negative effect on exploration activities. The maturity of the existing infrastructure and the high expenditure required to sustain its integrity is a systematic challenge in the UKCS. Early decommissioning appears to be an inevitable reality for several assets in the basin. Nevertheless, from a business and economic point of view, it is rational for a firm to shut down a field and its respective facilities (including pipelines), if the surplus from the production is not higher than the costs of maintenance and the overall fixed cost of the development. Although the Domino effect does not essentially consist of an economic consideration from a business perspective, the government may have different motives linked

to the overall UK economy to intervene and prevent an extensive Domino Effect from occurring in the North Sea. It is also important to highlight the fact that the term 'Domino Effect' represents more of an extreme scenario of premature shutdown of the whole basin rather than a synonym for early decommissioning.

Regarding price discrimination and high pricing, reaching an agreement regarding the transportation terms can become in practice a highly complex process involving several parties, the majority of which has often the monopoly within their geographical market. Nevertheless, despite the issues price discrimination creates in the UKCS, from an efficiency point of view, a discriminatory monopoly could be considered better than a non-discriminating one. In the case of a discriminatory monopoly, the owners of transportation and processing facilities can charge tariffs based on their knowledge regarding the unique conditions and features of each field in their geographical area. Consequently, they may charge higher tariffs than they would have charged in a perfectly competitive market, however, the price never exceeds the expected production revenues of each field. From the other hand, a unified tariff for the whole basin (or even one geographical region within the basin) would be more advantageous for some fields with higher revenues and robust production not enabling, though, the smaller marginal fields to operate.

Regarding high pricing, from an economic efficiency point of view, in the case of the UKCS, one could argue that infrastructure owners do not have a motive to overcharge tariffs to the point that transportation through their facilities would be deemed uneconomic by the third parties. Nevertheless, in the business reality of the North Sea, there are several incidents indicating that access tariffs are often significantly high resulting, thus, new fields to operate in the margin and create barriers for new entrants to commence exploration activities. However, we cannot overlook the fact that, in some situations, slightly higher prices enhance the revenue stream of older fields which operate on the margin and own at the same time the hosting facilities.

Looking at the long run, the business area more affected by tariffs being set above the cost-reflective levels is the exploration of new accumulations. The uncertainty in the exploration phase regarding the quantity and quality of future discoveries does not allow field owners to commit at the present for the future prices. The high sunk cost in combination with the

complexity of multi-party negotiations for transportation tariffs in the UKCS and the uncertainty regarding the exploration outcome make the creation of full contingent contracts uneconomic.

In the upstream oil and gas market, regulatory measures over the access rights and tariff pricing could provide a solution on the issue of high access costs to infrastructure facilities as increased transportation tariffs often discourage new participants to proceed with exploration operations in order to enter the market. With access regulation in place, the industry can become more attractive for new entries boosting consequently the exploration rates. In the case of UKCS, attention should be paid to the appropriate form of regulation setting the price on third party tariffs; very low prices can decrease the ex-ante pay-offs of infrastructure owners reducing as consequence their incentive to invest in both the construction as well as the appropriate maintenance of large projects with high sunk costs, such as pipelines or processing facilities. While the Gulf of Mexico 'common carrier' approach could be deemed unsuitable for the UKCS due to the different market conditions existing in the North Sea basin, a form of 'relaxed' price cap regulation could be considered to provide incentives in cutting costs and reducing information asymmetries.

Disintegrating a vertically integrated monopoly through regulation can decrease the costs for market participants operators and offer incentives to new entrants who are looking to undertake exploration activities. Vertical disintegration regulation works towards the liberalisation of service provision by securing equal and fair access. Nonetheless, disintegrating the North Sea offshore oil and gas transportation sector could be perplexing mainly since in upstream transportation sector competition cannot be easily promoted in all stages of oil and gas production.

If the Government is the owner and operator of fields and facilities, there are no concerns over natural monopoly and, in addition, no uncertainty over the third-party tariff pricing. This situation facilitates especially new entrants that can commit ex ante to transportation contracts as the government predefines the terms and conditions of access to critical infrastructure. Successful government intervention can be found in the Norwegian system, which is considered highly efficient from an economic perspective and it consists of a unique initiative worldwide as it combines the presence of a monopoly with the access to

infrastructure and tariffs to be highly regulated by the authorities aiming to balance corporate and State interests. The UKCS and the Norwegian sector share several common industry features and, in combination with the similar political and socio-economic background, Norwegian regulation can become an inspiration for the reformation of the British offshore upstream oil and gas industry.

To maintain the profitability and competitiveness of the oil and gas industry, access to new acreage for exploration and production is vital as it safeguards in order to future production rates and tackles uncertainties on security of supplies. During the last decade, the Norwegian government attempted to encourage production and recovery activities through the implementation of innovative regulatory approaches to acreage management and stimulation of exploration activities in both frontier and mature areas utilising effective licensing. The development of remote acreages in the UKCS (like West of Shetlands) has been challenging partly because of the lack of efficient and economically viable infrastructure facilities for both transportation and processing. The construction of such infrastructure should be supported by an active government participation given that transportation facilities are the key to increase future exploration and production activities. In addition, potential cooperation with neighbouring countries in promising regions around North Sea's exclusive economic zones could result to additional funds and solutions in the field of hydrocarbons development and transportation.

After exploring various regulatory tools, this chapter presented the case of government intervention in the UKCS and the prospect of creating a new regulatory authority for the UKCS or, alternatively, empowering the OGA. The importance of promoting a more active government role in the UKCS business environment was apparent with the creation of the OGA with which the UK attained an independent Executive Agency responsible for onshore and offshore regulation. However, despite the increased responsibilities of the OGA its role remained limited two years after its creation to non-binding recommendations and consultation. The creation of an empowered regulatory authority could be considered the middle ground solution between the direct government participation to the upstream oil and gas industry (with a state-owned company similarly to the Norwegian model) and the light-touch regulatory regime existing currently in the UKCS.

Launching a new authority should not necessarily require the absolute adaptation of the Norwegian model, which may represent an unrealistic option for the current corporate and political culture in the UK. On the contrary, the case for government intervention presented in this chapter advocates in favour of a system already existing in UK's utilities industry with the existence of several powerful regulatory authorities, such as Ofgem and Ofwat. An authority with expanded regulatory power would be able to apply price regulation, promote a more active government participation (by considering proposals like the previously mentioned PwC 'UK Offshore Equipment plc' entity), and, initiate greater collaboration with neighbouring countries to develop frontier resources. In addition, the new authority (or a reformed OGA) would be able to enforce sanctions and provide final determination in disputes. Finally, following the example of the Norwegian system, data sharing and proposals on alternative transportation methods would be under immediate consideration and implementation after consultation with the industry.

In the case of UKCS, a potential transition from an already long-established liberalised market framework to a highly regulated environment, which stretch to State ownership of facilities, would be challenging. The corporate culture facilitating the application of the Norwegian regulatory model cannot be found easily in other basins. However, the incorporation of certain regulatory approaches used in Norway might hold the key for the maximisation of the economic recovery of the UKCS remaining reserves. Therefore, despite the economic advantages government intervention and ownership of infrastructure equipment or assets entail, the UKCS industry business culture might not allow an implementation of such measures. In any case, government leadership could take a more active role in the basin by coordinating interests and policies which encourage the production and exploration of the last remaining hydrocarbon reserves. Through the creation of a consistent and efficient regulatory environment, the authorities can contribute to the maximisation of economic recovery of the remaining resources through the resourceful access to data, consistent entry to attractive acreage and stable regulatory framework conditions.

Chapter 3 provides an analysis of current and future policy options for regulation of the oil and gas transportation networks in the UKCS. The arrangements around third-party access to infrastructure facilities in the UKCS are investigated along with the existing market conditions and regulatory framework. This chapter also analyses the monopolistic ownership

structures of transportation facilities and the market inefficiencies arising in the market. Price discrimination, high pricing in access to infrastructure as well as the vertical structure of the market are examined aiming to discuss the application of various regulatory tools, which were presented in Chapter 2, in the UKCS. Finally, the chapter aims to present and critically discuss the case for government intervention and the role and limitations of government ownership in the basin.

Conclusion

Overall, the aim of this study has been to thoroughly examine the dynamic relationship between Governments and private companies under the light of the political economy of regulations and institutional economics. It is an attempt to comprehend in depth and formally analyse both the economic as well as the non-financial factors influencing the development of hydrocarbon resources. The goal was to present both companies' as well as governments' perspective while attempting to understand how social and political factors are often reflected on the economic aspects of the investment decision-making process in the oil and gas industry. The research attempted to combine political risk analysis with institutional economics and economics of regulation in order to answer not only theoretical questions but also examine their real-life application to the development of government policy.

Inspired by the competition between private international oil companies (IOCs) and national oil companies (NOCs), the first chapter of the thesis was concerned with the rapidly changing business landscape of the global oil and gas industry highlighting the social determinates of the phenomenon of resource nationalism. Although the financial case for making an investment is a vital part of the investment decision-making process, non-economic factors are also crucial. Besides, the non-economic variables may add to the disruptions resource nationalism practices can bring to an asset resulting to direct economic impacts for a private company. In the majority of contemporary studies, the issue of resource nationalism and, more generally, the decision of a government regarding the way in which the natural resources will be developed, becomes closely related with both institutional and social indicators. Chapter 1 draws theoretical inspiration from resource nationalism theories concerned with the role of institutional quality. It also borrows social indicators used in the resource curse theory under the hypothesis that the institutional quality in combination with social features, such as poverty and inequality, can have a great effect on the possibility of resource nationalism occurrence and, as consequence, on the relationships between the host country and private operators.

In this constantly growing field of research, several contemporary works attempt to extend this negative relationship between natural resource abundance and economic growth over to

other important social indicators as well as examine the effects of natural resources development on economic growth in relation to its dimensions on the human well-being. This study indicates that the phenomenon of resource nationalism streams from not only economic but also social determinants through the incorporation of variables linked with social factors and welfare. Chapter 1 adds empirical evidence to the existing literature regarding the negative correlation between nationalisation and institutional quality. Furthermore, by creating two new dependent variables, it expands the work of S. Guriev et al. (2011) and provides a comprehensive framework to define more broadly the phenomenon of resource nationalism as a wider spectrum of categories falling into the definition of 'nationalisations' is identified.

One could argue that regulatory innovation in oil and gas industry is as important as technical innovation. That is the reason why, the second chapter of this thesis has been focusing on the challenges the oil and gas transportation systems face. Chapter 2 was concerned with the analysis of oil transportation infrastructure economics focusing on the economics of regulation and the issue of third party access to infrastructure under conditions of natural monopoly. Classic economic theory of natural monopoly suggests that production efficiency can be better satisfied if a single firm supplies the market. The presence of strong economies of scale is one of the main reasons why competition was deemed undesirable for the oil and gas industry. In addition, due to the presence of vertical integration, a more competitive production stage might become monopolistic allowing the incumbent to extend her monopoly power to an originally competitive market. However, there may be efficiency gains arising from the presence of vertical integration as it can prevent double marginalisation.

The two main economic inefficiencies arising due to the presence of natural monopoly and the high prices set by the incumbent in the third-party access tariffs are the Domino Effect and the decreased exploration rates. After a critical investigation, Chapter 2 argued that the Domino Effect is not essentially an economic consideration from a business perspective, as it is reasonable that the no-profitable fields and related infrastructure facilities will shut down and eventually be decommissioned. Regarding the issue of decreasing exploration activity due to the high prices (anticipated or actual), exploration may lack efficiency as costs are expected to exceed the revenues. In both cases, the government might have incentives to

intervene in the market in order to attract new entrants, boost investment rates and maintain the significant revenue stream coming from oil and gas industry to the State budget.

In Chapter 2, special focus is given to the economic and business impact and limitations of a potential government intervention in the oil and gas industry. Policy makers have used access regulation to promote effective competition as it creates a regulatory environment which guarantees that the competitors have access to infrastructure facilities too costly to duplicate. Government ownership does not always correspond necessarily to absolute absence of foreign investments, as usually the Government owns one stage of oil and gas production (i.e. transportation) with other stages to be open to private operators. In rare cases, like Norway, there is a combined mixed model of state ownership and private interests. Government ownership has two important merits; no uncertainty regarding the terms and conditions of third party access and elimination of any concerns over monopoly. Without a doubt, the unique technical characteristics, the market conditions and the historically established socio-political conditions of each basin greatly affect the established regulatory framework and do not facilitate the direct application of the same regulations everywhere in the world.

The third, and last, chapter of this thesis has been investigating the existing business environment and regulatory framework in the UKCS aiming to provide policy recommendations for an industry critical to the country's economy. The UKCS entered a transition period from an upcoming province, which attracted high levels of investment, to one where the ageing fields and more technically challenging new discoveries increase the costs lowering, as consequence, the investment levels. The main challenge for the Government is to adapt quickly and effectively to this transition securing a reasonable rate of return for both the industry and for the nation. Chapter 3 has critically analysed the current main challenges for the Regulator applying the basic economic principles presented in Chapter 2; the Domino Effect, the price discrimination, the high pricing in third party transportation tariffs, and, the negative effect on exploration activities.

The Domino Effect, although presented in many cases as a synonym to early decommissioning, might constitute more to an extreme scenario than an inevitable reality for the basin, especially considering the evolving dynamics in the North Sea and the presence of new players specialised in infrastructure ownership and operatorship. In regard to price

discrimination and high pricing, reaching an agreement regarding the transportation terms can become a highly complex process involving several parties, the majority of which has often the monopoly within their geographical market. Nevertheless, despite the issues price discrimination creates in the UKCS, from an efficiency point of view, a discriminatory monopoly could be considered better than a non- discriminating one as the owners of transportation and processing facilities can charge tariffs based on their knowledge regarding the unique conditions and features of each field in their geographical area. In addition, one could argue that infrastructure owners do not have a motive to overcharge tariffs to the point that transportation through their facilities would be deemed uneconomic by the third parties. Still, in the business reality of the North Sea, there are several incidents indicating that access tariffs are often high pushing, thus, new fields to operate in the margin and create barriers in new entrants to commence exploration activities. Nevertheless, when looking the long-run, the business area more affected by tariffs being set above the cost-reflective levels is the exploration of new accumulations as the uncertainty in the exploration phase regarding the quantity and quality of future discoveries does not allow field owners to commit at the present for the future prices.

Chapter 3 also intended to provide an analysis of potential regulatory tools and their application in the case of the UKCS. Specifically, access regulation, vertical disintegration and government ownership are the cases taken under consideration (theoretically analysed in Chapter 2). In upstream oil and gas market, regulatory measures over the access rights and tariff pricing could provide a solution on the issue of high access costs to infrastructure facilities as increased transportation tariffs often discourage new participants to proceed with exploration operations to enter the market. Successful government intervention can be found in the Norwegian system and given the fact that the UKCS and the Norwegian sector share several industry features in addition to the similar political and socio-economic background, Norwegian regulation can become an inspiration for the reformation of the British offshore upstream oil and gas industry. Access to new acreage for exploration and production, effective licencing in frontier and mature fields, government participation in the construction of critical infrastructure facilities, effective cooperation with neighbouring countries and the creation of a new regulatory authority for the UKCS (or alternatively the empowerment of OGA) are some of the areas the UK Government could pursue more actively.

The incorporation of certain regulatory approaches, government leadership and the way a country will select to develop its natural resources can be decided only in a case-by-case basis, as socio-economic conditions and business culture tend to differ drastically in various areas of the planet. Nonetheless, in the ever evolving technical, economic and political settings surrounding the oil and gas industry, regulatory approaches applied in different countries can provide to both researchers as well as policy makers valuable lessons learned to assist them in the creation of the appropriate regulatory framework.

Overall, the three chapter of this thesis are all concerned with the economics of regulatory issues in the oil and gas industry. The theories and research developed are under the umbrella of examining the dynamic relationship between Governments and private companies under the light of the political economy of regulations and institutional economics. The empirical work of Chapter 1 explores how the socio-economic conditions affect the way a country will choose to develop its natural resource putting emphasis in the social determinants which contribute to the rise of nationalisation in the oil and gas industry. Chapter 2 by applying basic regulatory economic principles on oil and gas transportation networks explores various regulatory tools and their application with special focus to government intervention. Finally, Chapter 3 attempts to provide policy recommendations for the UKCS discussing of the role and limitations of government ownership in the UKCS. From hardcore nationalisation of the natural resources to the unique Norwegian model of State ownership, this work attempts to comprehend and analyse the economic, social and political issues surrounding the relationship between the government and the oil and gas industry.

Appendix

Appendix I- Resource Nationalism Index Table

The table below presents the nationalisation incidents that had be considered in the construction of the Resource Nationalism Index for the period 1996-2013. The table includes the index category in which the incident under investigation is falling. the country of occurrence and any additional relevant concerns. In the case of a country fitting in two or more categories, the categorisation process accounts only for the year(s) in which the incidents occurred and their relevant rating- as consequence, a country can have scores varying from '0' (no nationalisation incidents- not represented on this table) to '1' (softcore), '2' (midcore), and, '3' (hardcore).

Country	Incident	Concerns	Index Categorisation
Albania	• A little-known Albanian-U.S. joint venture accepted a bid from some new gas developments in the country, which several oil sector professionals considered it to be vastly overvalued. However, the company failed to make an initial payment. Florion Mima, a Berisha ally took over at the ministry until the polls, told Reuters he was too busy with a mountain of paperwork that included 47 disputed mining licenses to be interviewed regarding this case and he did not respond to any emailed questions. • Czech power group CEZ launched arbitration proceedings against Albania	Concerns over transparency, corruption	Softcore (1)

	after the country's power regulator revoked the distribution license of CEZ's local unit in a dispute over prices and imports. • Foreign players interested in country's promising gas reserves have been unnerved by an uncertain legal and regulatory framework, red tape and environmental regulation- some of them raising the issue in the EU.		
Algeria	• The state-controlled Sonatrach is the largest Algerian as well as African company and the 11th largest oil consortium in the world as it produces 30% of the GNP of Algeria. • In March 2005, the Algerian parliament adopted the hydrocarbon reform bill, encouraging IOC investment in the hydrocarbon sector aiming to reduce Sonatrach's domination. However, 2006 amendments to the hydrocarbon bill created a windfall tax on IOC profits with this tax to reach up to 50% on some contracts. In addition, the amendments gave Sonatrach rights to a 51% or higher participation option on each. • Algeria has experienced difficulties attracting foreign investors especially at licensing rounds. In the country's seventh licensing round in 2008, only 4	Dominance of NOC after reformation of the legal system Barriers of entry Concerns over transparency, corruption	Softcore (1) and Midcore (2)

	of the available 16 blocks were awarded, 3 of 8 in 2009, and 2 of 10 in 2011. The lack of fiscal incentives in combination with past Sonatrach corruption allegations were to blame for the lack of IOC operating in the country. • The 2013 amendments introduced a profit-based taxation, as opposed to revenue-based and lowered tax rates for unconventional resources allowing also for a longer exploration phase without though managing to change Sonatrach's role as a majority stakeholder in all upstream oil and natural gas projects.		
Angola	• The UN has criticised the Angolan government for using summary executions, rape, torture, torture, disappearances and arbitrary detention. The Angolan government has justified these actions on the need to maintain oil output. • In December 2011, Human Rights Watch called the Government of Angola to explain the whereabouts of approximately US$32 billion missing from government funds and which they were linked to Sonangol- the state oil company. The same year, the IMF published a report supporting that the government funds were spent or transferred from 2007 through 2010	Concerns over transparency, corruption leading to international arbitration Dominance of NOC after reformation of the legal system	Softcore (1) Midcore (2)

	without being properly documented in the budget. • A new private investment law, passed in May 2011, altered the benefits and incentives available for investors providing generous benefits to foreign companies investing outside of the petroleum industry and in geographic areas which are least developed.		
Argentina	• Decline in exploration and production from IOCs due to government controls on exports and price controls on domestic oil and gas. Political risks and government intervention have discouraged foreign investment in oil production in Argentina. • On 16 April 2012, the president announced the introduction of a bill for the renationalisation of YPF (Yacimientos Petrolíferos Fiscales; English: "Fiscal Oilfields"). According to the bill, the national government would purchase a controlling 51% share, with ten provincial governments receiving the remaining 49%. • In May 2012, the Argentine government passed legislation confirming the expropriation of the YPF oil and gas firm, which directly affected Repsol's 51% majority ownership of YPF. The Spanish firm received compensation for the	Price Controls Expropriations	Midcore (2) and Hardcore (3)

	expropriation by the Argentian Government. • However, on July 2013, the Argentinian government announced that companies can export 20% of their production without paying export taxes and have exemption from dividend repatriation after they invest in a project for five years to attract foreign investment		
Bahrain	• In 1999, the Bahrain Petroleum Company was created (BAPCO) and, along with the Bahrain National Gas Company (BANAGAS) dominate Bahrain's hydrocarbon industry.	Constitutional Prohibition- Fully nationalised oil and gas sector	Hardcore (3)
Bangladesh	• In 2003, Petrobangla national company was in breach of the construction contract and, after international arbitration, awarded damages to Saipem. Saipem could not though enforce this award in Bangladesh, the only state in which Petrobangla had assets, because Bangladeshi courts ruled that the award was "a nullity". Saipem argued that the Bangladeshi courts had indirectly expropriated its right to payment under the contract. • In 2000, a dispute arose between Bangladesh and Chevron over the interpretation of two production sharing contracts (PSCs) and three gas purchase and sale agreements	Illegal breach of contracts leading to international arbitration	Hardcore (3)

	(GPSAs). Petrobangla argued that was entitled to receive a 4% tariff for allowing Chevron to use their pipelines, when Petrobangla itself was the buyer of the said gas. Chevron counter-argued that such a tariff could only be charged when the pipeline was being used to supply gas to third parties. Chevron manage to recover which was illegitimately deducted from their earnings.		
Belarus	• All the activities related to exploration and the government-controlled Belneftekhim via its subsidiary, the unitary republic enterprise Belorusneft, carries out production of oil and associated gas in the country. • Since 1991, Belarus has two state-owned oil pipeline operating companies, the Gomel Oil Transportation Enterprise (RUP Gomeltransneft Druzhba) and the Novopolotsk Oil Transportation Enterprise (NRUPTN Druzhba). Their activities are regulated in accordance with the Law on Natural Monopolies, which considers oil pipeline transport operators to be natural monopolies. • However, in 2010, international tender was announced for participation in oil shale projects in the country representing a turn to the country's	Concerns over transparency Barriers to Entry Dominance of NOC after reformation of the legal system	Softcore (1) Midcore (2)

	policy towards a more liberalised approach. • The state-owned joint stock company Beltransgaz owned and operated the system of main natural gas pipelines since the dissolution of the Soviet Union. However, in November 2002, the Belarusian parliament passed a law allowing for the privatisation of Beltransgaz and opening the market to IOCs.		
Bolivia	• In 1994, the natural gas sector of the country was privatised, and it was subsequently re-nationalised in 2006. During the re-nationalisation, the military occupied Bolivia's gas fields and gave foreign investors a six-month deadline to comply with demands or leave. President Morales warned foreign companies that they would not be compensated if they have recovered their original investments. • During the same period, several contracts were consequently have breached illegally. IOCs had argued that the hydrocarbons law represented an arbitrary violation of legal security by unilaterally declaring invalid contracts signed with the Bolivian state. From the other hand, the Bolivian government argued that the original contracts were in any case invalid because they had never	Expropriations Nationalisation of the sector Illegal breach of contracts leading to international arbitration	Hardcore (3)

	received official approval from the Congress.		
Brazil	• Up to 1997, the oil monopoly belonged to state-owned Petróleo Brasileiro S.A. (Petrobras). • According to the legislation instituting a new regulatory framework that the Brazilian government passed in 2010, Petrobras will be the sole operator of each production-sharing agreement and will hold a minimum 30% stake in all projects. • When Luiz Inácio Lula da Silva was elected president in 2002, he created a system where all future foreign investment would consist of partnerships with Petrobras, which would hold a majority stake. He did not though amend existing oil contracts, nor did he expropriate international partnerships.	Dominance of NOC after reformation of the legal system Barriers of entry Legal changes in the organisational structure of the industry resulting NOC domination	Softcore (1) Midcore (2)
Chad	• In 2006, Chad expropriate the assets of Chevron and Petronas for allegedly failing to pay taxes. Many analysts argued that the firms might have been expelled to make room for Chinese oil companies.	Expropriations	Hardcore (3)
China	• Between 1994 and 1998, the Chinese government reorganised most state-owned oil and gas assets into two vertically integrated firms - the China	Concerns over transparency	Softcore (1) and Midcore (2)

	National Petroleum Corporation (CNPC) and the China Petroleum and Chemical Corporation (Sinopec). These two NOCs control China's upstream and downstream oil markets. • Additional state-owned oil firms have emerged over the past several years like China's National Offshore Oil Corporation (CNOOC), which operates mostly on offshore oil exploration and production. • Whereas onshore oil production in China is mostly limited to China's NOCs, international oil companies (IOCs) have been granted greater access to offshore oil prospects and technically challenging gas fields, mainly through production-sharing contracts (PSCs) and joint ventures (JVs). China's NOCs must hold though the majority participating interest and can become the operator once development costs have been recovered.	Dominance of NOC after reformation of the legal system Barriers of entry	
Colombia	• Ecopetrol, the national oil company of Colombia, formerly controlled the development of all hydrocarbon resources. However, in 2013, Colombia decided reforms were needed in the face of declining reserves and production towards the	Dominance of NOC after reformation of the legal system Barriers of entry	Softcore (1) and Midcore (2)

	liberalisation of the market and the attraction of foreign investments.		
Congo (Dem.Rep, DRC)	• According to the Natural Resource Governance Institute, Congo has substantial legal framework but insufficient public disclosure policies. • Even though the 2002 Natural Resources Code establishes procedures to obtain licenses, NOCs still hold many of the most lucrative titles undermining the competitive provisions of the Code. • The DRC's land law allows for expropriation of property by the government for the sake of public interest. • Despite attempts to enforce existing legal provisions, protection of property rights remains weak.	Concerns over Transparency Weak Property Rights Dominance of NOC after reformation of the legal system Barriers of entry	Softcore (1), Midcore (2)
Ecuador	• In 2012, the NOCs Petroecuador, Petroamazonas, and Operaciones Rio Napo accounted for roughly 73% of total production in Ecuador, with the remainder attributed to fields operated by private companies. • Hydrocarbon resources are exclusively owned by the state and the country limits foreign investment in the sector to service contracts that offer a fixed	Expropriations Legal changes in the organisational structure of the industry resulting NOC domination Illegal breach of contracts leading to international arbitration Weak property rights	Midcore (2) and Hardcore (3)

	per-barrel fee for their exploration and production activities. • In 2006, Petroecuador took over the production assets of Occidental Petroleum after contracts expired. In 2009, following a tax dispute, the government also appropriated two blocks assigned to Perenco. Chevron also got involved in a lengthy legal battle with Ecuadorean plaintiffs which is still under international tribunal and raised questions about the potential costs of investing in Ecuador.		
Gabon	• In June 2011, the government created a NOC, the Gabon Oil Company, to increase the government's involvement in oil production by taking equity stakes in future awards. • In 2012, the government started working on a new petroleum law (implemented in 2015) which provides Gabon's NOC the right to take a 15% equity stake in all new projects while locals should hold at least 90% of all jobs in the energy sector, including executive positions. • Several factors constrain foreign investment including: the lack of a clearly-established and consistent process for companies to enter the market, high production costs, a small domestic market, a dysfunctional	Concerns over transparency Weak Property Rights Legal changes in the organisational structure of the industry resulting NOC domination Dominance of NOC after reformation of the legal system Barriers of entry	Softcore (1), Midcore (2)

	judicial system, and inconsistent application of regulations. Lack of transparency in administrative processes and lengthy bureaucratic delays, often without explanation, raise questions for companies about fair treatment and the sanctity of contracts.		
Georgia	• The state-owned LLC Georgian Oil and Gas Corporation was established in March 2006 by the order of the Minister of Economic Development of Georgia. In September 2011, the corporation changed its legal form into a joint stock company. • The Georgian Oil & Gas Corporation (GOGC) is the enterprise established by LLC Oil and Gas Corporations and owns the high-pressure gas pipeline system of Georgia.	Legal changes in the organisational structure of the industry resulting NOC domination	Softcore (1)
Hungary	• In 2011, Hungary bought back a 21% stake of its NOC (MOL) from Russia, raising strategic concerns to the investors over the ownership of Hungary's energy supply. • In 2013, the Prime Minister Viktor Orban announced that the government would go ahead with the nationalisation of the German energy company E. ON's gas business. The Hungarian Electricity Works had reached an agreement with E. ON to	Expropriation Legal changes in the organisational structure of the industry resulting NOC domination Dominance of NOC after reformation of the legal system	Midcore (2) and Hardcore (3)

	buy its four gas storage facilities as well as Hungary's contract for gas deliveries from Russia.		
India	• The energy sector used to be nationalised since 1970s, but in 1991, the Indian government embarked on the New Economic Policy to open the market to foreign investors. However, international investment rates remain relatively low due to concerns over transparency, corruption and favouritism.	Concerns over transparency	Softcore (1)
Indonesia	• The Indonesian Ministry of Energy and Mineral Resources is responsible for entering into production sharing contracts (PSCs) while Pertamina, the national company, continues to be wholly state-owned. • Indonesia's 2001 Oil and Gas Law transferred the upstream regulatory role from Pertamina to BPMigas-, a state-owned legal entity that was tasked with managing and implementing PSC- to reduce NOC's power. However, In November 2012, Indonesia's Constitutional Court deemed upstream regulator BPMigas to be unconstitutional and ordered it to be dissolved. The Energy and Mineral Resources Ministry temporarily took over regulatory functions through a special task force, SKK Migas. Following a corruption case within	Legal changes in the organisational structure of the industry resulting NOC domination Dominance of NOC after reformation of the legal system Barriers of Entry Concerns over Transparency	Softcore (1), Midcore (2)

	SKK Migas and arrest of its former chairman in late 2013, the entity lost the right to market the country's unused oil and gas and the government transferred once more the exclusive domestic rights to Pertamina.		
Iran	• Between 1997 and 2004, Iran invested more than US$40 billion in expanding the capacity of existing oil fields and exploring new deposits. Some of these projects were financed joint investments with foreign companies and Iran's NOC through buyback agreements under which the Iranian national company was required to retain complete ownership of the oil fields. • The state-owned National Iranian Oil Company (NIOC) has ownership of all upstream oil and natural gas projects as the Iranian constitution prohibits foreign or private ownership of natural resources. However, international oil companies (IOC) can participate in the exploration and development phases through buyback contracts[57]. • Iran is planning to change the oil contract model to allow IOCs to participate in all phases of an upstream	Constitutional prohibition of foreign/private companies to have ownership/operatorship over natural resources Illegal breach of contracts leading to international arbitration	Hardcore (3)

[57] The buyback contract is similar to a service contract and requires the contractor (or IOC) to invest its own capital and expertise for development of oil and natural gas fields. The IOC does not get equity rights to the oil and gas fields.

	project, including production. The country announced a new oil contract model called the Iranian (or Integrated) Petroleum Contract (IPC) with the purpose to attract foreign investment. However, in 2007, international sanctions led to the near halt of most international investment. • During 2009-10, Iran forced out most of the companies from western countries, Japan and Malaysia due to non-delivery of projects making, thus, way for Russian and Chinese companies- an effect that did not last long as, in 2013, Iran cancelled China's CNPC's contract to develop South Pars natural gas field, and in 2014, Iran cancelled also the $2.5 billion contract with CNPC to develop the South Azadegan field.		
Iraq	• The Ministry of Oil in Baghdad oversees oil and natural gas exploration and production activities in all but the Kurdish territory through its operating entities- the North Oil Company (NOC), the Midland Oil Company (MDOC), the South Oil Company (SOC) and the Missan Oil Company (MOC) • IOCs operate under technical service contracts (TSCs) and production-sharing agreements (PSAs). However, due to the political tension in the area	Concerns over transparency Weak Property Rights	Softcore (1), Midcore (2)

	and concerns over transparency and corruption, several IOCs have been pressured on different occasions to reduce their investments in the country. • In 2009, for the first time since the U.S-led invasion in Iraq in 2003, Western oil firms (Exxon Mobil, Royal Dutch Shell, BP, and Total) signed agreements with the Baghdad government.		
Japan	• Until 2004, the Japan National Oil Corporation (JNOC) dominated Japan's oil sector. However, in 2004, JNOC's profitable business units were spun off into new companies as greater competition was introduced into Japan's energy sector. The two most important companies arising were Inpex (currently Japan's largest oil and gas company) and Japan Petroleum Exploration Company (Japex). • Even though in previous years foreign companies have historically faced regulatory restrictions in the country, over the past several years, these regulations have been eased allowing IOCs like Chevron, BP, Shell, and BHP Billiton to be involved in oil and gas activities in Japan.	Dominance of NOC after reformation of the legal system Barriers of entry Legal changes in the organisational structure of the industry resulting NOC domination	Midcore (2)
Kuwait	• The government of Kuwait owns the oil industry. The two main policy and	Constitutional prohibition of	Midcore (2) and Hardcore (3)

	regulatory bodies are the Supreme Petroleum Council and the Ministry of Petroleum. The Kuwait Petroleum Corporation and its various subsidiaries execute the will of the government. • However, despite Kuwait's constitutional ban on foreign ownership of country's resources and revenues, the government has taken measures to increase IOCs participation in the oil and gas sectors through technical and service contracts. • With its formulation in 1997, 'Project Kuwait' attempts to incentivise foreign investment and bring production capacity to 4 million bbl/d by 2020 creating the first step towards liberalisation in an otherwise nationalised oil sector.	foreign/private companies to have ownership/operatorship over natural resources Barriers of entry Legal changes in the organisational structure of the industry resulting NOC domination	
Libya	• The National Oil Corporation (NOC) is the national oil company of Libya which, along with its subsidiaries, account for around 70% the country's oil output. • Prior to former Libyan leader Muammar Qadhafi's ouster, NOC was responsible for implementing Exploration and Production Sharing	Dominance of NOC after reformation of the legal system Barriers of entry Legal changes in the organisational structure of the industry resulting NOC domination	Midcore (2) and Hardcore (3)

	Agreements (EPSA) with IOCs, as well as its own field development. • After the 2011 civil war, there were a series of regulatory reviews pertaining to the structure and management of the hydrocarbon industry. However, formal discussions have been stalled because of the civil war. • IOCs, mainly from the United States and Europe, participate in Libya's hydrocarbon sector, especially after the mid-2000s as several sanctions were lifted by the U.S and the UN. IOCs involvement in Libya will depend, though, on resolution of political issues, operational security, and new regulatory legislation. • ConocoPhillips along with Marathon Oil and Hess (the so-called Oasis Group) experienced illegal breach of contracts for several field developments.	Illegal breach of contracts leading to international arbitration Weak Property Rights	
Malaysia	• Malaysia's national oil and gas company, Petroliam Nasional Berhad (Petronas), holds exclusive ownership rights to all oil and natural gas exploration and production. The Prime Minister acts as the director of Petronas and controls appointments to the company board. The company is the single largest contributor to	Dominance of NOC, monopoly, preferential rights based on legal provisions Barriers of entry Legal changes in the organisational structure	Midcore (2)

	Malaysian government revenues (up to 45% of taxes and dividends) • Under legislation enacted in 1985, Petronas is required to hold a 15% minimum equity in production sharing contracts (PSC) with all foreign and private companies.	of the industry resulting NOC domination	
Mexico	• In December 2013, the Mexican government enacted constitutional reforms that ended the 75-year monopoly of Petroleós Mexicanos (PEMEX), the state-owned oil company. • In 1938, Mexico nationalised its oil sector and PEMEX was created as the sole oil operator in the country. • Mexico tries now to develop and approve secondary legislation which still faces, though, significant opposition. Mexico's government plans to offer acreage for bidding which will be open to international firms by 2017.	Constitutional prohibition of foreign/private companies to have ownership/operatorship over natural resources Barriers of entry Concerns over transparency	Softcore (1) and Hardcore (3)
Mongolia	• Mongolian law requires foreign oil firms to enter into production sharing contracts (PSAs) with the government as a precondition for petroleum exploration and extraction. However, investors suggest that the current regulatory framework does not allow	Expropriation Constitutional prohibition of foreign/private companies to have ownership/operatorship over natural resources	Hardcore (3)

	for exploration and extraction natural resources. • In 2006, a new law (2006 Minerals Law and Petroleum Law) was introduced which empowers the GOM (Mongolia's NOC) to obtain up to a 50% share of any enterprise developing a "strategic deposit". In addition, the law restricts licenses to entities registered in Mongolia and, as a result, a foreign entity, in its own right, cannot hold mining or petroleum licenses. • In December 2012, the President of Mongolia offered amendments to the 2006 Minerals Law with most investors to argue that this proposed legislation is consistent with, and represents a continuation of, actions that represent both "creeping expropriation" and explicitly expropriatory acts sanctioned through force of law.		
Morocco	• In 2000 decision, Morocco decided to modify its hydrocarbons law to reduce the government's stake in future oil concessions to a maximum of 25% and attract more foreign investments. The entire energy sector was due to be liberalised by 2007. However, recent activity in Western Sahara has been controversial with many IOCs raising	Dominance of NOC, monopoly, preferential rights based on legal provisions Weak Property Rights Barriers of Entry	Softcore (1) and Midcore (2)

	concern for corruption and preferential rights. • In Paris on May 2012, Morocco signed the OECD's Convention on Propriety, Integrity, and Transparency declaring its willingness to adopt best practices for a more open and transparent economy.	Concerns over Transparency	
Nigeria	• All petroleum production and exploration activities take place under joint ventures between foreign multi-national corporations and the Nigerian federal government. All companies operating in Nigeria must legally be sub-entities of the main corporation, often incorporating "Nigeria" into their name. • The Petroleum Industry Bill, which was initially proposed in 2008, was expected to change the organisational structure and fiscal terms governing the oil and gas industry. However, IOCs operating in the country were concerned as some of the proposed changes include the potential renegotiation of contracts with IOCs, restructuring of NNPC (Nigeria's NOC), and, among others, a mandatory contribution by IOCs of 10% of monthly net profits to the Petroleum Host Communities Fund. The long effort to reform Nigeria's oil and gas legal framework has created	Dominance of NOC, monopoly, preferential rights based on legal provisions Barriers of entry Legal changes in the organisational structure of the industry resulting NOC domination Clear barriers of entry	Midcore (2)

	uncertainty that has delayed billions of dollars in potential investment in this country.		
Oman	• Since 1999, Oman has witnessed increased foreign direct investment through the privatisation process. However, Petroleum Development Oman (PDO) holds most of Oman's oil reserves and is responsible for more than 70% of country's crude oil production with the government to hold 60% ownership stake in PDO- Shell (34%), Total (4%), and Portugal's Partex (2%) also own stakes. • After 2000s, the contract terms for IOCs have become more favourable in Oman than in other countries in the region, some allowing significant equity stakes in certain projects. • Nationalisation of property is still allowed by the law (Article 11 of the Basic Law of the State).	Constitutional prohibition of foreign/private companies to have ownership/operatorship over natural resources Dominance of NOC after reformation of the legal system Barriers of entry Legal changes in the organisational structure of the industry resulting NOC domination Illegal breach of contracts leading to international arbitration	Midcore (2) and Hardcore (3)
Pakistan	• The Oil and Gas Development Company Limited (OGDCL) dominates Pakistan's oil industry with the government to own a majority share in OGDCL- the remaining is owned by the public. • In 1996, the Peoples Party intensified the government control as all shares	Dominance of NOC after reformation of the legal system Barriers of entry Weak property rights	Midcore (2) and Hardcore (3)

	were kept under government management ownership. In 1998, the Prime minister, Nawaz Sharif, imposed economic emergency after performing nuclear deterrence in a direct response to India. As a result, all state-owned corporations and private sector industries' assets were frozen by Nawaz Sharif to prevent the financial collapse. • From 1999 to 2010, the nationalisation programme was swiftly decreased and effectively came to its end until 2011.	Illegal breach of contracts leading to international arbitration	
Paraguay	• The state-owned Petróleos Paraguayos (Petropar) has a monopoly on all crude oil and petroleum production in Paraguay while foreign IOCs are not allowed to participate in the market.	Constitutional prohibition of foreign/private companies to have ownership/operatorship over natural resources	Hardcore (3)
Peru	• Most of the oil and gas fields were owned and controlled by the state-owned company, Petroperú, from 1968 to 1991. Foreign firms were allowed to participate in exploration for new fields, although negotiations over their rights often has proved to be difficult. • In 2013, Peru opened a bidding process for six offshore oil blocks after having	Dominance of NOC, monopoly, preferential rights based on legal provisions Weak Property Rights Barriers of Entry Concerns over Transparency	Softcore (1) and Midcore (2)

	agreed to exclude Petroperu from the auction.		
Philippines	• The Philippine National Oil Company (PNOC) has historically dominated the country's oil sector until 1998's market reform which aimed at deregulating the oil industry and brought many new oil companies to the Philippines. PNOC remains the primary player in the upstream oil activities.	Concerns over transparency, corruption	Softcore (1)
Poland	• In Poland, the two key oil companies are PKN Orlen (established in 1999) after a merge of the two large, former state-owned, enterprises and Grupa Lotus (GL) (formed in 2003). • In September 2002, the Polish government adopted a restructuring and privatisation program for the oil sector by creating the entity Nafta Polska to be in charge while the government retained 100% ownership in PERN (state-owned joint stock Oil Pipeline Operation Company specialising in oil transportation and storage). Nafta Polska reportedly transferred 10% stakes in three southern refineries and a 75% stake in Petrobaltic to GL. Since 2004, the Polish government controls directly and indirectly 85% of GL.	Dominance of NOC, monopoly, preferential rights based on legal provisions Weak Property Rights Barriers of Entry Concerns over Transparency	Softcore (1) and Midcore (2)
Qatar	• Qatar Petroleum (QP) is the state-owned petroleum company in Qatar,	Constitutional prohibition of	Hardcore (3)

	responsible for all oil and gas activities in the country and directly linked with state planning agencies, regulatory authorities, and policymaking bodies. Together, revenues from oil and natural gas amount to 60% of the country's GDP while it is the third largest oil company in the world by oil and gas reserves. • Qatar recently began moving toward using more joint venture (JV) agreements. However, natural resources are still state property under the Natural Resources Law. Qatar Petroleum has exclusive rights to explore, develop and produce oil and gas with authority to grant rights to third parties to carry out petroleum operations only through EPSAs or DPSAs (collectively PSAs).	foreign/private companies to have ownership/operatorship over natural resources	
Russia	• Most of Russia's production is dominated by domestic firms. Following the collapse of the Soviet Union, Russia initially privatised its oil industry, but country's oil and gas sector has reverted to state control over the past few years.	Accusations for indirect Expropriations Dominance of NOC after reformation of the legal system Barriers of entry Weak property rights	Midcore (2) and Hardcore (3)

	• ConocoPhillips also attempted to enter Russia's oil exploration and production in the 1990s, but it was unsuccessful. • With the possible exception of ExxonMobil, which signed an agreement with Rosneft to develop the Arctic shelf and the Black Sea, foreign operators experience difficulty operating in Russia. In general, while foreign companies can invest in Russia, the investment is generally done with a Russian company (usually Rosneft). • In 2013, BP cancelled a planned Arctic partnership with Rosneft as a result of a dispute with its Russian partners. BP was forced once more to sell its Russian assets which were acquired by Rosneft. • In 2012 and 2013, TNK-BP partnership was dissolved under suspicious conditions and BP divested its assets in Russia as Rosneft acquired nearly all of them. • By the end of 2013, with the buy-out of BP by the Rosneft, Russia took the basic step in order to bring its oil industry back under state control. In fact, many analysts called Putin's nationalisation policy as the largest re-	Illegal breach of contracts leading to international arbitration	

	nationalisation in the history of oil and gas industry.		
Saudi Arabia	• The state-owned Saudi Aramco- the world's largest producer and exporter of crude oil- owns, operates and develops all energy resources based in Saudi Arabia. Aramco's board reports to the Supreme Council for Petroleum and Minerals Affairs, which the King chairs. • The foreign-direct-investment law was revised in 2000 to set off-limits foreign investment and allow foreign minority ownership in joint ventures with Saudi partners in some sectors, such as petrochemical development.	Constitutional prohibition of foreign/private companies to have ownership/operatorship over natural resources	Hardcore (3)
Suriname	• The oil sector is entirely state-owned as the Petroleum Law of 1990 and 1996; exploration and developments rights for hydrocarbons can only be obtained by state-owned enterprises. The state has the authority for expropriation under Article 34 of the Constitution.	Constitutional prohibition of foreign/private companies to have ownership/operatorship over natural resources	Hardcore (3)
Turkey	• Although there are several international firms operating in Turkey, the state-owned firm TPAO (Türkiye Petrolleri Anonim Ortaklığı) has preferential rights in petroleum exploration and production as any foreign involvement in upstream	Dominance of NOC, monopoly, preferential rights based on legal provisions Weak Property Rights	Softcore (1) and Midcore (2)

	activities is limited to joint ventures with TPAO which produces approximately the 75% of the total oil output.	Barriers of Entry Concerns over Transparency	
Turkmenistan	• The Turkmenistan Natural Gas Company (Türkmengaz), under the Ministry of Oil and Gas, controls gas extraction in the country. • The Trans-Caspian pipeline (TCP) project, backed by the EU, has so far remained on paper, mainly due to Turkmenistan's refusal to sign production-sharing agreements (PSAs) with foreign companies for some major hydrocarbon deposits. • Most of Turkmenistan's oil is extracted by the Turkmenistan state-owned company, Türkmennebit without any legal provisions though prohibiting IOCs participating in the market.	Dominance of NOC, monopoly, preferential rights based on legal provisions Concerns over Transparency	Softcore (1)
Ukraine	• Naftogaz is the state-owned gas company. As of 2009, the company owned and operated the major gas infrastructure located between Russia and the EU, leading the firm to feature prominently in regional politics. Another subsidiary of Naftogaz, Gas of Ukraine, is responsible for domestic gas distribution to the local district heating companies.	Legal changes in the organisational structure of the industry resulting NOC domination Concerns over Transparency	Softcore (1)

	• After the dissolution of the Soviet Union, the Ukrainian oil and gas industry went through number of changes. In the early 1990s, there was privatisation of gas distribution network known as Ukrgas. The process took place unnoticed and when Naftogas was constituted, not all privately-owned distributers wanted to transfer their own stocks to the statutory fund of the National Joint Stock Company. • During 2000s, Ukraine opened its oil and gas industry to IOCs with the creation of several open joint-stock associations.		
United Arab Emirates (UAE)	• The Abu Dhabi National Oil Company (ADNOC) leads the day-to-day operations and implementation of the Supreme Petroleum Council (SPC) directives as the key shareholder in nearly all upstream activity. • UAE bases contract structures on long-term, production-sharing agreements (PSAs) between ADNOC and IOCs with the state holding a majority share in all projects. • In 2008, Occidental Petroleum secured the first new concession offered by the UAE in more than 20 years.	Constitutional restrictions of foreign/private companies over ownership/operatorship of natural resources Dominance of NOC after reformation of the legal system Barriers of entry	Midcore (2) and Hardcore (3)

	• However, at present, the regulatory and legal framework favours local over foreign investors as, for example, foreign ownership of land and stocks is restricted. • The UAE do not have any domestic laws to protect foreign investors from nationalisation or expropriation and the oil industry is a protected national sector.		
Uzbekistan	• The national oil and gas company Uzbekneftegaz was founded and was almost immediately reorganised as a national holding company. Since 2000, Uzbekneftegaz has been attracting foreign investments for the development of the oil and gas industry in the country. • However, several sources attribute the current lack of foreign investments and the decreasing rates of production to the existing multilevel management structure of the firm, the increased bureaucracy, the increased tax burden and the inefficient allocation of resources.	Concerns over Transparency	Softcore (1)
Venezuela	• Despite the steps towards the liberalisation of the petroleum sector during the 1990s, since the election of Hugo Chavez in 1999, Venezuela has	Dominance of NOC after reformation of the legal system Barriers of entry	Midcore (2) and Hardcore (3)

	increased public participation in the oil industry. • On 13 November 2001, Chávez enacted the new Hydrocarbons Law, which came into effect in January 2002 and, among other things, provided that all oil production and distribution activities were to be the domain of the Venezuelan state. • Following the December 2002 to February 2003 oil strike, Chávez referred to the regaining industry's control as "re-nationalisation" by initially raising tax and royalty rates on new and existing projects and mandating majority ownership of all oil projects to Petroleos de Venezuela S.A. (PDVSA)- the national company. • In 2006, Chavez implemented a complete plan towards the nationalisation of oil exploration and production mandating a renegotiation of a 60% minimum PDVSA share in projects. Sixteen firms complied with new agreements while Total and Eni were forcibly taken over. After Chavez's death in 2013, President Maduro continued Chavez's policies.	Weak property rights Illegal breach of contracts leading to international arbitration NOC preferential rights based on legal provisions	
Yemen	• The national oil company, Yemen General Corporation for Oil, Gas, and Mineral Resources, guides many state-owned subsidiaries that handle most	Expropriation	Hardcore (3)

	day-to-day operations and deals with energy sector revenues. • In 2015, "YEPC"- a partnership between Hunt Oil Company and ExxonMobil- announced that arbitration has been filed with the International Chamber of Commerce in Paris against the Republic of Yemen in response to Yemen's expropriation of Block 18. • In 2013, Yemen's government announced plans to transfer any expiring exploration licenses to state-owned companies.	Illegal breach of contracts leading to international arbitration	

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Appendix II- Data on Oilfields Size in the UKCS

According to Oil & Gas UK 2016 production data (Oil & Gas Authority, 2017), 170 offshore fields (highlighted in blue in the table below) out of the 223 in total of fields operating in the UKCS produce oil volumes lower than the average 4391.6 bpd (measured in barrels per day), and, therefore, they can be classified as 'small' developments. Out of the total of 942,095.45 bpd daily on average production on 2016, approximately 924 bpd are coming from smaller fields or, to put it differently, almost the 30% of total daily oil production for the same period.

Oil Fields	Company	Jan. 2016 bpd	Feb. 2016 bpd	March 2016 bpd	April 2016 bpd	May 2016 bpd	June 2016 bpd	July 2016 bpd	August 2016 bpd	Sept. 2016 bpd	Oct. 2016 bpd	Nov. 2016 bpd	Dec. 2016 bpd	Average
AFFLECK	MAERSK	3,252.	2,493.	2,526.	2,975.	2,216.	0.	0.	0.	0.				1,496.
ALBA	CHEVRON	8,025.	13,541.	14,427.	16,091.	19,734.	18,654.	15,756.	14,460.	13,797.	15,488.	14,405.	14,191.	14,881.
ALDER	CHEVRON											8,823.	12,296.	10,560.
ALMA	ENQUEST	3,762.	2,008.	4,968.	11,330.	13,465.	976.	8,936.	16,649.	12,174.	6,592.	8,893.	7,286.	8,087.
ALWYN NORTH	TOTAL	4,952.	4,994.	4,938.	4,701.	4,580.	4,506.	4,001.	3,651.	3,486.	3,980.	2,149.	1,258.	3,933.
ANDREW	BP	1,164.	1,870.	2,316.	1,634.	2,091.	282.	1,438.	1,520.	2,134.	2,428.	2,749.	3,529.	1,929.
ARBROATH	REPSOL	2,468.	2,875.	2,936.	1,593.	0.	0.	0.	0.	0.	0.	316.	2,552.	1,062.
ARKWRIGHT	REPSOL	1,203.	1,234.	1,839.	1,182.	0.	0.	0.	0.	0.	0.	0.	833.	524.
ATHENA	ITHACA	410.												410.
AUK	REPSOL	984.	2,531.	1,947.	960.	2,015.	0.	1,365.	1,704.	2,276.	880.	1,286.	288.	1,353.
AUK NORTH	REPSOL	1,798.	1,495.	1,600.	1,328.	869.	0.	0.	518.	1,135.	819.	908.	727.	933.
AVIAT	APACHE						0.	0.	0.	0.	0.	0.	0.	0.
BACCHUS	APACHE	4,809.	3,823.	3,161.	4,428.	3,826.	1,410.	0.	3,994.	3,013.	3,035.	3,490.	3,385.	3,198.
BALLOCH	MAERSK OIL NORTH SEA UK LIMITED	21,664.	31,029.	27,486.	30,325.	31,807.	29,395.	31,497.	30,358.	24,400.	24,310.	19,984.	11,795.	26,171.
BALMORAL	PREMIER	79.	696.	593.	602.	586.	600.	266.	625.	498.	585.	622.	632.	532.
BANFF	CNR	1,156.	3,599.	3,549.	3,190.	3,321.	1,166.	3,151.	2,957.	2,747.	2,796.	2,698.	3,033.	2,780.
BARDOLINO	SHELL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.	0.	0.
BEAULY	REPSOL	0.	0.	232.	839.	561.	491.	254.	692.	369.	420.	804.	78.	395.
BEINN	MARATHON	212.	136.	188.	0.	153.	58.	224.	178.	227.	247.	234.	220.	173.
BERYL	APACHE	12,193.	11,340.	10,426.	11,345.	10,292.	10,870.	9,447.	9,064.	9,304.	8,815.		8,129.	10,111.
BIRCH	CENTRICA	0.	0.	0.	0.	14.	594.	328.	73.	0.	20.	0.	0.	86.
BITTERN	SHELL	9,419.	7,705.	8,896.	8,440.	8,730.	8,884.	6,148.	4,998.	8,365.	7,552.	6,975.	4,593.	7,559.
BLACKBIRD	NEXEN	1,123.	1,137.	1,069.	1,022.	857.								1,042.
BLAKE	REPSOL	8,849.	14,285.	1,569.	0.	8,046.	17,919.	15,570.	11,759.	13,723.	7,969.	13,504.	8,417.	10,134.
BLANE	REPSOL	2,974.	3,136.	1,437.	2,856.	3,384.	0.	2,612.	2,703.	3,326.	2,050.	2,744.	2,544.	2,481.
BOA	MAERSK	1,246.	1,286.	1,146.	1,129.	1,092.	1,626.	1,675.	889.	1,807.	1,859.	1,675.	1,527.	1,413.
BRAE CENTRAL	MARATHON	1,126.	632.	954.	1,432.	1,329.	1,149.	1,464.	1,298.	1,516.	1,502.	1,527.	1,534.	1,289.
BRAE EAST	MARATHON	541.	575.	499.	412.	556.	583.	557.	360.	600.	505.	379.	625.	516.
BRAEMAR	MARATHON	1,128.	1,120.	938.	530.	1,098.	1,085.	1,083.	560.	1,011.	946.	872.	909.	940.
BRAE NORTH	MARATHON	477.	213.	379.	377.	505.	353.	354.	267.	243.	292.	306.	358.	344.
BRAE SOUTH	MARATHON	0.	0.	160.	2,064.	4,443.	4,678.	4,676.	5,016.	3,245.	3,957.	3,813.	4,020.	3,006.
BRECHIN	REPSOL	10.	0.	0.	0.	0.	0.	0.	0.	0.	0.	90.	103.	17.
BRENDA	PREMIER	0.	0.	309.	1,870.	1,560.	1,618.	989.	1,730.	1,488.	1,636.	1,808.	1,847.	1,238.
BRENT	SHELL	242.	300.	329.	505.	676.	824.	1,182.	188.	10.	10.	273.	249.	399.
BRIMMOND	APACHE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BRITANNIA	BOL	2,478.	2,300.	1,699.	2,918.	2,566.	2,168.	2,389.	977.	2,465.	2,556.	2,544.		2,278.

BRODGAR	**CONOCOPHILLIPS**	6,064.	5,481.	4,662.	6,294.	6,127.	4,871.	5,311.	1,886.	5,606.	6,000.	5,657.	6,016.	5,331.
BROOM	**ENQUEST**	3,130.	3,176.	3,335.	3,170.	3,335.	3,353.	3,422.	3,332.	3,361.	3,248.	3,345.	3,199.	3,284.
BRUCE	**BP**	1,995.	2,627.	2,588.	2,413.	2,416.	2,529.	3,322.	2,556.	2,915.	2,562.	2,032.	2,094.	2,504.
BRYNHILD	**LUNDIN**						364.							364.
BUCHAN	**REPSOL**	1,932.	2,900.	2,260.	2,505.	3,108.	3,496.	3,431.	468.	3,119.		2,482.	2,990.	2,608.
BUCKLAND	**APACHE**	535.	1,005.	990.	1,170.	1,110.	1,060.	1,009.	752.	526.	648.	587.	657.	837.
BURGHLEY	**REPSOL**	0.	0.	367.	1,768.	1,100.	957.	521.	1,417.	505.	1,205.	1,566.	1,399.	900.
BUZZARD	**NEXEN**	177,875.	169,292.	173,964.	173,567.	175,228.	165,455.	157,326.	153,979.	84,649.	28,109.	172,963.	166,996.	149,950.
CALEDONIA	**PREMIER**	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CALLANISH	**CONOCOPHILLIPS**	5,098.	3,690.	3,663.	5,241.	4,073.	4,450.	3,505.	687.	2,776.	3,291.	4,868.	4,727.	3,839.
CAPTAIN	**CHEVRON**	26,322.	28,529.	25,338.	18,315.	5,395.	26,914.	29,576.	28,778.	22,729.	25,814.	26,016.	28,309.	24,336.
CARNOUSTIE	**REPSOL**	67.	72.	75.	46.	0.	0.	0.	0.	0.	0.	24.	87.	31.
CAUSEWAY	**ITHACA**	666.	665.	387.	79.	19.	0.	0.	0.	0.	0.	0.	0.	151.
CHANTER	**REPSOL**	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CHESTNUT	**CENTRICA**	5,819.	6,021.	5,962.	5,059.	3,768.	4,806.	5,456.	1,694.	5,443.	3,346.	1,688.	4,085.	4,429.
CLADHAN	**TAQA**	12,102.	12,578.	10,038.	8,909.	5,971.	8,003.	6,927.	6,294.	4,373.	3,287.	2,097.	0.	6,715.
CLAIR	**BP**	18,900.	26,627.	24,920.	23,160.	24,360.	22,814.	24,580.	18,742.	20,380.	2,328.	16,314.	19,587.	20,226.
CLAPHAM	**DANA**	1,845.	1,929.	1,609.	2,188.	16,610.	1,095.	598.	323.	0.	0.		709.	2,446.
CLAYMORE	**REPSOL**	8,122.	10,954.	11,224.	10,384.	10,322.	11,165.	10,265.	9,943.	6,002.	0.	2,446.	9,283.	8,343.
CLYDE	**REPSOL**	455.	224.	354.	695.	614.	0.	451.	506.	567.				430.
COLUMBABD	**RANGER OIL**	1,448.	1,306.	1,209.	1,177.	1,114.	900.	1,127.	1,161.	1,018.	2,947.	2,881.	1,174.	1,455.
COLUMBAE	**CNR**	248.	294.	318.	303.	270.	210.	231.	151.	112.	123.	150.	96.	209.
CONRIE	**ENQUEST**	130.	29.	82.	88.	150.	214.	274.	232.	275.	217.	119.	20.	153.
CONWY	**ENI**	0.	0.	3,691.	2,724.	0.	1,621.	3,923.	6,374.	7,581.	7,119.	5,813.	1,690.	3,378.
COOK	**ITHACA**	3,921.	3,784.	2,723.	4,779.	4,101.	4,503.	4,937.	4,834.	5,645.	5,411.		5,142.	4,525.
CORMORANT EAST	**TAQA**	1,402.	1,482.	1,318.	1,304.	1,251.	1,095.	976.	815.	757.	361.	591.	468.	985.
CORMORANT NORTH	**TAQA**	6,557.	6,319.	5,908.	6,383.	5,087.	4,657.	6,143.	5,589.	5,492.	5,363.	3,301.	2,674.	5,289.
CORMORANT SOUTH	**TAQA**	5,439.	5,087.	5,085.	4,412.	4,421.	4,137.	4,425.	3,996.	0.	4,516.	4,398.	4,173.	4,174.
CRATHES	**ENQUEST**											1,104.	9,527.	5,316.
CURLEW	**SHELL**	1,598.	627.	1,092.	1,607.	1,478.	1,411.	1,702.	1,052.	709.	1,865.	1,065.	1,656.	1,322.
CURLEWC	**SHELL**	3,543.	1,209.	2,687.	3,206.	1,489.	2,466.	1,178.	1,542.	1,252.	2,157.	1,249.	2,350.	2,027.
CYRUS	**BP**	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	218.	565.	65.
DEVENICK	**TAQA**	2,643.	395.	2,151.	948.	2,322.	2,016.	2,264.	983.	1,878.	1,672.	1,603.	1,032.	1,659.
DEVERON	**ENQUEST**	3,382.	3,335.	3,261.	3,136.	3,224.	3,018.	3,064.	3,154.	3,153.	2,728.	1,999.	368.	2,819.
DONAN {MAERSK}	**MAERSK OIL NORTH SEA UK LIMITED**	6,326.	6,910.	8,322.	6,506.	6,873.	2,818.	4,659.	4,760.	3,723.	4,150.	4,009.	5,499.	5,380.
DON SOUTH WEST	**ENQUEST**	4,451.	5,680.	4,035.	5,848.	4,937.	4,991.	4,085.	3,686.	3,592.	2,745.	1,430.	563.	3,837.
DOUGLAS	**ENI**	3,487.	4,363.	3,504.	4,138.	4,238.	1,262.	1,620.	3,200.	3,413.	3,907.	3,785.	2,249.	3,264.
DOUGLAS WEST	**ENI**	575.	613.	368.	419.	430.	127.	224.	438.	417.	375.	358.	222.	380.
DRAKE	**BG**	0.	214.	301.	274.	0.	0.	27.	12.	321.	111.	0.	178.	120.
DUART	**REPSOL**	1,394.	832.	0.	0.	205.	644.	139.	539.	26.	722.	1,203.	489.	516.
DUNBAR	**TOTAL**	5,808.	6,079.	5,562.	5,333.	5,804.	4,163.	4,249.	3,651.	2,774.	2,424.	1,452.	1,792.	4,091.
EGRET	**SHELL**	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EIDER	**TAQA**	1,258.	1,007.	1,283.	893.	1,058.	1,100.	1,422.	1,384.	1,269.	1,533.	451.	387.	1,087.
ELGIN	**TOTAL**	10,792.	9,421.	7,776.	10,499.	8,347.	11,617.	18,960.	10,882.	16,074.	18,544.	22,719.	26,998.	14,386.
ELLON	**TOTAL**	745.	668.	592.	502.	477.	408.	449.	943.	706.	689.	361.	293.	570.
ENOCH	**REPSOL**	0.	0.	0.	0.	1,105.	2,188.	1,818.	1,463.	1,680.	1,665.	1,035.	0.	913.
ENOCHDHU	**CONOCOPHILLIPS**	11,562.	7,794.	9,136.	11,814.	10,772.	7,744.	8,782.	4,136.	7,744.	8,526.	11,991.	11,353.	9,280.
ERSKINE	**CHEVRON**	9,560.	7,657.	0.	0.	0.	0.	1,215.	1,215.	7,555.	7,200.	9,094.	10,025.	4,460.
ETTRICK	**NEXEN**	3,333.	3,218.	3,277.	3,281.	3,090.								3,240.
EVEREST	**BG**	3,964.	3,640.	4,082.	3,964.	2,806.	0.	1,124.	3,335.	3,475.	3,350.	3,880.	3,773.	3,116.
FALCON	**TAQA**	767.	865.	892.	831.	567.	972.	828.	761.	1,037.	720.	486.	0.	727.
FARRAGON	**BP**	0.	0.	0.	0.	0.	0.	0.	0.	432.	1,967.	3,782.	4,030.	851.
FIONN	**ITHACA**	601.	618.	863.	88.	574.	627.	686.	509.	461.	519.	196.	164.	492.
FLEMING	**BG**	1,022.	813.	802.	841.	0.	0.	305.	143.	430.	292.	275.	603.	461.
FOINAVEN	**BP**	22,167.	27,103.	33,241.	28,041.	30,158.	29,426.	30,735.	18,898.	22,206.	25,211.	29,226.	20,450.	26,405.
FORTIES	**APACHE**	42,880.	39,137.	41,526.	45,157.	41,427.	39,216.	39,469.	29,213.	35,427.	37,681.	38,302.	38,786.	39,018.

FRANKLIN	**TOTAL**	45,710.	40,175.	35,548.	42,346.	35,598.	40,179.	39,595.	16,375.	35,671.	37,231.	40,139.	38,957.	37,294.
FULMAR	**REPSOL**	1,679.	1,438.	1,570.	1,745.	1,217.	0.	0.	755.	1,510.	1,301.	1,338.	1,480.	1,169.
GADWALL	**ENQUEST**	947.	4,103.	1,640.	3,072.	3,624.	3,260.	2,423.	1,829.	799.	2,573.	1,372.	1,279.	2,244.
GALIA	**ENQUEST**	4,972.	2,404.	1,937.	2,215.	482.	1,125.	1,057.	783.	628.	602.	791.	614.	1,468.
GALLEY	**REPSOL**	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GANNET A	**SHELL**	13,918.	4,727.	7,208.	10,356.	10,981.	0.	10,676.	11,736.	11,747.	8,995.	8,192.	8,887.	8,952.
GANNET B	**SHELL**	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GANNET C	**SHELL**	395.	227.	483.	630.	546.	0.	0.	14.	591.	866.	802.	959.	459.
GANNET D	**SHELL**	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GANNET E	**SHELL**	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GANNET F	**SHELL**	12,916.	7,955.	12,557.	12,070.	11,652.	0.	6,017.	7,633.	10,802.	12,894.	12,331.	11,473.	9,858.
GANNET G	**SHELL**	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GLAMIS	**PREMIER**	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GLENELG	**TOTAL**	0.	0.	0.	0.	2,647.	7,615.	9,735.	5,169.	3,707.	0.	0.	3,099.	2,664.
GODWIN	**REPSOL**	4,837.	4,672.	6,743.	4,211.	0.	0.	0.	0.	0.	398.	2,871.	4,546.	2,357.
GOLDEN EAGLE	**NEXEN**	51,502.	55,079.	58,038.	60,312.	64,700.	62,697.	61,834.	29,676.	64,085.	57,281.	61,819.	62,512.	57,461.
GOOSANDER	**ENQUEST**	1,710.	1,717.	1,224.	1,694.	1,489.	1,307.	405.	528.	184.	816.	980.	562.	1,051.
GRANT	**TOTAL**	737.	772.	734.	774.	834.	713.	697.	853.	704.	709.	433.	300.	688.
GROUSE	**ENQUEST**	1,570.	1,024.	1,231.	1,606.	1,481.	1,290.	0.	0.	0.	301.	977.	441.	827.
GRYPHON	**MAERSK OIL NORTH SEA UK LIMITED**	7,060.	5,954.	6,789.	7,439.	5,720.	5,259.	5,972.	3,609.	0.	3,914.	3,861.	3,219.	4,900.
GUILLEMOT A	**Anasuria Operating Company**	4,764.	4,555.	2,922.	4,350.	3,110.	892.	1,823.	1,938.	4,087.	4,138.	3,510.	4,154.	3,354.
GUILLEMOT NW	**DANA**	3,110.	3,272.	2,753.	3,665.	3,671.	3,348.	2,284.	2,362.	2,474.	2,487.	2,556.	2,000.	2,832.
GUILLEMOT W	**DANA**	3,827.	3,151.	2,272.	2,948.	3,600.	4,007.	1,691.	1,679.	4,190.	4,096.	3,675.	3,289.	3,202.
HALLEY	**REPSOL**	0.	0.	0.	0.	0.	0.	0.	0.	1,123.	0.	0.	0.	94.
HANNAY	**REPSOL**	0.	0.	0.	0.	0.	0.	0.	0.	0.		0.	0.	0.
HARDING	**TAQA**	9,411.	9,044.	10,231.	10,098.	8,871.	9,736.	157.	3,931.	10,320.	3,130.	2,863.	9,388.	7,265.
HAWKINS	**BG**	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HEATHER {AND EXT}	**ENQUEST**	3,796.	3,871.	3,788.	3,769.	3,717.	3,549.	3,542.	3,532.	3,523.	3,216.	3,210.	2,999.	3,543.
HERON	**SHELL**	1,219.	147.	1,648.	1,304.	939.	81.	1,505.	213.	2,451.	1,859.	1,359.	1,471.	1,183.
HIGHLANDER	**REPSOL**	1,842.	3,654.	0.	1,431.	3,012.	3,437.	2,654.	2,448.	723.	2,550.	3,261.	1,891.	2,242.
HOWE	**SHELL**	3,090.	2,941.	3,005.	3,111.	3,263.	3,221.	3,348.	1,346.	21.	967.	3,779.	3,355.	2,621.
HUDSON	**DANA**	2,533.	2,584.	2,631.	2,517.	1,707.	2,090.	763.	188.	0.	0.	0.		1,365.
HUNTINGTON	**PREMIER**	11,793.	11,504.	11,886.	11,468.	11,206.	3,591.	10,368.	11,582.	10,881.	8,953.	10,527.	10,591.	10,362.
IONA	**REPSOL**	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ISLAY	**TOTAL**	91.	90.	82.	75.	69.	85.	77.	76.	65.	54.	29.	38.	69.
JADE	**CONOCOPHILLIPS**	4,206.	1,575.	1,494.	4,752.	4,097.	15.	1,226.	4,027.	4,472.	4,182.	3,762.	3,000.	3,067.
JAMES	**MAERSK**	722.	636.	650.	665.	388.	0.	0.	0.	0.				340.
JANICE	**MAERSK**	3,169.	2,936.	3,018.	3,138.	1,779.	0.	0.	0.	0.				1,560.
JASMINE	**CONOCOPHILLIPS**	15,561.	12,847.	14,593.	13,158.	12,146.	183.	7,639.	14,815.	13,579.	11,465.	10,373.	12,233.	11,549.
JOANNE	**CONOCOPHILLIPS**	4,630.	3,303.	2,853.	3,296.	2,724.	8.	976.	3,325.	2,810.	3,870.	2,591.	1,297.	2,640.
JUDY	**CONOCOPHILLIPS**	5,074.	2,206.	1,370.	772.	656.	62.	1,368.	1,207.	1,152.	4,438.	3,886.	4,130.	2,193.
JURA	**TOTAL**	712.	698.	682.	623.	639.	692.	694.	644.	771.	604.	482.	326.	631.
KEITH	**BHP**	0.	789.	1,131.	1,068.	1,039.	993.	825.	692.	882.	661.			808.
KESTREL	**TAQA**	0.	0.	200.	327.	0.	0.	0.	0.	0.	0.	0.	0.	44.
KINGFISHER	**SHELL**	1,215.	777.	1,078.	1,133.	981.	917.	1,269.	514.	946.	1,281.	1,289.	1,281.	1,057.
KINNOULL	**BP**	28,207.	26,990.	29,696.	23,915.	26,440.	2,802.	17,342.	19,273.	24,013.	23,428.	22,457.	24,627.	22,432.
KITTIWAKE	**ENQUEST**	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
KYLE	**CNR**	1,626.	3,682.	4,835.	4,011.	4,670.	2,610.	4,318.	4,355.	3,963.	3,867.	3,918.	3,904.	3,813.
LARCH	**CENTRICA**	0.	0.	0.	0.	0.	107.	106.	53.	171.	374.	223.	152.	99.
LENNOX	**ENI**	86.	82.	269.	286.	261.	73.	146.	246.	245.	252.	260.	172.	198.
LEVEN	**REPSOL**	0.	13.	12.	90.	68.	0.	0.	3.	0.				21.
LOCHRANZA	**MAERSK**	1,468.	1,606.	1,416.	1,419.	1,470.	1,427.	1,444.	1,408.	1,460.	1,505.	1,508.	1,377.	1,459.
LOIRSTON	**APACHE**	0.	0.	0.	0.	0.	0.	0.	0.	0.	101.	228.	5.	28.
LOMOND	**BG**	387.	648.	3.	3.	25.	0.	441.	879.	1,009.	1,014.	806.	857.	506.
LOYAL	**BP**	0.	0.	0.	0.	0.	0.	0.	0.	0.		0.	0.	0.
LYBSTER	**IGAS**	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
LYELL	**CNR**	1,449.	2,723.	1,948.	2,099.	1,604.	1,478.	2,150.	2,541.	1,538.	526.	789.	1,541.	1,699.
MACHAR	**BP**	4,470.	4,830.	5,418.	2,182.	10,741.	13,817.	10,816.	7,690.	5,598.	10,298.	15,782.	14,204.	8,820.
MACLURE	**MAERSK**	8,030.	8,427.	8,235.	8,184.	8,030.	6,613.	8,133.	4,216.	0.	7,193.	7,306.	6,399.	6,730.

MADOES	**BP**	2,514.	2,482.	4,110.	4,063.	3,052.	4,694.	3,128.	1,877.	4,610.	3,568.	4,817.	3,605.	3,543.
MAGNUS	**BP**	17,388.	16,291.	16,491.	16,614.	14,762.	16,191.	6,994.	9,485.	12,372.	15,121.	11,520.		13,930.
MALLARD	**ENQUEST**	22.	1,040.	1,388.	299.	1,430.	1,526.	2,303.	1,078.	593.	1,114.	2,131.	1,687.	1,217.
MARIA	**BG**	119.	199.	198.	134.	0.	0.	0.	0.	0.	0.	0.	0.	54.
MARNOCK	**BP**	117.	361.	676.	468.	549.	268.	849.	196.	330.	494.	435.	346.	424.
MAULE	**APACHE**	1,067.	1,005.	1,200.	1,238.	1,145.	991.	771.	611.	804.	681.	856.	855.	935.
MEDWIN	**REPSOL**	0.	22.	41.	43.	89.	0.	88.	49.	41.				41.
MERGANSER	**SHELL**	1,832.	3,257.	3,071.	3,067.	2,520.	2,170.	2,160.	1,174.	1,383.	1,563.	1,393.	419.	2,001.
MIRREN	**BP**	29.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	2.
MONAN	**BP**	537.	1,964.	3,683.	1,155.	0.	828.	757.	222.	0.	1,340.	1,992.	1,585.	1,172.
MONTROSE	**REPSOL**	344.	399.	317.	210.	0.	0.	0.	0.	0.	0.	94.	272.	136.
MUNGO	**BP**	9,210.	7,917.	10,844.	4,932.	7,610.	11,944.	8,828.	4,515.	12,680.	13,983.	11,705.	12,831.	9,750.
NELSON	**SHELL**	10,470.	8,579.	10,443.	9,527.	9,961.	9,607.	10,231.	3,398.	3.	1,648.	12,239.	11,789.	8,158.
NESS	**APACHE**	149.	24.	157.	121.	110.	49.	235.	121.	140.	27.	389.	311.	153.
NETHAN	**REPSOL**	0.	2.	4.	3.	0.	0.	0.	8.	0.				2.
NEVIS	**APACHE**	5,398.	5,772.	5,782.	5,668.	10,607.	10,482.	9,747.	6,911.	8,831.	9,350.	8,573.	7,811.	7,911.
NICOL	**PREMIER**	0.	0.	95.	755.	595.	512.	282.	495.	406.	398.	538.	502.	382.
NINIAN	**CNR**	9,579.	12,188.	12,629.	12,219.	11,473.	10,457.	11,135.	11,238.	11,865.	6,661.	12,136.	11,769.	11,112.
ORION	**REPSOL**	2,538.	1,406.	2,731.	3,218.	2,330.	0.	2,706.	2,232.	2,021.				2,131.
OTTER	**TAQA**	5,904.	5,744.	5,289.	2,750.	4,965.	6,722.	6,537.	3,682.	3,251.	5,762.	763.	628.	4,333.
PELICAN	**TAQA**	3,810.	3,688.	3,620.	3,240.	2,869.	2,128.	3,135.	2,950.	3,172.	2,911.	2,075.	2,354.	2,996.
PENGUIN EAST	**SHELL**	3,629.	3,189.	6,152.	5,685.	4,692.	4,277.	2,915.	0.	0.	0.	5,958.	5,084.	3,465.
PENGUIN WEST	**SHELL**	2,030.	1,947.	1,376.	2,404.	1,606.	0.	743.	0.	0.	0.	0.	989.	925.
PEREGRINE	**NEXEN**	7,568.	8,385.	8,385.	7,790.	6,832.	9,056.	8,906.	786.	8,883.	7,446.	8,715.	7,526.	7,523.
PETRONELLA	**REPSOL**	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PICT	**DANA**	0.	0.	0.	0.	225.	0.	5.	181.	587.	658.	575.	296.	211.
PIERCE	**SHELL**	4,835.	6,946.	2,246.	1,611.	4,226.	9,511.	15,855.	16,031.	3,461.	6,670.	11,255.	16,598.	8,270.
PIPER	**REPSOL**	6,325.	6,331.	6,623.	1,417.	2,901.	7,082.	7,226.	7,591.	7,126.	42.	5,654.	8,007.	5,527.
RHUM	**BP**	165.	217.	266.	284.	281.	256.	698.	453.	990.	958.	981.	1,067.	551.
ROCHELLE	**NEXEN**	2,075.	1,849.	1,996.	2,346.	1,701.	1,697.	1,252.	12.	746.	328.	339.	527.	1,239.
ROSS	**REPSOL**	25.	454.	113.	0.	357.	419.	354.	146.	787.	754.	749.	539.	392.
SALTIRE	**REPSOL**	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SAXON	**DANA**	1,317.	1,417.	1,164.	1,590.	1,550.	1,662.	656.	503.	799.	810.	761.	584.	1,068.
SCAPA	**REPSOL**	1,861.	3,307.	2,681.	2,834.	3,078.	2,228.	1,749.	1,656.	259.	0.	231.	1,261.	1,762.
SCHIEHALLION	**BP**	0.	0.	0.	0.	0.	0.	0.	0.	0.		0.	0.	0.
SCOLTY	**ENQUEST**											1,588.	4,845.	3,217.
SCOTER	**SHELL**	922.	235.	340.	350.	1,122.	974.	714.	450.	523.	639.	512.	178.	580.
SCOTT	**NEXEN**	24,001.	12,945.	14,228.	14,458.	12,077.	11,021.	12,363.	754.	12,210.	13,054.	8,348.	8,574.	12,003.
SEYMOUR	**BG**	1,558.	1,117.	1,487.	1,500.	0.	0.	1,157.	643.	1,388.	844.	1,713.	1,359.	1,064.
SHEARWATER	**SHELL**	20,618.	13,643.	14,152.	12,746.	14,213.	18,651.	22,432.	18,841.	16,479.	14,116.	13,870.	4,341.	15,342.
SKENE	**APACHE**	386.	513.	493.	332.	432.	388.	391.	93.	254.	331.	290.	211.	343.
SKUA	**BP**	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOLAN	**PREMIER**				644.	0.	1,281.	8,367.	9,690.	9,184.	7,478.	8,620.	7,564.	5,870.
SOLITAIRE	**NEXEN**	5,082.	4,967.	4,596.	4,816.	4,573.	3,443.	3,841.	262.	174.	0.	0.	2,141.	2,825.
SOUTH MAGNUS	**BP**	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.		0.
STARLING	**SHELL**	4,988.	4,955.	4,837.	5,410.	5,080.	4,178.	4,207.	3,326.	3,769.	3,919.	2,570.	219.	3,955.
STATFJORD	**STATOIL**	4,968.	4,843.	4,621.	4,531.	3,149.	3,794.	4,184.	4,802.	4,324.	3,861.	3,579.	3,711.	4,197.
STIRLING	**PREMIER**	0.	176.	307.	357.	478.	411.	27.	0.	6.	289.	556.	467.	256.
STRATHSPEY	**CNR**	229.	478.	432.	424.	518.	380.	111.	39.	1,006.	376.	1,428.	949.	531.
SYCAMORE	**CNR**	269.	219.	240.	727.	406.	311.	390.	318.	315.	171.	502.	437.	359.
TARTAN	**REPSOL**	1,448.	1,709.	0.	0.	977.	1,003.	999.	1,131.	457.	1,165.	1,194.	1,033.	926.
TEAL	**Anasuria Operating Company**	0.	1,959.	2,058.	1,955.	1,180.	1,071.	710.	1,491.	2,186.	2,088.	2,430.	1,064.	1,516.
TEAL SOUTH	**Anasuria Operating Company**	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TELFORD	**NEXEN**	1,240.	1,823.	2,144.	3,351.	3,042.	2,983.	3,391.	52.	43.	4.	7,259.	4,114.	2,454.
TERN	**TAQA**	4,294.	4,981.	6,953.	6,362.	5,402.	6,707.	6,636.	5,710.	7,228.	5,996.	3,856.	0.	5,344.
THELMA	**CNR**	2,661.	2,729.	2,830.	2,864.	2,774.	3,066.	2,741.	1,813.	2,435.	3,278.	4,262.	4,335.	2,982.
THISTLE	**ENQUEST**	6,802.	6,007.	6,036.	5,267.	5,066.	5,246.	4,839.	5,125.	5,239.	3,870.	2,870.	350.	4,726.
TIFFANY	**CNR**	1,732.	2,294.	2,761.	2,669.	2,409.	2,252.	2,109.	1,404.	2,123.	1,585.	2,197.	2,098.	2,136.
TONI	**CNR**	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TONTO	**APACHE**	271.	285.	313.	370.	355.	360.	362.	271.	292.	29.	59.	15.	248.
TULLICH	**MAERSK**	6,428.	4,549.	5,989.	5,281.	4,123.	3,439.	5,490.	2,651.	0.	3,723.	5,538.	2,984.	4,183.
TWEEDSMUIR	**REPSOL**	0.	0.	0.	0.	0.	0.	843.	1,418.	1,220.	0.	453.	931.	405.
TWEEDSMUIR SOUTH	**REPSOL**	2,509.	2,248.	2,271.	1,500.	1,573.	2,572.	1,473.	2,330.	2,311.	21.	1,673.	2,433.	1,910.
WEST BRAE	**MARATHON**	0.	0.	0.	101.	8,879.	10,049.	9,709.	9,346.	6,796.	6,142.	4,651.	6,597.	5,189.
WEST DON	**ENQUEST**	3,304.	359.	2,972.	3,090.	3,007.	2,826.	1,628.	1,835.	1,679.	1,286.	1,047.	456.	1,957.
WOOD	**REPSOL**	1,222.	1,148.	1,234.	905.	0.	0.	0.	0.	0.	719.	1,977.	1,654.	738.
YTHAN	**ENQUEST**	1,393.	2,801.	1,833.	2,977.	2,281.	2,907.	2,037.	3,475.	3,316.	2,768.	1,582.	754.	2,344.
	Average:	**4,723.**	**4,625.**	**4,654.**	**4,635.**	**4,661.**	**4,236.**	**4,545.**	**3,775.**	**3,891.**	**3,680.**	**4,665.**	**4,587.**	**4,392.**

Appendix III- UKCS Fiscal Regime

The UKCS oil and gas profits retrieved from extraction activities were traditionally falling within two distinct fiscal regimes: Petroleum Revenue Tax (PRT) and two Corporate Taxes (CT)- Ring Fence Corporation Tax (RFCT) and Supplementary Charge (SC). The overall tax regime should aim to ensure a fair return for the nation keeping the system cost-effective. Although tax measures cannot be considered the sole solution to all the challenges facing the UKCS, through reaching an understanding with the industry, tax changes could have a substantial impact on the objective of maximising economic recovery.

During the last decade, the tax burden has doubled affecting adversely the competitiveness of the UKCS as investors expressed concerns regarding UK's fiscal stability, high complexity and lack of compatibility with the current issues of basin's maturity. For instance, in the UK sector of the southern North Sea (SNS), the headline tax rates are between 50-70% while in the Dutch sector of SNS, the same taxes reach 50% (OGUK, October 2014).

Between 2002 and 2011, two different governments have initiated significant tax increases. However, since 2001, ongoing engagement with the industry resulted in the introduction of several fiscal incentives. In 2014, the UK Government conducted a fiscal review to ensure the maximisation of the economic recovery (MER-UK) of the oil and gas sector in the North Sea which led to the reduction of the Supplementary Charge Tax (SCT) and an extension to the Ring Fence Expenditure Supplement (RFES) as well as the HP/HT Cluster Allowance (OGUK, October 2014).

Prior to UK Budget 2016

On the 18th of March 2015, the UK Government announced four changes to the UKCS upstream fiscal regime as a response to industry pressure, lower oil prices and higher costs. The announced changes were (Wood Mackenzie, 2015a):

- Reduction in SC from 30% to 20%
- Reduction in PRT from 50% to 35%

- Introduction of a basin-wide Investment Allowance, introducing the exemption of 62.5% of new investment expenditure from SC, and,
- £20 million support in 2015-16 for surveys conducted on under-explored areas.

It was estimated that the marginal tax rate would decrease due to the cuts in the headline rates for at least all new, as well as onstream, fields from 60% to 50% and, at the same time, older fields liable to PRT would see a reduction of 80% to 67.5% (Wood Mackenzie, 2015a). However, it has been recognised that these fiscal changes did not fully address the challenges existing in the UKCS.

Pipeline expenditures were included in field's overheads for tax purposes. Third party tariff income was taxable according to the vintage of the field/pipeline, with PRT paying fields receiving an additional tariff receipts allowance before paying PRT on tariff income (Wood Mackenzie, 2015b). The profits of pipelines operating as separate entities to producing fields were only subject to normal CT rules.

Summary Table of UKCS Main Taxation prior to UK Budget 2016

TAX	% Charge	Key Points	Infrastructure
Petroleum Revenue Tax (PRT)	35% (lowered from 50% since March 2015)	• field-based tax charge on profits arising from oil and gas production • two six-month chargeable periods	• Finance Act 2004 exempted from PRT tariff receipts for new fields and certain new assets from 9 April 2003 • Remote associated assets[59], any part of which is situated more than 100 metres from a main field asset, e.g. a spur pipeline, are also exempted

[59] Those assets put in place purely to earn tariff income.

Ring Fence Corporation Tax (RFCT)	30%	• profits arising from 'oil extraction', or, the '*acquisition, enjoyment and exploitation of oil rights*' in the UKCS.	• Pipeline profits from facilities operating as separate entities
Supplementary Charge (SC)	20% (lowered from 30% since March 2015)	• an additional charge of 20%[60] on company's ring fence profits after removing all financing costs and deducting any field allowance available	
Interaction between the elements of the fiscal regime			
• Fields that were given consent before March 1993 were subject to the PRT, RFCT and SC- they pay a marginal tax rate of 67.5%. • Fields that were given consent after March 1993 were subject to the RFCT and SC. • PRT was deductible in computing profits for RFCT and SC. • SC was charged on the profits for RFCT, but without any deduction for finance costs.			

UK Budget 2016 Fiscal Changes

Considering the increasing development costs in the mature basin of the UKCS and the depressed global oil price, the UK government introduced some significant tax cuts in the Budget 2016 to support the UK oil and gas industry. Specifically, the PRT was abolished, the SC was reduced effectively from 20% to 10% and the oil and gas companies gained access to tax allowances, which aim to encourage investment in infrastructure, as well as decommissioning tax relief allowances (UK Government , 2016). The abolishment of PRT applies to all chargeable periods ending after 31st December 2015 and the new SC applies for accounting periods starting on, and after, 1st January 2016 (UK Government , 2016). The Budget 2016 followed the recommendations firstly introduced in the Wood Review towards

[60] SC was set originally at 10%, increased at 20% on 2006, and, it was set at 32% in 2011.

the maximisation of the economic recovery of the UKCS to create a more efficiently operating and attracted to new investments business environment.

However, one needs to keep in mind that approximately 60 out of the 100 oil and gas fields subject to PRT[61] have never been profitable enough to pay the tax (King & Spalding , 2016). Although the Budget 2016 was welcomed by the industry, several economists argued that the Government could have been proceeded to the introduction of more radical measures through, for example, the abolishment of the SC altogether and/or the introduction of allowances specifically designed for exploration. In addition, it has been suggested that the changes were in line with the historical tradition of the UK government responding to low or high oil prices- a fiscal legacy that adds to the uncertainty of the business environment in the UKCS without providing some assurance to new investors (King & Spalding , 2016).

The effect of the Budget 2016 in the UK oil and gas industry remains to be seen. However, the UK government recognises the need to find the appropriate fiscal tools to improve the competitiveness of the UKCS in a global level and encourage new investment achieving while achieving the MER-UK.

Tariffs Taxation

In the pursuit of increasing the UKCS competitiveness so investors will be able to attract the required capital needed to sustain activity in the basin, infrastructure can play a central role and, specifically, the appropriate tax treatment of tariff incomes. Assets put in place for the sole purpose of earning tariff income (namely 'remote associated assets'), any part of which is situated more than 100 meters from a main field asset, i.e. a spur pipeline, are entitled for a cost relief only against the tariff income (net or with Tariff Receipt Allowance) earned from that asset (CW Energy LLP, 2010).

According to Wood Review recommendations, there is the need for a fundamental change in the fiscal treatment of infrastructure in the UKCS. The Review supports the removal of the third-party tariff income from the scope of SC based on the argument that since infrastructure is a utility business to its core, it should be available to all interested parties without

[61] This category includes fields receiving development consent prior to 16 March 1993.

supplementary taxes. This would drive down operating costs within the ring fence, help assets move outside the ring fence and encourage investors, especially new entrants, to pursue third party business rather than prematurely decommissioning their assets.

In the past, the high rate of tax relief against PRT and CT, it was widely considered that could encourage the proliferation of pipelines. Therefore, the abolishment of PRT on tariff income relating to new contracts was initiated partly to create a more competitive business environment in the basin including the potential to sign contracts for gas imports from Norway through UKCS infrastructure grid.

Tariff Receipt Allowance (TRA)

Tariff receipts allowance (TRA) is an allowance given against tariffs chargeable on a participator where the chargeable tariffs are 'qualifying tariff receipts' received, or, receivable from a 'user field' (CW Energy LLP, 2010). TRA is not available where the tariffs are received, or, receivable from a non-taxable field. There is no similar allowance for disposal receipts.

For TRA purposes, the field in which the tariffs are chargeable on the participator is referred to as the 'principal field'. Qualifying tariff receipts from a user-field are fully relieved by TRA where the amount of oil extracted from the user-field as well as transported, initially treated or stored by means of assets of the principal field did not exceed 250,000 metric tonnes in the chargeable period (CW Energy LLP, 2010).

If the amount of oil transported exceeded 250,000 metric tonnes in the chargeable period, the TRA is a proportion of the qualifying tariff receipts (CW Energy LLP, 2010).

In addition, Wood Review argued that more competitive tariffs are required to improve marginal field economics and reduce tieback costs. The Review supports that tariff business should not be treated as high margin activity. Ensuring that the savings for the infrastructure owners will pass to their clients, and field owners, through tariffing is fundamental.

Appendix IV- UKCS Further Considerations; Improved stewardship

UKCS stewardship model is based on a 'light-touch' regulatory approach and it was designed when the basin was at an early stage of development. According to the Wood Review, the decreasing production efficiency is an indicator, among other, of poor asset stewardship. The Regulator needs to address adequately the issues related to ageing assets and under-investment in assets' maintenance which often result to an insufficient uptake of an air injection Improved Oil Recovery (IOR) and Enhanced Oil Recovery (EOR) techniques affecting adversely the maximisation of basin's economic recovery.

In the 'Corporate Plan' published in November 2015, the Oil & Gas Authority (OGA) aimed to address asset stewardship through, among other, the following measures (OGA, November 2015):

- Developing, together with the industry, an asset stewardship strategy
- Implement an Enhanced Oil Recovery (EOR) strategy in Q4 2015 to deliver up to 300 mmboe of additional reserves by 2020
- Work collaboratively with operators to understand key cost drivers to develop industry-wide solutions to reduce OPEX by 30% by end 2018, and,
- Drive the work of the Asset Stewardship Board in support of the Oil & Gas MER UK Forum

Operators are expected to develop, maintain and operate their assets and infrastructure at all times in an efficient and effective manner sharing, at the same time, information regarding their asset stewardship strategy with the Regulator. Encouraging companies to improve asset stewardship can enable the development of new field that rely heavily on the existing infrastructure to transfer the hydrocarbons produced onshore. Several rejuvenation projects had been put in place in order to encourage a co-operative regional approach and improve the exploration outlook using the latest technology.

The OGA is using stewardship data, retrieved from the annual industry activity survey, to prepare regional development plans in order to work closely with the operators to develop hub strategies which aim to optimise the use of infrastructure and maximise value by integrating exploration, development, production, late life planning and decommissioning (OGA, September 2014). Facilitating the preparation of regional development plans on stewardship for critical regions of the UKCS, built on data provided by operators, is one of the main priorities for the OGA to facilitate the removal of commercial barriers and deliver maximisation of economic recovery solutions.

Appendix V- UKCS Guidance on Disputes over Third Party Access to Upstream Oil and Gas Infrastructure

In April 2009, DECC published the Guidance on Disputes over Third Party Access to Upstream Oil and Gas Infrastructure including a section dealing with the principles which the Regulator would employ in settling tariffs when required. The Guidance on Disputes was putting emphasis in the competitive pricing and the absolute need for the payment to reflect the real costs, risks faced and opportunities forgone (Kemp & Phimister, July 2010). The document identified four scenarios resulting on a dispute each of which entails different considerations regarding the determination of appropriate tariffs (DECC, 15 July 2013);

(i) Infrastructure built as part of an integrated field development project
(ii) Infrastructure deliberately built oversized with a view to procuring third-party business
(iii) Noteworthy competition among potential asset-user for a limited infrastructure capacity, and,
(iv) Third party business resulting in the displacement of the asset-owner own production and/or other contractual obligations.

As Prof Kemp highlights in his analysis (Kemp & Phimister, July 2010), in the first case, DECC supports that the tariff terms should reflect the incremental costs and risks (if spare capacity was already available) providing, thus, a suitable cost sharing (if the field is near the end of its economic life). In the second scenario, tariff terms would compensate the capital costs incurred in the expectation of such third-party business, and, in the third one, DECC views that agreed tariffs could generate economic rent to the asset-owner. Lastly, in the fourth case, the tariff should reflect the cost of the asset-owner of reducing his own production based on the economic concept of opportunity cost.

Appendix VI- UKCS Regional Development of Ageing Infrastructure Facilities

The regional development strategies have been proposed by the Wood Review to ensure the exploitation of the remaining resources as well as incentivise investment at the most critical regions of the basin. For instance, in the South (SNS) and Northern North Sea (NNS), mature hub facilities require investment to remain viable. However, narrowly targeted field-specific incentives are not likely to have sufficient impact given the strong interrelation between hubs and transportation facilities within the region. The potential of other resources within the catchment of several hubs had been often overlooked, affecting the commercial ability for individual fields to tieback to the infrastructure. Effective stewardship of critical hubs can be an opportunity to both strategically plan new facilities and consolidate existing underutilised infrastructure. According to Wood Mackenzie's analysis of the NNS, in 2015, approximately 90% of all NNS production is via fixed infrastructure, with an average utilisation of 15% of capacity (Wood Mackenzie, 2015b). The NNS is reliant on 10 key hubs that service 42 fields (Wood Mackenzie, 2015b). Future throughput coming from the existing fields is limited unless new fields are commercialised and E&A (Exploration & Appraisal) success improves. If hubs were to cease at this point, 300 mmboe of reserves being currently classified as 'commercial' (meaning that they can be developed) would go unrecovered and a US$ 24 billion in revenue would be lost (Wood Mackenzie, 2015a).

On the UKCS, especially on the NNS, many platforms remain active beyond their original 'life expectancy' requiring increased maintenance and asset integrity activity to support production. Since 2010, the UKCS operators have spent at least £1 billion per year on facility upgrades (McKinsey & Company, April 2014). On a large asset, for instance, maintenance and integrity-related well work over activity went up by nearly 57% per year between 2009 and 2013 (McKinsey & Company, April 2014). This increased maintenance work drives also additional logistics activity, such as helicopter flight tours that increased by 2% per year between 2003–2013 (McKinsey & Company, April 2014). Hence, since maintaining and investing on infrastructure assets which have exceeded, or they are reaching, their original life end, requires high opex rates. In general, it is considered more difficult to incentivise the owners of this type of assets through a field allowance mechanism.

The Regional Plans could target one by one all the North Sea geographical areas focusing on the prospectively, exploration, development planning, decommissioning specifications and asset infrastructure utilisation for each area addressing, thus, their unique needs and provide targeted solutions, such as resource maturation plans. The Wood Review attempted to calculate the benefits arise from achieving recovery from existing assets whilst postponing of decommissioning costs, with further upside from the opportunity to explore for more years using the existing infrastructure. A range of scenarios were considered to predict and evaluate the total extra production capability expected to arise due to the extension of the life of assets for another five years at the same overall rates of production as for the previous final five years. Even under the assumption of a 50% decline in production for the last five years, the Review assessed that the benefits of postponing decommissioning by five years across the UKCS would enable an additional 1.0 billion boe to be recovered (Wood, 2014).

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