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The Role of Research and Development in Increasing the Competitive Performance of Petroleum Companies: A Case Study of Royal Dutch Shell PLC

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Abstract---This study aims to highlight the role of research and development in enhancing the competitive performance of companies operating in the refining and petroleum industry in the face of competition from other firms in the same sector. This will be achieved by examining the relationship between research and development expenditure, market share and competitive performance through a case study of the multinational oil company Royal Dutch Shell PLC, considered one of the transnational companies, during the period from 2005 to 2021. Accordingly, this study will analyse competitive performance using a descriptive approach, analysing data through simple linear regression to determine the relationship between research and development expenditure and competitive performance. The study concluded that, despite maintaining its market position, research and development have a limited role in increasing the company's competitiveness. Therefore, improving the quality of petroleum products and controlling production costs is suggested as a means of achieving better competitiveness.

Keywords---Competitiveness, Research and Development, Petroleum Industry, Performance, Multinational Companies.

Introduction

Competitiveness is one of the factors affecting the status and performance of companies. It enables competitive firms to market their products and services efficiently and effectively at competitive prices, while ensuring an appropriate level of quality for their customers. This is particularly important for

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institutions operating in a highly competitive and volatile environment, such as petroleum companies, where overall demand can be unpredictable.

Competition among global oil companies is linked to the evolving status of national oil companies in oil-producing countries. This follows significant advancements by these national companies in the oil sector, initially aimed at asserting control over their resources. As they have made substantial progress in this field, however, their strategies and objectives have changed and their ambitions have grown, leading them to strive for the technology and expertise required to operate in this complex industry. They have achieved this to varying degrees, gaining recognition from global oil companies and sometimes collaborating with them to exploit oil fields. This new reality has had an impact on the oil industry, prompting specialists to discuss on various occasions the ability of national companies to compete with global firms (Ahmed, 2020). This reinforces the need to enhance the role of research and development to improve the competitive performance of oil companies, whether national or multinational. Many previous studies have addressed this issue, including the study by Sidqi Ghrisi, Yaqoub Muhammad and Bouchekhi Muhammad, which was published in the Journal of Development and Applied Economics in 2017 and was titled 'The importance of research and development in enhancing the competitiveness of economic institutions in Algeria: A Case Study of the Saidal Group'. The study concluded that the research and development operations of the companies examined were not competitive compared to other global institutions.

This highlights the importance of enhancing the role of research and development in order to improve the competitive performance of various oil companies, whether they are national or multinational. This issue has been addressed in many previous studies, including one by Sidqi Ghrisi, Yaqoub Muhammad and Bouchekhi Muhammad. This study was published in the Journal of Development and Applied Economics in 2017 and is titled 'The importance of research and development in enhancing the competitiveness of economic institutions in Algeria: A Case Study of the Saidal Group'. The study concluded that the research and development operations of the companies in the sample do not yield satisfactory results in terms of competitiveness compared to other global institutions. It was suggested that the Saidal Group (a pharmaceutical manufacturer) should resort to alternative, lower-cost generic products to maintain its market share, given its weak innovation and knowledge base.

Another study by Hicham Hariz was part of a doctoral thesis in economic sciences specialising in industrial economics at Biskra University in 2016. This study concluded that the research and development operations of the sample achieved very positive results for external indicators, particularly with regard to new products. These results were obtained by dividing the indicators into two main groups within the survey framework: the first relating to research and development and its role in competitive ability; and the second including two internal indicators (research and development) and two external indicators (researchers and patents, and new products) and their impact on competitive ability.

The problem statement:
The issue of the topic emerges as follows: To what extent does research and development contribute to enhancing the company's competitive performance?

1.1 Study objectives
In light of the previous introduction, this study aims to improve understanding of the role of research and development (R&D) in achieving or promoting competitiveness at an institutional level, focusing specifically on the company under study. Performance has also been introduced as an indicator to clarify the relationship more significantly, given the conceptual overlap between performance and competitiveness.

1.2 Study methodology

To investigate this issue, this research paper presents a case study of a company operating in the petroleum industry: the British-Dutch multinational Royal Dutch Shell PLC, one of the largest companies in the field and a transnational corporation. The study will analyse R&D and assess its competitiveness in terms of market penetration against six major competing companies in the global petroleum industry. These companies are involved in various activities, including exploration, production, transportation, sale of crude oil, refining, petrochemicals and various types of natural gas. The analysis will cover the period from 2005 to 2020 and will employ a descriptive methodology and case study approach to address the issue raised in this paper. The analysis will focus on the following elements:

- The competitiveness of the institution.
- The concept of research and development within the institution.
- The role of R&D in enhancing Royal Dutch Shell PLC's competitive performance.

2. Competitiveness among oil companies

The Organisation for Economic Co-operation and Development (OECD) uses various tools and methods to assess competitiveness and ensure organisational sustainability, helping institutions to achieve their objectives in volatile and unstable environments. Competitiveness assessment evaluates the impact of laws, regulations and policies on the institution, and helps to design the most suitable regulations for market forces.

2.1 Definition of global oil companies

These companies emerged following the discovery of oil in the United States in 1858. They are characterised by their control over this material and the associated industry, from discovery to extraction and refining. This concept is epitomised by the vision of businessman and transport pioneer Rockefeller, who sought to dominate the refining sector and marketing through Standard Oil, thereby establishing the petrochemical industry. His vision was to monopolise oil (Aknour, 1984).

Global oil companies can also be defined as a type of multinational company involved in the exploration, extraction, refining, production, transportation, distribution, marketing and manufacturing of oil and petroleum products. Historically, these companies have dominated the oil industry.

As each stage of the oil industry is crucial, global oil companies have focused their efforts on controlling oil transportation. Consequently, unions of oil tanker owners were established to address the decline in oil transportation prices. Five companies emerged to dominate this stage: three American (Standard Oil of New Jersey, Standard Oil of Mobil and Standard Oil of California) and two Dutch-English (Shell and British Oil). (Ahmed, 2020).

2.2 The concept of competitiveness

It is not possible to define or limit the concepts of competitiveness and competition to a single definition. However, this study outlines the essential pillars and determinants from its perspective. The position of an institution can be viewed in relation to several dimensions: (market, sector and international market). Therefore, competitiveness can be perceived differently depending on the type of institution or its activity.

As previously mentioned, a set of criteria can be used to assess an institution's competitiveness and enhance its market position. This can be achieved using a set of analytical tools proposed by the Organisation for Economic Co-operation and Development (OECD, July 2018). One of these tools was used to present the competitiveness indicator as follows:

- Criterion One: Determine the number or scope of competitors.
- Criterion Two: Limit competitors' ability to compete (this criterion is the basis for presenting the competitiveness indicator in this paper).
- Criterion Three: Tools to reduce competitors' incentives to compete.
- Criterion Four: Limit the options and information available to customers.

2.3 Development of the competitiveness of Royal Dutch Shell PLC

Based on the previous definition of competitiveness, which translates specifically into the position of the institution and its performance against competitors across several dimensions (market, sector and international market), we have recognised the importance of the market and sector for the company in question compared to its competitors. This is based on indicators such as asset size and total revenue relative to those of competing companies.

2.4 Development of Market Share of Royal Dutch Shell PLC

The adjacent figure reflects the level and size of Royal Dutch Shell PLC's assets, the first indicator adopted to measure competitiveness. This was analysed over different periods of the study, starting from 2015. At that time, the company's assets represented approximately 13% of those of the original study population, consisting of the six largest petroleum companies in the world. This placed the company third in terms of asset size. The company maintained this percentage in 2019, confirming its competitiveness in terms of asset size and volume within this sector and the oil market in general.

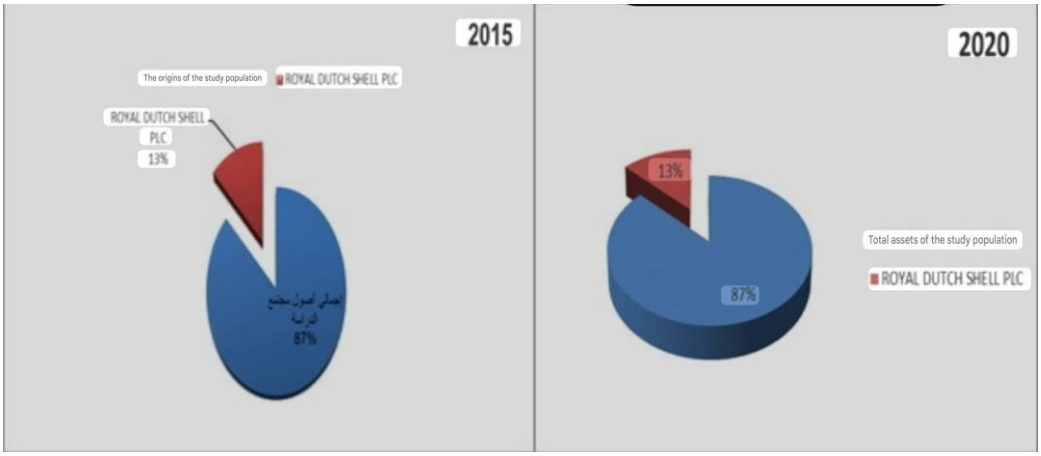
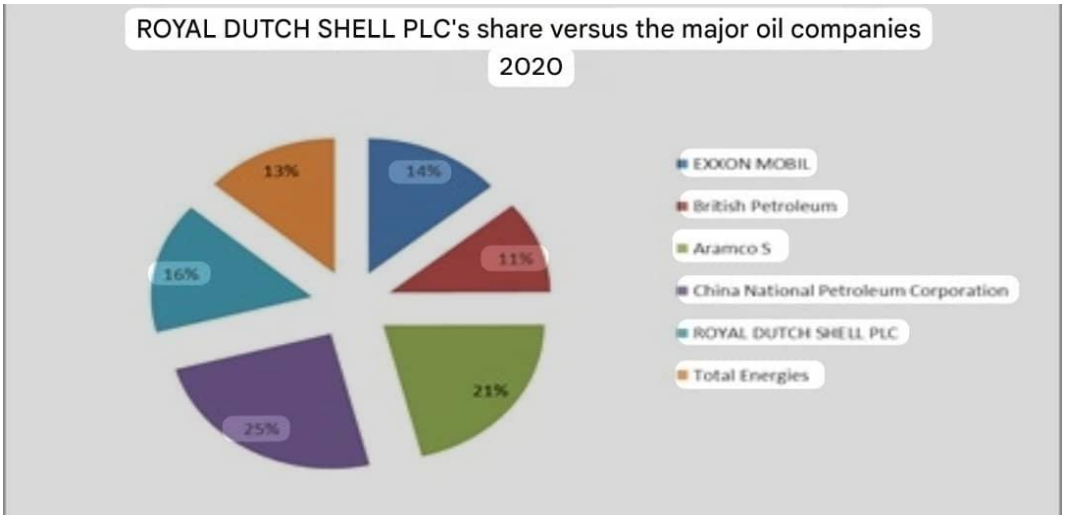


Figure 1: Market share of Royal Dutch Shell PLC compared to competing companies (2015–2020).

At the end of 2020, the company's assets also amounted to about 16%, which indicates that the company maintained its competitiveness in the overall market against other competing companies, thus achieving third place (03) among six major oil companies in the world.



Source: Royal Dutch Shell PLC Annual Report, Pursuant to Section 2014–2020.
Annual Report for Corporation 2010–2020.

It should also be noted that during the period 2020–21, the company experienced challenging economic conditions, similar to those faced by competing firms, due to the decline in global demand for petroleum products resulting from significant economic lockdowns caused by the outbreak of the health pandemic, 'Covid-19'.

2.4 Development of Revenues of Royal Dutch Shell PLC

The second indicator used to assess the company's competitiveness against others is the size of its annual revenues. This indicator also reflects market share in terms of profits and revenues achieved amid intensified competition during different periods. The greater the company's ability to maintain its level of annual revenues compared to other companies, the greater the reflection of its competitiveness and performance, confirming the significance of the previous indicator.

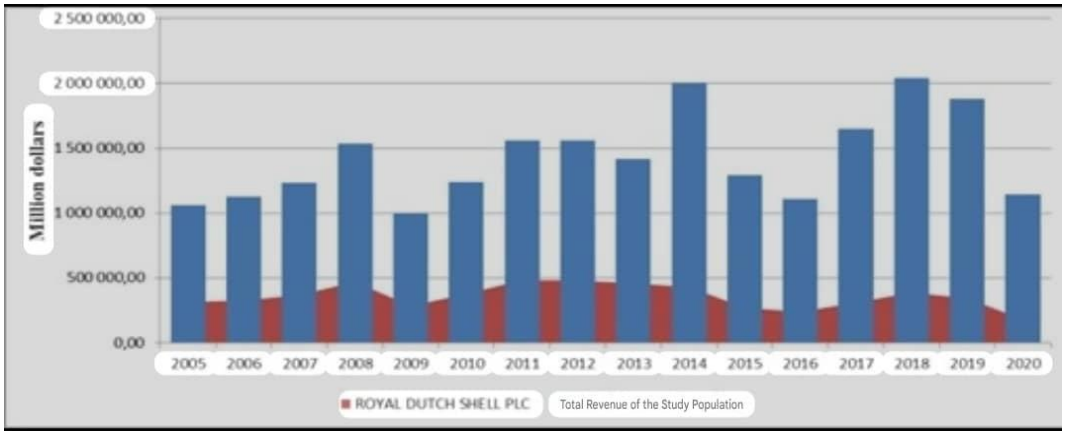


Figure 02: Development of Revenues of Royal Dutch Shell PLC Compared to Its Competitors (2005–2021).

Source: Royal Dutch Shell PLC Annual Report, pursuant to Section 2014–2020.
Annual Report for Corporation 2010–2020.
Macrotrends.net/stocks/stockcomparison?s=revenue&axis=multiple&comp=SHEL, accessed 17/10/2022 (20:15).

Figure 02 shows how Royal Dutch Shell PLC maintained its total revenues from 2005 to 2020, demonstrating the company's dominant position compared to other firms in the same sector. This confirms the importance of the previous indicator relating to asset size and market share, thanks to the company's ambitious strategy for sustaining its markets. This demonstrates the strength of its competitive performance in terms of pricing, production quality and cost control. A fundamental question raised is the role of human and technological factors in maintaining this performance, and their place in the company's overall strategy. The next section discusses the importance of research and development at Royal Dutch Shell PLC in sustaining this performance, which is the second step in this study's problem statement.

3. Concept of Research and Development in the Institution

Research and development contribute to the development of strategies for institutions, particularly small and medium-sized enterprises, to help them maintain their market share against competitors, especially during the growth phase. The R&D process focuses on product improvement due to budget and cost constraints. This comprehensive definition outlines the types of competition faced by the institution, whether price- or production-based (quality), particularly in the era of globalisation.

3.1 Definition of research and development

The Organisation for Economic Co-operation and Development (OECD) defines R&D as a creative activity involving systematic processes aimed at expanding knowledge and developing new applications. The term R&D encompasses three main activities: basic research, applied research and experimental development (OECD, 2020).

Research and development (R&D) is defined as the activities carried out by companies and institutions to innovate and provide new products and services to the market (OECD, 2020). Based on this definition, Royal Dutch Shell PLC is seeking to maintain its market position amid intense competition from other companies. This is because the technological nature of exploration, petroleum industry activities, production, petrochemicals and refining processes requires continuous efficiency improvements, as well as the development of the talents and capabilities of its users and professionals. It also requires the continuous updating of production tools. The following section outlines the extent of the company's interest in R&D and its importance to the company's strategy.

3.2 Development of research and development at Royal Dutch Shell PLC

The company is keen to develop the talents of its employees through comprehensive and advanced training and qualification programmes, whether individually or collectively, and through programmes designed to facilitate broad development and a deep understanding of the company's activities across the business cycle. This stability in the performance of the company's users and professionals has been evident for more than two decades. Research and development projects often involve cooperation agreements with public and private entities, including universities, government laboratories, technology start-ups and incubators. This collaborative approach to innovation with partners inside and outside the petroleum industry and the energy sector generally helps to launch new ideas and accelerate their development and dissemination (Shell, 2020). This has a positive effect on the institution's performance and competitiveness against other companies. Royal Dutch Shell PLC also strives to remain competitive by continuously adapting and leveraging the advantages of new technologies. This is the starting point for this study's problem statement.

Table 01: Development of Research and Development Expenses at Royal Dutch Shell PLC (2005–2020)

Return on Equity (ROE)	Return on Assets (ROA)	Total Revenues	Total Assets	Research and Development	Years
28,88%	11,96%	316399	219516,00	517	2005
24,89%	11,18%	327516	235276,00	812	2006
25.06%	11,85%	369776	269470,00	1167	2007
20,80%	9,38%	470940	282401,00	1230	2008
9,32%	4,35%	285129	292181,00	1125	2009
14,58%	6,35%	378152	322560,00	620	2010
55,13%	2,53%	484489	345257,00	682	2011
15,43%	7,48%	481700	360325,00	1307	2012
9,18%	4,62%	459599	357512,00	1318	2013
8,57%	4,17%	431344	353116,00	1222	2014
1,35%	0,65%	272156	340157,00	1093	2015
2,56%	1,16%	240033	411275,00	1014	2016
6,91%	3,30%	311870	407097,00	922	2017
12,03%	5,99%	388379	399194,00	986	2018
10,93%	5,04%	344877	404336,00	962	2019
54,35%	2,23%	180543	379268,00	907	2020

Unit: Million US Dollars

1. Royal Dutch Shell plc, Annual Report, 2014-2020.
2. macrotrends.net/stocks/stock-comparison?s=research-development-expenses&axis=multiple&comp=SHEL 17/10/2022 (22 :10)
3. macrotrends.net/stocks/stock-comparison?s=net-income&axis=multiple&comp=SHEL17/10/2022 (22 :15)

From the end of 2012 to the end of 2016, research and development expenses exceeded $1 billion, with a significant portion dedicated to maintaining the technology utilised by the company for activities ranging from upstream to downstream. In 2020, $907 million was spent on R&D, compared to $962 million in 2019. Despite this decrease in spending, which was less than half of the previous year's amount due to disruptions caused by the pandemic, work began on 124 R&D projects with universities. Many of these projects focus on areas considered critical for low-carbon energy, such as energy storage, fuel cells, and greenhouse gas emissions (Shell, 2020).

Meanwhile, the profitability indicator (ROA) exceeded an average of 20% from 2005 to 2008, reflecting the company's profitability in production despite significant competition from other aforementioned companies. The return on equity (ROE) indicator mirrored this performance at 11%, representing the most profitable phase in terms of this indicator due to the substantial economic expansion witnessed prior to the major global financial crisis of 2008.

By the end of 2009, the ROA profitability indicator had fallen to around 4%, with the ROE indicator at approximately 9%, due to the repercussions of the global financial crisis. However, it quickly improved with the recovery of global demand for raw materials, especially energy, at the beginning of 2012. This performance remained stable until it recorded its first downturn at the end of 2020, with asset profitability at 2% and return on equity at 5%, reflecting the major economic lockdown (Shell, 2020).
The overall performance of these indicators reflects their proximity to R&D expenses, which accounted for around 4% of total assets and an average of around 4% of the institution's revenues. To understand

the impact of R&D expenses on the institution's performance and competitiveness, we will conduct a statistical analysis using simple linear regression. The next section describes this methodology.

4. The Role of Research and Development in Performance and Competitiveness at Royal Dutch Shell PLC

Building on the previous economic analysis of competitiveness, performance and R&D indicators for Royal Dutch Shell PLC, this section aims to confirm the relationship between R&D and its importance in supporting competitive performance and enhancing company performance. To this end, we will use simple linear regression analysis to study the impact of these indicators during the period from 2005 to 2020. Thus, we will identify the relationship between the following indicators:
Dependent variable: competitiveness, expressed as Royal Dutch Shell PLC's asset size relative to the total assets of six competing companies, alongside revenue size compared to those companies' total revenues.
- Independent variable: the research and development expenditure of Royal Dutch Shell PLC.

4.1 Sample definition:

Royal Dutch Shell PLC is considered one of the world's most important oil companies. It is a multinational and transnational corporation that was established in 1907. Its core activities include the exploration and production of oil and natural gas, the manufacture of petroleum products and petrochemicals, and the production of a wide range of related products, including those involved in trade and transportation. In 2009, Fortune magazine (MONEY, 2009) ranked it as the largest company in the world, and Forbes ranked it as the second largest company that same year. The company is headquartered in The Hague, the Netherlands, with additional offices at the Shell Centre in London (Shell, 2022). It operates in over 150 countries and, in addition to its presence in the United States, has a branch in Houston, Texas, one of the largest commercial companies in the area. Shell began exploring for oil in North Africa in the 1950s and operates in the oil sector in Algeria, Egypt and Tunisia. Royal Dutch Shell PLC operates in a highly competitive environment, which compels it to improve its performance in order to maintain its market share.

As part of its new methodology and strategy, Royal Dutch Shell PLC conducts oil and gas exploration worldwide with minimal environmental impact. The company uses innovative technology and industry-leading techniques to safely produce hydrocarbons and meet global energy demand, all the while maintaining the market share it has held since the inception of the petroleum industry. The company's focus on fundamental sciences and research helps to reduce operational and project costs, as well as developing high-value products that meet customer needs.

Figure 03 below illustrates Royal Dutch Shell PLC's total assets compared to those of the other five major competing companies in the field. It showcases one of the most advanced refining and petrochemical programmes in the global petroleum industry, which is aimed at achieving the company's goal of maintaining its position as a leader in the field. Royal Dutch Shell PLC is one of the world's largest manufacturers and marketers of fuel and lubricants, selling over three million barrels of petroleum products per day from various global sources. Figure 3 illustrates the development of its assets from 2005 to 2020 in comparison to its major competitors, which are classified as transnational companies.
1. China National Petroleum Corporation
2. TotalEnergies
3. ExxonMobil
4. Aramco
5. Royal Dutch Shell
6. British Petroleum

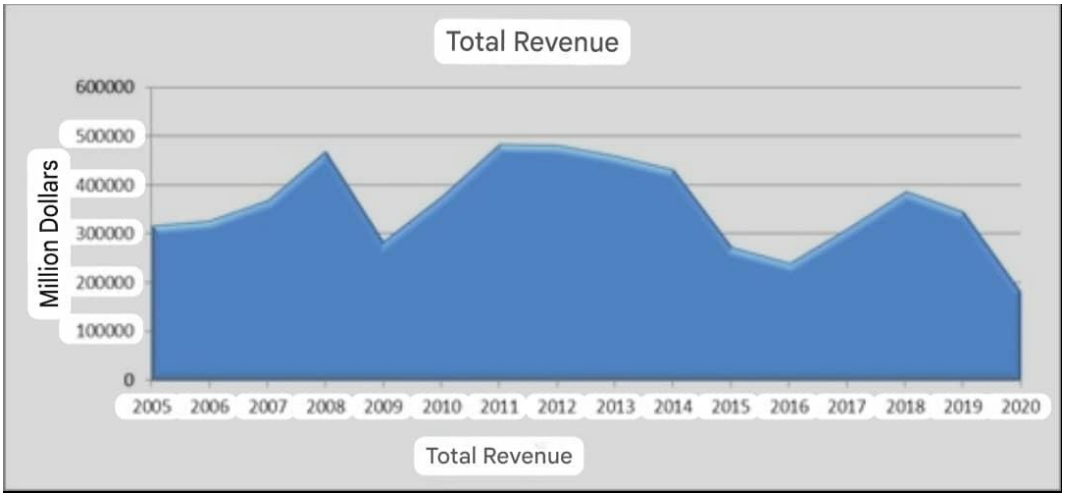


Figure 3: Development of revenue levels at Royal Dutch Shell PLC

Source:

1. Royal dutch Shell plc, 2014-2020 Annual Report, Energy And Technology Solutions.
2. cks/stock-comparison?s=roi&axis=multiple&comp=XOM24/01/2022 (16 :15)

The company's declining profitability from late 2014 to early 2021 reflects the significant global economic shutdown that led to a decrease in demand for raw materials and energy, resulting in losses. This situation caused losses for most global oil companies operating in the same sector. It should be noted that Royal Dutch Shell PLC's overall performance is reflected in the fluctuations of the global hydrocarbon market, indicating that it is entirely constrained by price volatility in global markets and geopolitical factors.

4.2 The Impact of Research and Development on the Competitiveness of the Institution

The statistical estimation of the regression relationship revealed a significant finding regarding the relationship between research and development at Royal Dutch Shell PLC and its competitiveness, as reflected in the aforementioned variables. It showed that research and development does not affect the company's ability to dominate the market, as neither model was significant when market share and total revenues were used as dependent variables. Appendices 01 and 02 illustrate this.

Therefore, in this context, research and development at Royal Dutch Shell PLC may have no impact on increasing the company's revenue, and may not make it more competitive against rival companies. Therefore, Royal Dutch Shell PLC should aim to dominate the market in terms of size rather than price to increase its competitiveness. Price competition could increase the company's costs at the expense of revenues, reducing its profits — precisely what the company's profitability analysis highlighted.

5. Conclusion:

In order to explore the importance of research and development in enhancing competitiveness and improving performance in oil companies, this paper examined Royal Dutch Shell PLC, a British-Dutch company, during the period from 2005 to 2020. The study analysed the significance of research and development at Royal Dutch Shell alongside that of other competing companies, including the six largest firms in the global petroleum industry.

Economic analysis supported by statistical analysis was used to address the issue of the role of research and development in improving Royal Dutch Shell PLC's competitive performance. The company ranks third in terms of total assets and revenues among the six largest companies in the world. A descriptive

approach and case study method were used to address this issue. The findings concluded that research and development expenditure at Royal Dutch Shell PLC does not improve its competitiveness, particularly with regard to pricing, as research and development is considered a cost that negatively impacts the company's total revenues compared to competing firms. Therefore, competition based on size or quality may be more beneficial, as suggested by the analysis.

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7. Appendices

- [Appendix 01: Statistical Analysis Results]

Dependent Variable: TOTAL_ASSETS
Method: Least Squares
Date: 10/18/22 Time: 20:49
Sample: 2005 2020
Included observations: 16

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESEARCH_AND_DEVELOPMENT	62.48810	65.22248	0.958076	0.3543
C	274148.8	66531.02	4.120616	0.0010

R-squared	0.061531	Mean dependent var	336183.8
Adjusted R-squared	-0.005503	S.D. dependent var	61002.76
S.E. of regression	61170.38	Akaike info criterion	24.99718
Sum squared resid	5.24E+10	Schwarz criterion	25.09376
Log likelihood	-197.9775	Hannan-Quinn criter.	25.00213
F-statistic	0.917910	Durbin-Watson stat	0.224190
Prob(F-statistic)	0.354278		

Dependent Variable: NET_INCOME
Method: Least Squares
Date: 10/18/22 Time: 20:51
Sample: 2005 2020
Included observations: 16

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESEARCH_AND_DEVELOPMENT	1.152825	9.835609	0.117209	0.9084
C	16621.97	10032.94	1.656740	0.1198

R-squared	0.000980	Mean dependent var	17766.44
Adjusted R-squared	-0.070378	S.D. dependent var	8916.132
S.E. of regression	9224.548	Akaike info criterion	21.21359
Sum squared resid	1.19E+09	Schwarz criterion	21.31017
Log likelihood	-167.7087	Hannan-Quinn criter.	21.21854
F-statistic	0.013738	Durbin-Watson stat	1.149679
Prob(F-statistic)	0.908359		

Dependent Variable: TOTAL_EQUITY
Method: Least Squares
Date: 10/18/22 Time: 20:54
Sample: 2005 2020
Included observations: 16

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESEARCH_AND_DEVELOPMENT	92.98620	68.15904	1.364253	0.1940
C	38960.20	69526.49	0.560365	0.5841

R-squared	0.117342	Mean dependent var	131272.3
Adjusted R-squared	0.054295	S.D. dependent var	65733.92
S.E. of regression	63924.49	Akaike info criterion	25.08526
Sum squared resid	5.72E+10	Schwarz criterion	25.18183
Log likelihood	-198.6821	Hannan-Quinn criter.	25.09021
F-statistic	1.861187	Durbin-Watson stat	1.520414
Prob(F-statistic)	0.194018		

Dependent Variable: REVENUES_AND_OTHER_INCOME
Method: Least Squares
Date: 10/18/22 Time: 20:56
Sample: 2005 2020
Included observations: 16

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESEARCH_AND_DEVELOPMENT	106.8567	96.30613	1.109553	0.2859
C	252849.4	98238.29	2.573837	0.0221

R-squared	0.080828	Mean dependent var	358931.4
Adjusted R-squared	0.015173	S.D. dependent var	91016.03
S.E. of regression	90322.88	Akaike info criterion	25.77664
Sum squared resid	1.14E+11	Schwarz criterion	25.87321
Log likelihood	-204.2131	Hannan-Quinn criter.	25.78158
F-statistic	1.231107	Durbin-Watson stat	1.200358
Prob(F-statistic)	0.285888		