International Journal of Production Management and Engineering

https://doi.org/10.4995/ijpme.2018.8758
Received 2017-10-15 Accepted: 2018-01-17

Derailed locomotive? Petrobras investments and economic growth in Brazil

Raíssa Fernandes Yabiko*and Rosemarie Bröker Bone

Industrial Engineering Department (DEI) – Polytechnic School of the Federal University of Rio de Janeiro (UFRJ). Athos da Silveira Ramos Avenue, 149/Room F106-6 - Cidade Universitária, Rio de Janeiro/RJ, Zip Code 21941-909, Brazil

rayabiko@poli.ufrj.br

Abstract: Petrobras is the largest firm in Brazil and one of the largest in the world. Its investment plans are among the biggest in the oil and gas industry, focused in Brazil and on E&P. Petrobras is responsible for a large share of gross capital formation and gross domestic product (GDP) growth in the country. The correlation between its investments and the country investment and GDP growth is above 0.8 and shows the dependency of the economy to Petrobras activity. At the same time, as a state enterprise it has been a tool of macroeconomic policy. In the 2010´s its gasoline and diesel prices were frozen to keep inflation down. The recent crisis in the company, including corruption scandals and oil price slump increased debt levels and reduced its capital expenditures. The sale of assets directive since 2016 is required to reduce its net debt. While a medium to long term survival strategy, the change in Petrobras' investment profile may decrease the prospects of GDP growth in the Brazilian economy.

Key words: Brazil, Oil sector, Petrobras, Investment, Gross Domestic Product, Gross Capital Formation.

1. Introduction

Created in 1953 as sole oil producing firm in Brazil, Petrobras has been responsible for the development of the oil and gas industry along the vertical chain, including exploration and production (E&P), refining, transportation, retail and all links of natural gas chain. It is one of the largest firms in the world oil and gas industry and part of the 'new seven sisters' – domestic oil producers that currently challenge the industry role of the international conglomerates of the 'seven sisters' (Hoyos, 2007). Even the oil sector deregulation in the 1990´s did not reduce Petrobras expansion. By 2010, with the prospect of the newly found pre-salt reserves, it presented the largest investment plan, with over USD 220 Billion capital expenditures (Petrobras, 2011).

This investment plan was backed by a regulatory change (Law no. 12351/2010 that settled the terms of a shared oil partition regime) that provided Petrobras a leading (if not exclusive) role in developing the pre-salt area. In addition, Petrobras controlling bondholder, the Brazilian government, pushed for one of the largest equity issue in history doubling Petrobras capital to USD 223 Billion, making it the second largest oil firm at the time (MF, 2010). The raised capital would finance the required investments for pre-salt exploration and production (E&P) and keep financial solvency indicators within investment grade level.

Nevertheless, by 2015 the firm and the country situation was in stark contrast. Posting a loss of USD 8 Billion including a significant write-off due

To cite this article: Yabiko, R.F., Bone, R.B. (2018). Derailed locomotive? Petrobras investments and economic growth in Brazil. *International Journal of Production Management and Engineering,* 6(1), 47-55. https://doi.org/10.4995/ijpme.2018.8758

to corruption overcharges from suppliers, Petrobras faced a second year of losses in a row. The corruption scandal and investigation known as Car-Wash ("Lava Jato") involved directors and suppliers of Petrobras. Its effects were deeply felt in the administration and put great investments as the Petrochemical Complex of Rio de Janeiro in check. Not only Brazil itself faced an unprecedented recession with a gross domestic product *per capita* fall of 4.6% (IBGE, 2017).

Given the size and role of Petrobras in a key strategic sector for a country economy and development, it is not surprising that its woes may influence the country and may as well help it leave recession. This paper explores the relationship between Petrobras investment outlays and the country economic welfare through indicator such as gross capital formation and gross domestic product (GDP), highlighting the company impact in Brazil development, positive or negative.

The study investigates the profile of Petrobras investments dividing them by areas. The change in investments across activities over the last decade was not homogeneous or in line with the goals of an oil and gas (O&G) corporation. The lack of cohesion between what should be the company strategy and the effect of its role in economic growth in the country further understanding.

The article is organized as follows. The next section presents the evolution of Petrobras investments in total volume and broken down by activities over the oil and gas vertical chain, revealing the strategic choices made over time and the monetary impact of these actions in the company welfare. The third section highlights the role of Petrobras investment on economic growth and evaluates the effect of the strategic investment choices current and future economic growth. The analysis course was to use the economy indicators to correlate then with the company investments growth. The last section collects concluding comments and possible forecasts to both Brazil and Petrobras.

2. Petrobras Investments

The goal of this section is to the analyise Petrobras investment levels and trends and its relationship with oil refined goods prices and their consequences to firm indebtness. Investment is taken here as gross fixed capital formation, net of disinvestments. Investment itself is broken down in business segments, namely Exploration and Production (E&P); Refining, Transportation and Marketing (Supply); Gas and Energy (Gas & Energy); Distribution; Biofuel; Corporate; and International.

The first aspect to be analyzed is the volume of Petrobras total investment in the last eleven years, from 2005 to 2016. This period comprehends several critical changes in the scenario, since the discovery of pre-salt reserves, the global financial crisis, the Brazilian recession, up to the launch of Lava-Jato investigation. Petrobras investment information were collect-ed from the F-20 forms presented to the Securities and Exchange Commission (SEC) in the United States of America.

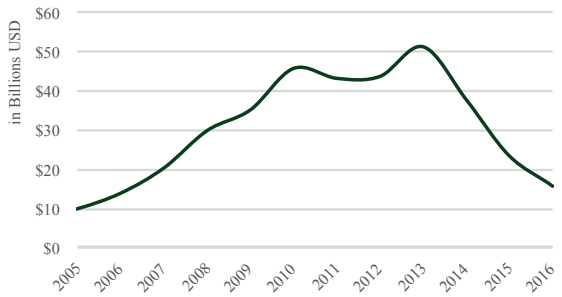

Figure 1. Petrobras historical investment series (total volume) 2005-2016 (source: SEC FORM-20F, 2006-2016 and Petrobras, 2017).

The information displayed in Figure 1 shows that Petrobras overall investment did not decrease in the face of the 2008-2009 global financial crisis. Investment reached a first peak in 2010 with an amount of USD 45 Billion and this magnitude order were maintained up to 2012. Looking closely, the year of 2011 saw a 6% decrease in total investment and 2012 a modest 1% increase in relation to the previous year, keeping it virtually frozen. In 2013 a new high was reached with over USD 50 Billion spent on investment. This huge increase happened in the wake of a management change that replaced the presidency and directors.

The decay began in 2014 and were prolonged until last year. In 2015 there is a decrease in total investment when the level was close to the 2007 level, reaching only USD 23 Billion. The investment decrease between 2014 and 2015 reflected the fall in international oil prices, the increasing burden of debt at Petrobras. The loss of its international rating agencies (Fitch, Moody´s and Standard and Poor´s) investment grade in 2015 and the Brazilian Real

(R$) devaluation from 2014 that made investment financing harder and the company more selective in its capital expenditures (capex).

For many years the Brazilian government imposed on Petrobras a populist agenda of not passing through international oil price increases to gasoline and diesel. This generated losses for Petrobras, as the sale price of gasoline was not able to cover the refining, extraction and production costs for most of the time between 2010-2014 when oil prices increased after the 2009 drop.

To illustrate the contrasting scenario in the country figure 2 compares the trend of Brent oil prices with the percentage variation in the conventional gasoline and Diesel distribution price in Brazil and USA (NY market). Brent oil price is an international oil price benchmark for internationally traded oil. It is measured at the North sea production and used here given the increasing domestic influence of shale oil and gas on the other international reference price, the Western Texas Intermediate (WTI). Refined goods gasoline and diesel New York prices are taken as reference for international competitive prices, while Brazil prices are national averages registered by the Oil Regulatory Agency (ANP).

The trends determined by the commodity international prices (Brent oil prices) clearly determine refined products such as gasoline and diesel in international markets, as seen by the New York benchmark. The trend seen in internal markets in Brazil is markedly different. The gasoline and diesel pricing followed Petrobras main controller – the Government of Brazil– macroeconomic policies, such as inflation control. International oil price changes pass through to refined goods prices are smoothed over a very long term and show often different trends. Given the inflation surge in 2009-2012 gasoline and diesel prices were frozen as an anti-inflationary policy, placing a heavy burden on Petrobras cash flow. It was laid in Petrobras shoulders to carry these police of inflation control.

Additionally, another important event to Petrobras woes is the launch of the Car Wash corruption and embezzlement investigation in 2014. This put board decisions to a near halt from 2014 and drained the company forces to keep up investments levels.

Figure 3 is a clear reflection of the chaotic scenario faced by Petrobras since 2010. It presents the evolution of the debt in the firm by showing the ratio of the Net Debt to EBTIDA. Net debt is the amount of money the company needs to clear the liability that generates financial expense. EBITDA stands for Earnings before taxes, interest depreciation and amortization –a measure of operational profits and cash generation (Damodaran, 1997). This indicator gives a clear view of Petrobras financial health.

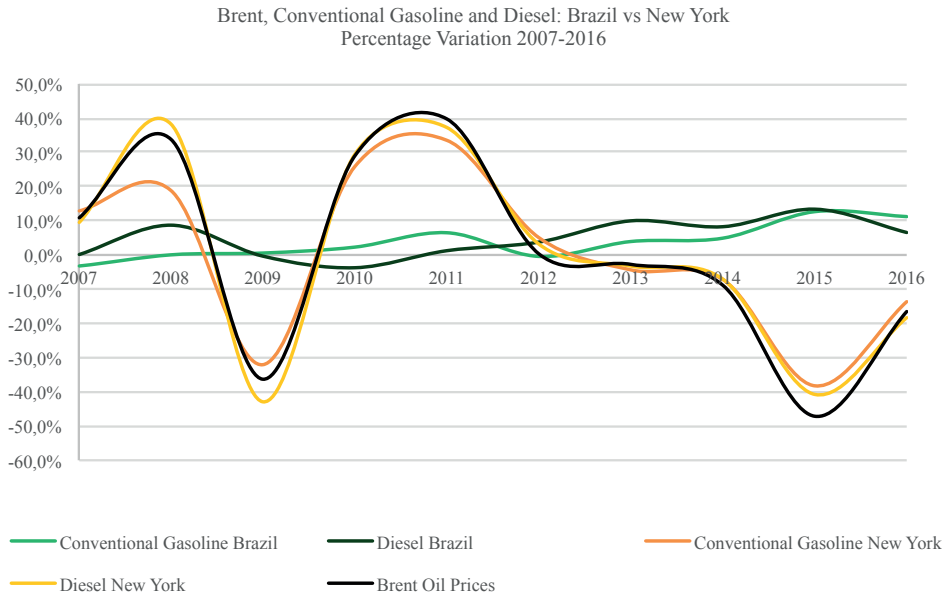

Figure 2. Percentage variation between Brent oil prices, Conventional gasoline and Diesel in Brazil and USA (New York market) 2007-2016 (*source*: EIA, 2017 and ANP, 2017).

The sharp rise in its indebtedness, from 1.5 of EBITDA to 5 times its earnings in five years raised an urgent change in policy within the company to avoid insolvency. The Petrobras latest announced business set a goal to reducing its Net Debt to EBITDA indicator to 2.5, leading to important changes in its investment policy as will be seen below.

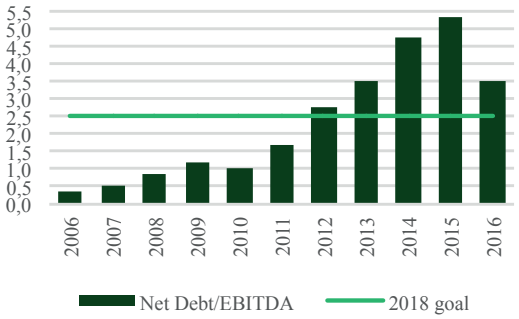

Figure 3. Evolution of Petrobras Leverage: Net Debt/EBITDA (*source*: Petrobras, 2017).

Figure 3, when compared with the level of investments, allows us to say whether the company indebtedness is due to capital expenditures and future growth perspectives or whether it is a symptom of say poor administration. Compared to Figure 1, we see that indebtness rose in the wake of largest investment levels. Nevertheless the difference between oil cost growth and refined goods prices hurt EBITDA and pushed indebtness up.

Aware of the need to overcome this situation of high levels of leverage, Petrobras established in its last business plan (2017-2021) a goal to reduce its indebtedness to a 2.5 reason of Net Debt/EBITDA. Besides the company started to prioritize its expenditures to maximize the cash flow and to make a series of disinvestments to promote profit in short term (Petrobras, 2017).

Now it is possible to tread the path to understand how Petrobras found itself in the midst of such crisis. Also, it is time to begin the questioning of how deep it goes the role of Petrobras in the Brazilian economy.

2.1. Petrobras Investments Profile

In this section the investment is broken down in business segments, namely, Exploration and Production (E&P), that includes the oil and gas exploration and production activities onshore and offshore; Refining, Transportation and Marketing (Supply), that includes the next activities in the oil and gas vertical chain once oil is extracted, namely refining and transportation and sale of crude oil; Gas and Energy (Gas & Energy), that includes all activities related to natural gas (NG), as NG sale, and thermal power generation and its commercialization; Distribution, that involves oil refined products wholesale and retail; Biofuel, that covers biodiesel and co-products; as well as two additional classification: Corporate, which comprehend financial management and human resources activities; and International, that consolidates activities abroad.

The overall trend that was analyzed first may hinder a better view of the investment profile at Petrobras. Figure 4 shows the amount of cash that was focused in each of those areas and their evolution over eleven years.

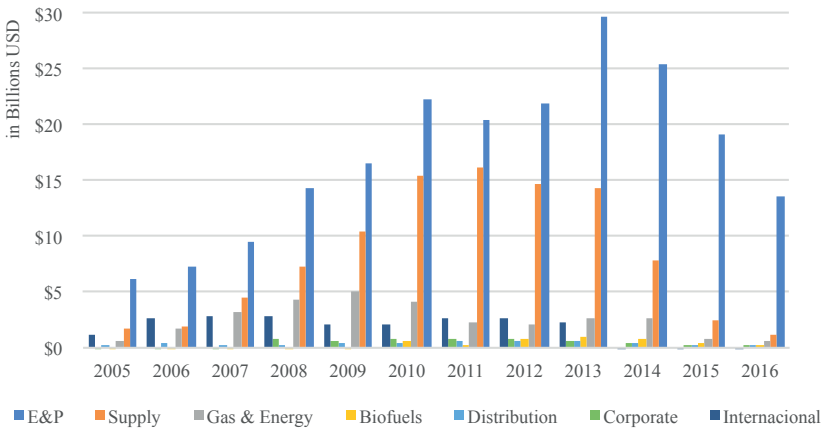

Figure 4. Petrobras historical investment series: sectoral development 2005-2016 (*source*: SEC FORM-20F 2006-2016 and Petrobras, 2017).

A relative ranking of business segments was nevertheless maintained over time: E&P taking the largest share of investment outlays, followed by Supply, Gas & Energy and International investments. Biofuels, Distribution and Corporate were always very small compared to the others.

This trend is expected from an oil and gas company that draws profits from the commercialization of oil (crude or refined products). It can also be explained by the fact that E&P is the most expansive link from the petroleum chain. A contributor factor to the peak in E&P in 2013 was the realization of the first bidding round of pre-salt fields, when the consortium led by Petrobras was the winner.

The most relevant change visible from figure 4 is the role of supply segment. From 2008 onwards, it followed the increase in E&P investments up to 2013. This year E&P investments were made priority and Supply investments started decreasing. While in 2012 Supply investment reached 37% of total investment, by 2015 it accounted for just 10% of total investment.

Figure 4 is net of disinvestments. The 2015 figures reflect the 2015-2019 Petrobras Business Plan revision to the new the proposed growth for the next five years, as seen in the 2017-2021 Petrobras Business Plan that included the sale of transportation units, gas retail business and even oil fields to manage the increasing debt that rose sharply from 2011 (Petrobras, 2016 and 2017).

In 2014 after the beginning of Car-Wash the investments in the International segment were not accounted for separately. Since that year onwards, the investments abroad have been divided by company activity.

The decrease in supply investments had important effects on the current refining capacity and the prospects for internalizing the refining of the pre-salt oil in Brazil, as shown in Yabiko, Medeiros and Bone (2016). Even though E&P is the responsible for the principal cash flow in an oil company, the largest increase in value added is in refining the oil produced from these blocks.

Notwithstanding the level of total investment was reduced by nearly half from 2013 to 2016, E&P investment decreased by only a third and is at the 2008 level. Supply investment itself decreased more than 50% from 2013 to 2016. This strategic choice of protecting E&P investment from such large cuts makes sense given that Petrobras is an integrated oil and gas company and guaranteeing a level of proven and commercial oil reserves over time has a positive impact on stock prices (Ribeiro, Almeida and Bone, 2017).

In the first semester of 2017 the Brazilian government announced the realization of two more bidding round in the pre-salt area (ANP, 2017). However, due to Petrobras economic situation is questionable if the company is going to be able to maintain its role in petroleum exploration in Brazil and contribution to the national development.

3. Economic Growth and the Role of Petrobras

Since its creation in the 1950´s Petrobras investment decisions have a significant impact in the Brazilian economy. Here we compare Petrobras activities with Brazil´s gross fixed capital formation (aggregate investment) and gross domestic product (GDP), allowing us to show Petrobras role in the economy.

3.1. Gross Capital Formation and Petrobras Investments

Gross fixed capital formation, or Gross capital formation measures the aquisition of machinery and equipment as well as vehicles and the addition of building and construction in the economy. According to the Brazilian Institute of Geography and Statistics (IBGE, 2017), this national accounts measure does not substract depreciation .

Figure 5 presents the time series analysis of Petrobras total investment and Gross Capital Formation for Brazil, data collected from the (IBGE) National Accounts.

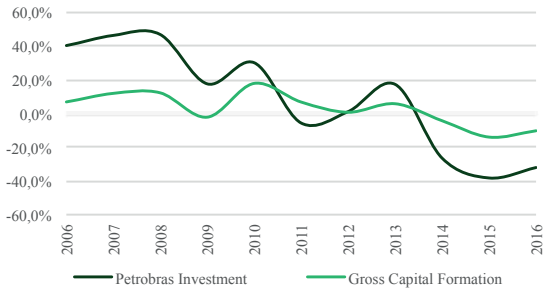

Figure 5. Petrobras Investment and Gross Capital Formation in Brazil 2006-2016 (*source*: IBGE, 2017 and Petrobras, 2017).

We see that Petrobras investment and Gross Capital Formation (or Aggregate Investment) have a similar trend from 2006 to 2016. At the same time, Petrobras investment is more volatile than Gross Capital Formation. This is expected since Aggregate Investment includes residential home building and infrastructure investment, taking in consideration the whole economy and not just one sector (OECD, 2015).

Looking closely, from figure 4, from 2006 to 2008 Petrobras investment follows an equal trend of aggregate investment. Justified by the fact that Petrobras is an entity responsible for the largest investments in the country economy and its strategic role is to be a mechanism that encourages economy growth in Brazil.

In 2009, the year affected by global financial issues, the slowdown (but not decrease) in investments generated an echo in the gross capital formation, with a rebound in 2010.

Then in 2011-2013 we see a different trend between Petrobras and Aggregate Investment. This found difference is a consequence of two major events that were held in Brazil: The World Cup and Olympic Games. These occasions shielded Gross Capital Formation as strong investments in infrastructure were made and several foreign companies saw Brazil as a country to invest.

However, in 2014-2015 both investment indicators showing negative growth, more pronounced in Petrobras line. In this year is when the effects of an economy crisis in Brazil begin conjointly with the newly found but deep-rooted deficit in Petrobras cash flow. In 2016 in both indicators it is possible to see a small recovery, the early signs of an economy rebirth.

3.2. Gross Domestic Product and Gross Capital Formation

The role of investment on economic growth is well known (BLANCHARD, 2011). Investment multipliers, that is, the effect of a 1 growth in investment (with respect to GDP) on the growth of GDP, can be larger than 1 (OECD, 2015), so that a 1% increase in investment may lead to a more than 1% increase in GDP. This effect is relevant, in the face that investment is only part of total GDP (that includes consumption, government spending and net exports).

The leading effect of investment on economic growth can be seen in Figure 6. Upward trends of investment growth are followed by upward trends in GDP growth and negative trends of investment are followed by downward trends in GDP.

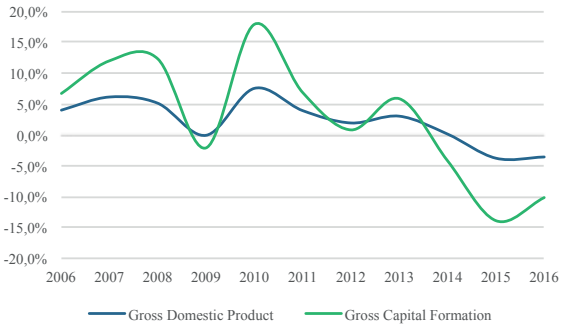

Figure 6. Gross Domestic Product and Gross Capital Formation in Brazil 2006-2016 (*source*: IBGE 2017).

The trajectory of the Brazilian economy from 2005-2016 can be divided between before and after the 2009 financial crisis. Up to 2008, the country benefited from the commodity price boom and experienced increasing GDP growth, only to meet a GDP decrease in 2009. Countercyclical policies, including Petrobras investment policy, and investment projects in 2010 proved effective but short-lived, as growth faltered, albeit in positive territory from 2011 to 2013. The exhausted public finance could no longer sustain the attempts at economic growth and GDP contracted.

In 2016 GDP also felt the remerge of the national economy, although still in contraction. According to the latest forecast published by the International Monetary Fund (IMF) it is expected that Brazil will leave this recession to grow 0.7% in 2017 and 1.5% in 2018 in terms of GDP (IMF, 2017).

3.3. Correlation between Petrobras Investments and Economic Indicators

This section aims to learn if Petrobras investment decision, as the 'locomotive' of the Brazilian economy, affected national growth, looking at the correlation matrix of Petrobras investment and national GDP and gross fixed capital formation indicators. The correlation figures show how strong

is the relationship between the figures and the direct of ingluende whenther inverse or direct.

For computing the data it was used used in the study was the Pearson correlation coefficient (ρ). It is a measure of the linear correlation between two variables and varies between +1 (perfect positive correlation) and −1 (perfect negative correlation), when the value is close to zero, the variables analyzed are linear independents. Gathering all data in the table 1, it was possible to use Pearson formula and calculate the correlation between Petrobras Investments, GDP and Gross Capital Formation, stated in table 2.

Table 1. Annual rate of growth Gross Capital Formation, GDP and Petrobras Investment. (*source*: IBGE, 2017 and Petrobras, 2017).

	Gross Domestic Product	Gross Capital Formation	Petrobras Investment
2006	4.0%	6.7%	39.8%
2007	6.1%	12.0%	46.2%
2008	5.1%	12.3%	46.8%
2009	-0.1%	-2.1%	17.6%
2010	7.5%	17.9%	30.1%
2011	3.9%	6.8%	-5.6%
2012	1.9%	0.8%	1.2%
2013	3.0%	5.8%	17.3%
2014	0.1%	-4.2%	-26.3%
2015	-3.8%	-13.9%	-38.1%
2016	-3.6%	-10.2%	-31.9%

Table 2. Correlation Coefficient: Gross Capital Formation, GDP and Petrobras Investment. (*source*: IBGE, 2017 and Petrobras, 2016).

	Gross Domestic Product	Gross Capital Formation	Petrobras Investment
Gross Domestic Product	1.00	0.99	0.84
Gross Capital Formation	0.99	1.00	0.86
Petrobras Investment	0.84	0.86	1.00

From Table 1 it can be verified that Brazilian GDP had it best year in 2010 with 7.5% per year. This positive result can be justified by advances in gross capital formation and Petrobras investments. Looking through Petrobras point of view, the year of 2010 was not the most expressive in terms of growing, but the previous years with remarkable performance (2008 with 46.8% per year) made it investments echoed years later.

From Table 2, the correlation coefficient between investment growth and GDP growth is at 0.99, highlighting the relevance of gross capital formation for the economy. Such high correlation is impressive given the short sample and the use of variables in growth rates, to avoid the spurious correlation problem (GUJARATI, 2001). Petrobras investment and gross capital formation correlation is at 0.86. And the correlation coefficient between Petrobras investment and economic growth is at 0.84, showing the relevance of the firm to the Brazilian Economy, since these values (between 0.7 and 0.9) are characteristics of a strong link between the variables.

The role of Petrobras in economic growth cannot be undermined. Nevertheless, the changes in the profile of Petrobras investment may reduce its role as 'locomotive' of the Brazilian economy. While Distribution and Supply investment are strongly associated with local productive capacity and the use of domestic inputs in construction and equipment use, E&P investments use more international supplied services and relatively less local technology, including engineering services. Even under strict local content requirements on E&P, Petrobras has had difficulties meeting these requirements for lack of adequate suppliers in Brazil. The reduction in the relative share of investment in Supply may suggest a lesser role of Petrobras in leading the economy.

4. Concluding Comments

Since its creation, Petrobras has been considered a firm with a development public policy role, as the main shareholder used as a policy tool. The firm directed its efforts just for the oil and gas sector, but to the domestic manufacturing industry as a whole. The impact of the firm in the economy is visible and the technological advances and R&D expenditures influenced other sectors in the economy. The degree of association of the gross capital formation in the economy and Petrobras investments were visible in the decade since 2005.

Investment is a key variable for economic growth. As part of aggregate demand, it increases an economy productive capacity and its multiplier effect has a significant impact in income (GDP) growth. The correlation coefficient between investment and GDP growth is higher than 90% for Brazil.

At the same time the Petrobras investment was more volatile than gross capital formation. Petrobras investment is more exposed than the aggregate of the economy to sector effects such as international crude oil price volatility and is more exposed to factors that led to the decline in the observed investment level and the pro-posed growth for the next five years, as seen in the 2017-2021 Petrobras´ Business Plan (Petrobras, 2017). The firm is reacting to the effect of government deficits and recovering from the initially paralyzing effect from the Car Wash investigation.

In this crisis scenario, the profile of Petrobras investment changed. E&P investments increased its share in total investment significantly, while Supply (such as refining and petrochemicals) investments decreased sharply. The E&P emphasis is in line with the needs of an integrated Oil and Gas company and its requirements to maintain and explore reserves and produce crude oil for domestic consumption at refineries or export. But at the same time, the E&P investments may have relatively lower impact in the economy than Supply in-vestments. A long-term view would suggest a more balanced approach as the extracted oil will need refining and the more balanced in-vestment profile may lead to a more effective contribution to growth and the reduction of the unemployment in the economy.

Acknowledgements

We acknowledge the support from Labecopet/Poli/UFRJ and comments and suggestions from Eduardo Pontual Ribeiro (IE/UFRJ).

References

ANP. (2017). Brazil Rounds. Rio de Janeiro: Agência Nacional do Petróleo, Gás Natural e Biocombusíveis/Coordenadoria de Defesa da Concorrência. Available from: http://www.brasil-rounds.gov.br/Round_P2/portugues_RP2/cronograma.asp [Accessed: 09 Sep 2017].

ANP. (2017). Relatório de Defesa da Concorrência. Rio de Janeiro: Agência Nacional do Petróleo, Gás Natural e Biocombusíveis/Coordenadoria de Defesa da Concorrência. Available from: http://www.anp.gov.br/wwwanp/precos-e-defesa/234-precos/levantamento-de-precos/868-serie-historica-do-levantamento-de-precos-e-de-margens-de-comercializacao-de-combustiveis [Accessed: 25 Sep 2017].

Blanchard, O. (2011). *Macroeconomia*, 5th Edition. São Paulo: Ed. Pearson.

Côrrea, A. (2009) 'Crise muda perfil das exportações brasileiras', Brasil. BBC Brasil, São Paulo. Available from: http://www.bbc.com/portuguese/noticias/2009/09/090908_crise_exportacoes_ac_np [Accessed: 01 Sep 2017].

Damodaran, A. (1997). *Avaliação de Investimentos: Ferramentas e técnicas para a determinação do valor de qualquer ativo*, 1st Edition. Rio de Janeiro: Qualitymark.

EIA. (2017). Petroleum & Other Liquids. Washington: U.S. Energy Information Administration. Avalaible from: https://www.eia.gov/dnav/pet/PET_PRI_SPT_S1_A.htm [Accessed: 10 Oct 2017]

Gujarati, D. N. (2001). *Basic Econometrics*, 4th Edition. São Paulo: McGraw-Hill Company.

Hoyos, C. (2007). 'The new Seven Sisters: oil and gas giants dwarf western rivals', Oil & Gas. The Financial Times Limited, São Paulo. Available from: https://www.ft.com/content/471ae1b8-d001-11db-94cb-000b5df10621 [Accessed: 07 Jan 2017].

IBGE. (2017). Formação Bruta de Capital Fixo Variação em volume: taxa acumulada ao longo do ano. Instituto Brasileiro de Geografia e Estatística (IBGE), Rio de Janeiro. Available from: http://seriesestatisticas.ibge.gov.br/series [Accessed: 05 Oct 2017].

IBGE. (2017). Produto Interno Bruto Variação em volume: taxa trimestral. Instituto Brasileiro de Geografia e Estatística (IBGE), Rio de Janeiro. Available from: http://seriesestatisticas.ibge.gov.br/series [Accessed: 01 Oct 2017].

IMF. (2017). Brazil: At a Glance. United States: International Monetary Fund. Available from: http://www.imf.org/en/Countries/BRA [Accessed: 10 Oct 2017]

Ipea. (2017). Taxa de câmbio nominal. Rio de Janeiro: Instituto de Pesquisa Econômica Aplicada (Ipea). Available from: http://ipeadata.gov.br/ExibeSerie.aspx?serid=38389 [Accessed: 05 Mar 2017].

MF. (2010). Petrobras arrecada cerca de R$ 120 bilhões em maior capitação do mundo. Ministério da Fazenda (MF). Available from: http://www.fazenda.gov.br/noticias/2010/setembro/petrobras-arrecada-cerca-de-r-120-bilhoes-em-maior-operacao-de-captacao-do-mundo

OECD. (2015). OECD Chapter 3, Lifting investment for higher sustainable growth. Economic Outlook. Volume 2015/1.

Paduan, Roberta (2016) *Petrobras: uma história de orgulho e vergonha.* Rio de Janeiro: Ed. Objetiva.

Presidência da República, Casa Civil, Subchefia para Assuntos Jurídicos. (2010). Lei Nº 12.351/2010. Available from: https://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/lei/l12351.htm [Accessed: 12 Dec 2016].

Petrobras. (2017). Plano Estratégico e Plano de Negócios e Gestão 2017-2021. Rio de Janeiro: Petrobras. Available from: goo.gl/nHx5dn [Accessed: 10 Nov 2017].

Petrobras. (2016). Plano de Negócios e Gestão 2015-2019. Rio de Janeiro: Petrobras. Available from: goo.gl/5vFils [Accessed: 20 Jul 2016].

Petrobras. (2011). Plano de Negócios 2011-2015. Rio de Janeiro: Petrobras. Available from: http://investidorpetrobras.com.br/pt/comunicado-e-fatos-relevantes/plano-de-negocios-2011-2015 [Accessed: 13 Jan 2017]

Petrobras. (2017). Resultados Financeiros: Ebitda, Available from: http://www.investidorpetrobras.com.br/pt/resultados-financeiros/holding [Accessed: 10 Oct 2017]

Petrobras. (2017). Alavancagem: Dívida líquida. Available from: http://www.investidorpetrobras.com.br/pt/divida/endividamento-e-alavancagem [Accessed: 05 Oct 2017]

Ribeiro E.P., de Almeida W.F., Bone R.B. (2017) Stock Market Firm Value Effects of Research and Development Expenditures in the Oil and Gas Industry. In: Amorim M., Ferreira C., Vieira Junior M., Prado C. (eds) *Engineering Systems and Networks. Lecture Notes in Management and Industrial Engineering*. Springer, Cham. https://doi.org/10.1007/978-3-319-45748-2_7

SEC. (2016). FORM 20-F Annual Report. Washington: U.S. Securities and Exchange Commission (SEC). Available from: https://www.sec.gov/Archives/edgar/data/ [Accessed: 20 Jan 2017].

Yabiko, R., Medeiros, G., Bone, R. B. (2016). Petrobras' Investment Projects in Brazil under Check-mate: the ghost refineries case. International Joint Conference - CIO-ICIEOM-IIE-AIM (IJC 2016).