Oil Price Fluctuations and Facilities Investment in South Africa

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Abstract

This research explored the impact of oil price fluctuations on facilities investment in South Africa, using time series data from 2013 to 2023. The data has been studied via cointegration, variance decomposition, and impulse response analysis to ascertain the impact of fluctuations in oil prices on facilities investment in South Africa. The trend analysis indicates that oil prices and government investment on infrastructure exhibit concurrent fluctuations. The impulse response indicated that the effect of crude oil price shocks is significant in the near term yet maintains constant and increases in the long term, suggesting that the influence of crude fluctuations in oil prices may last into the future. The research results indicate that the government should pursue other financing methods for infrastructure due to the unpredictability of oil prices.

Keywords: *Oil price fluctuations, facilities investment, macroeconomic landscape and balancing of payments.*

Introduction

Oil is a critical socioeconomic aspect in the economy of the world, with the market for crude oil being the biggest market for goods worldwide (Tala and Hlongwane, 2023). Unlike other resources, oil is arguably the sole input to manufacturing that may influence economic development beneficially and, potentially resulting in a period of recession. Since the 1970s, the worldwide crude oil price has exhibited increasing fluctuation, resulting in unpredictability (Iyke and Ho, 2021). Fluctuations in oil prices hinder GDP via various mechanisms, including heightened costs for manufacturing and anticipations of inflation. Moreover, higher oil prices can lead to elevated transport, manufacturing, and warming expenses, thereby hindering company profits. It may impact pricing security, business viability, and the resilience of the financial system in a country (Nwosa, 2021). Surprises in oil prices are often sent to the macroeconomy through a variety of means. A favourable spike in oil prices in businesses will elevate costs for manufacturing, thereby constraining results, with price hikes at least largely transferred to customers. Furthermore, when the costs of Oil and electricity rise, families encounter elevated living expenses, with the impoverished being especially susceptible(Umeaduma and Dugbartey, 2023). These influences can produce substantial additional consequences across the economy, influencing macroeconomic variables that involve jobs, trade ratios, price increases, public finances, stock market prices, and currency rates (Olamide et al., 2022). The form and degree of these repercussions are contingent upon the fundamental features of an economy; for example, a nation that is heavily involved in oil commerce is more susceptible to price disruptions in worldwide markets for commodities.

Nations with a substantial oil and gas proportion within their renewable energy composition, as well as power-intensive manufacturing, have been likewise susceptible. Moreover, international oil price fluctuations may be exacerbated in certain nations, contingent upon the local currency's value and existing inflationary trends (Umeaduma and Dugbartey, 2023). Rising in oil prices could be viewed favourably by nations that export petroleum and unfavourably by importing nations; however, heightened oil price fluctuations—characterized by successive both beneficial and detrimental price shocks—augments expected unpredictability for every nation, irrespective of their current trade balance (Olamide et al., 2022). Elevated prices for oil may hinder economic development, incite stock market turmoil, and induce price increases, resulting in macroeconomic and economic instability. This may result in elevated borrowing costs

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and maybe an economic downturn (Ali et al., 2022). Significant rises worldwide oil prices and exchange rate changes are typically considered issues that hinder the economy from expanding.

Numerous countries that produce oil encounter challenges in administering their finances due to the significant fluctuation for oil prices. Several performed more favourably compared to individuals to achieve elevated true GDP economic growth (Asafo-Adjei et al., 2024). When handled correctly, income from oil may contribute to steady, non-inflationary expansion of the non-oil sector, as well as protecting the nation's finances from volatile fluctuations in oil prices along with income. Research concerning the asymmetrical impact of oil price income fluctuations in South Africa indicates that benefits from oil income surprises promote a repressive fiscal stance in the short term, consistent with theoretical expectations, resulting in inflationary pressures and devaluation of the domestic currency (Zhao et al., 2024). This necessitates a successful integration of fiscal and monetary policy to attain lasting stability in the economy. Crude oil has produced significant revenue for South Africa; nevertheless, its impact on the development of the South African economy concerning returns and efficiency remains uncertain (Zhao et al., 2024). The newfound oil wealth has resulted in a simultaneous decrease of various other industries, exacerbating significant urban migration and contributing to the pervasive poverty, particularly in rural regions. Consequently, South Africa's labour market has experienced a significant level of joblessness, inadequate salaries, and deplorable conditions for employees (Wang et al., 2022). From 2013 to 2023, South Africa's income inequality rose from 36 to 70 percent, and it is posited that oil wealth did not enhance the average quality of life during this period but rather contributed to its deterioration (Chapungu et al., 2022). In South Africa, investing by the government is significantly associated with fluctuations in oil prices, particularly the turbulent boom-bust periods. Simultaneously, the significant escalation in public investment has not corresponded with a proportional enhancement in the country's level of living, resulting in an accumulation of inefficient and subpar capital investment (Berahab, 2022). Furthermore, the material requirements in industries such as energy production, telecommuting, and travel have been insufficiently addressed, while vital social services have been overlooked.

These policies, including stringent trade protections, exchange rate control systems, and fraud, have modified incentive systems, caused inefficiencies in the business community's choice-making, while undermining the expansion potential that awaits non-oil industries in the economic growth of the nation (Karacan et al., 2021). The primary aim of this paper has been to ascertain whether an ongoing connection is present between oil price fluctuations and impact on facilities investment in South Africa. The explicit aims encompass the following:

1. Analyse the correlation between oil price fluctuations and investing on facilities in South Africa.

2 Ascertain the causal relationship between oil price fluctuations and facilities investment.
3.Ascertain the percentage of variation in facilities investment owing to fluctuations in oil prices.

Literature Review

Before the late 2013s, it was widely believed that mineral wealth positively influenced industrialisation (Zhang and Hamori, 2022). This perspective was endorsed by numerous sociologists of development as well as neoliberalism financial analysts until the emergence from a contrasting viewpoint in the 2013s, which asserted which a wealth of natural resources was not advantageous for people in developing countries. This theory underpins the beneficial approach, which posits that environmental assets can facilitate the transition of emerging economies from poverty to technological 'launch', as evidenced in nations that include England, and the USA (Agyei et al., 2021). The significant earnings compared to oil allows government officials of nations that produce oil to engage in extensive investing and investment while relying on taxes for generating income.

Effectively exploited, oil revenues might provide a significant impetus for growth. This pathway is particularly significant for emerging nations, where a lack of finance frequently poses a substantial obstacle to advancement and growth (Doorga et al., 2022). The substantial foreign exchange revenue from the export of oil, in addition to facilitating the importation of raw materials, finished products, and capital

equipment for manufacturing in the non-oil industries, might also contribute to enhancing the foreign reserves of energy-exporting nations. South Africa has consistently engaged in this technique after the oil price, importing turn-key innovations; but the necessary skills and knowledge were not sufficiently entrenched to foster development and independence in the future (Liu et al., 2022). The buildup of foreign reserves from energy export sales acts as security that oil-producing countries might utilise to draw in foreign investment. This research is theoretically grounded in the finding that many resource-rich emerging nations often demonstrate slower development rates contrasted to their resource-poor counterparts.

Although seemingly unproductive, experts have identified minimum three mechanisms that explain how the availability of fossil fuels may hinder growth in the economy(Norouzi, 2021). The cost of materials in global markets is often variable, leading to significant consequences from fluctuations in the selling price that constitutes the primary income source. Work and revenues tend to be elevated during periods of rising resource costs; yet economic growth deteriorates when prices decline (Mensi et al., 2021). Governments frequently participate within the perilous 'boom-and-bust' dynamic. Government investment on buildings, schools, as well as healthcare climbs significantly during periods of rising resource prices and diminishes sharply when resource costs decline. This engenders disturbance and adversity. Societies reliant on energy sources have been susceptible to the 'Dutch Plague'(Wang et al., 2023). The event gets its name following the Dutch economic hardships during the 2013s. Natural gas has been obtained from the Norwegian Sea, as well as the heightened manufacturing in natural gas overshadowed everything else.

Societies afflicted by 'Dutch Disease' observe a reallocation of resources towards the thriving natural resource industry, leading to a decline of output within other industries, notably manufacturing and agriculture. Furthermore, a strengthening of the actual currency rate frequently intensifies the issue by rendering domestic goods more costly in world markets.

This adversely affects domestic sectors that export (Shannon and Waller, 2021). In the 1970s, South Africa had substantial economic difficulties stemming from worldwide oil crises that revealed its reliance on imported energy. The 1973–74 Oil Embargo, initiated by Arab oil producers in reaction to the Yom Kippur War, significantly curtailed oil supplies to countries seen as supportive of Israel, especially South Africa (Lindner, 2023). The embargo significantly restricted South Africa's ability to obtain oil and resulted in substantial price hikes. Subsequently, the 1979–80 Oil Crisis, resulting from the Iranian Revolution, exacerbated oil supply disruptions from the Middle East, intensifying the challenges. South Africa's circumstances were especially dangerous owing to its substantial dependence on imported oil, mostly from the Middle East (Dong et al., 2023). The apartheid system exacerbated these weaknesses via its policies, which resulted in international penalties and restricted commercial links, hence complicating the nation's ability to obtain alternate energy sources or alleviate the economic repercussions caused by worldwide disturbances. South Africa's experiences, characterised by stagnation despite its oil resources, serve as a pertinent study in which to examine the effects of the natural resource curse and strategies for its mitigation(Das, 2021).

Impact of fluctuations in oil prices on the macroeconomic landscape

Oil prices significantly impact the economy in various manners. Fluctuations in oil prices immediately influence transportation expenses, expenses for heating, and the prices of things manufactured from petroleum-based substances. Fluctuations in oil prices generate greater confusion over the future, influencing the purchasing and choices about investments of people and enterprises (Mesagan et al., 2022). Furthermore, fluctuations in oil prices result in the shift of labour and capital between energy-intensive industries and non-energy-intensive sectors of the economy.

South Africa, like numerous other oil-producing economies globally, has generated significant wealth from its naturally loaded crude oil assets. They are making substantial income from shipping the product as well as their subsequent sale in the global marketplace (Xiuzhen et al., 2022). However, its selling is contingent upon the global price per barrel of crude oil. Before South Africa's industrial selling of crude oil, crude oil costs were volatile.

Although different commodities exhibit comparable or greater price fluctuation, the unpredictable nature of oil prices is deemed particularly detrimental due to oil's significance in all economies(Xiuzhen et al., 2022). In the transportation sector specifically, there are no viable alternatives to petrol and diesel on a broad scale. Fluctuations in oil prices impact freight costs for transportation, which are essential for all goods, as well as consumer transit expenses.

Quantitative research has not definitively corroborated the prevalent notion that oil prices exhibit greater fluctuation compared to that for many different goods. Miamo and Achuo (2021) determined that farm price movements exhibited the highest fluctuation from 2015 to 2022, a time that encompassed the second phase of the oil crisis. Chien et al. (2022) analyzed the cost of commodities from February 2010 to September 2016 and discovered that the costs of crude oil, improved crude oil, and gas itself showed more fluctuation than about 95 percent of items offered by US companies. In comparison to the pricing of other essential goods, fluctuation in oil prices was determined to be larger than that of 60 percent of fundamental goods (which incorporates agricultural goods, food, and feed) but a little lower than that of 21 percent of the primary goods. The history of price fluctuations demonstrates that policymakers encounter two distinct yet interconnected uncertainty. The first aspect is the current pattern of pricing; the second is the degree of variation in prices along this trend (Rosnawintang et al., 2021). Even though prices had fluctuated in a gradual manner, regulators would still need to consider the alteration in price levels and modify how they responded to significantly new conditions and anticipated future price levels (Adeola et al., 2022). The second unpredictability stems from the significant fluctuation surrounding the medium to long-term pattern in price levels. Authorities must acknowledge that certain price fluctuations are transient and may be partially reversed; yet the economy is influenced by these changes in prices, regardless of how the nation is importing or exporting oil or its derivatives (Li et al., 2022). As these differences increase, the necessity for an approach to control or mitigate pricing fluctuations might grow increasingly critical. Fluctuating oil prices can have several detrimental impacts on an economy. others of these factors have immediate effects on the economy, while others impact the government and, consequently, the economy through governmental responses. Additionally, others effect individual enterprises and customers immediately (Işık et al., 2024).

Balancing of Payments

As oil prices increase, the balance of payments would deteriorate due to a higher import investment. The impact will be mitigated by any rise of currencies versus the U.S. dollar amounts in which worldwide oil transactions are denominated. Concurrently, there may be additional compounding import cost escalations (including food costs) or mitigating advantages from a concurrent rise within the prices of exported goods (particularly stones) over nations that happen to be net suppliers (Habiyaremye et al., 2022). The deterioration of the current account of transactions can be temporarily managed by reserves of currencies or global lending; but this approach is unsustainable in the long term in the face of ongoing oil price escalations, like those experienced since the year 2023. Authorities might feel compelled to collapse the financial system to diminish bring in demand, especially of oil, which could affect all societal groups (Habiyaremye et al., 2022). Variability can intensify this issue as transient price surges above the pattern are difficult to differentiate compared to the pattern itself, especially if costs do not oscillate within a relatively uniform figure. An escalation within the oil importations could push an authority to take measures due to concerns of its permanence; nevertheless, it may ultimately be revealed that the rise in costs was transient (Bogmans et al., 2024). Consequently, the implementation of a subsidy program may be prompted by a significant increase in prices from a political perspective, such an arrangement cannot be readily rescinded if prices revert to their previous pattern. This is similarly applicable to temporary price declines; such fluctuations can mislead an administration through an inaccurate impression of security, prompting actions it might later rue, such as diminishing efforts to decrease crude oil and energy efficiency (Udeagha and Ngepah, 2022).

Fiscal Surplus or Deficit

Governments covering local oil prices experience fluctuations in prices worldwide that result in corresponding fluctuation in government investment. This situation may result in challenges in

administering budgetary programs, which are often scheduled a year in advance and rely on projections of average oil prices(Jaffe et al., 2023). Transient yet significant increases that are indistinguishable from enduring improvements may prompt a government to alter its budgetary policies due to concerns that the modifications are irreversible.

Domestic Economic Production

Fluctuating oil prices, which may occur without government price stabilisation, have been associated with reduced production. Three reasons seem to account for this relationship. Initially, fluctuation often postpones investment as companies await stabilisation of price levels to validate their investment choices (Anyanwu and Salami, 2021). Second, as oil prices increase, industries with higher oil consumption should experience a reallocation of resources towards those with lower consumption; however, limited labour mobility may lead to joblessness in oil-intensive fields, as displaced employees do not easily transition to alternative industries (Baptista et al., 2022). If actual wages are inflexible downward (they do not decrease even as labour supply diminishes), this will also impede inter-sectoral adjustment. Third, the continual modification of rates as well as production in reaction to fluctuations in labour costs incurs adjustment expenses for companies, hence impeding short-run responsiveness to price fluctuations (Ebner and Iacovidou, 2021). This consequently results in poor output choices, an effect that would be compounded by rising fluctuations in oil prices.

Domestic Conduct

Households experiencing fluctuating prices typically strive to stabilise real spending. Consuming smoothing is the welfare-optimizing reaction to variations in projected revenue or price trends (Ahmed et al., 2023). During periods of elevated oil prices (or other essential consumer items), households may be unable to sustain their investment stages. If families must take out loans or deplete money saved to sustain spending during periods of elevated prices, yet face credit constraints or lack conveniently accessible assets, they will be compelled to curtail consumption, leading to a decline in well-being (Ebner and Iacovidou, 2021). The most disadvantaged households could therefore be particularly negatively impacted by fluctuating prices. The proportion of both immediate and subsequent oil expenses could prove greater for lower income groups compared to those with greater incomes, hence exacerbating the negative impacts of fluctuations in the cost of oil, as their adaptive capacities are limited.

Government Reaction

Numerous governments have endeavoured to mitigate the detrimental impacts of fluctuations in oil prices on their economies. Although these measures aim to transfer dangers to an external entity, the associated expenses will ultimately be absorbed by the budget, so impacting current as well as generations to come of citizens (Ebner and Iacovidou, 2021). The potential compromises of a project like this might prove significant, as well as the benefits of diminished fluctuation may not justify the costs. Furthermore, while the overall balance of transactions or governmental lack is influenced by fluctuations in other sources, concentrating solely on mitigating the impact of unpredictable oil prices could provide only a partial solution. When governments endeavour to transfer the negative impacts of fluctuation from customers to themselves via price stabilisation and similar initiatives, the expenses of such programs will ultimately be incurred through customers as well (Agyei et al., 2022). The impact of altered investment (or tax) policies necessary to cover these budgeting expenses could vary from the effect of fluctuations in prices on consumers, potentially resulting in an allocation of benefit. This impact is particularly evident when oil price stabilisation leads to substantial short-term incentives that advantage consumers in relation to how they use oil, whereas the expenses for the program are allocated among every family via diminished monetary investment (Li et al., 2021).

Research Methods

This study employed the ordinary least squares (OLS) method. In an effort to determine the relationship between government investment, oil revenues, and economic expansion in South Africa, the causation within oil revenues and spending by government has been studied. To conduct the empirical analysis, the variables in the model require to be non-stationary as well as combination of comparable control, or they must remain stationary. Consequently, both the Augmented Dickey-Fuller (ADF) test and the Syed and Bouri (2022) unit root tests were employed to ascertain the prior need to integrate the variables. Two distinct methodologies were employed in the cointegration testing procedure. The possibility of unit roots in the residuals generated by regressions of variables in their respective values was initially explored.

The whole information with the greatest probability of a VECM model, as employed by Uhunamure and Shale (2021), was applied. Additionally, the pairwise causality among the variables, referred to as the Granger causality test was conducted through three essential steps: analysing the time series to ascertain the order of integrating; assessing the long-term neutral connection among both variables; as well as exploring both the immediate and longer-term causal relationships in every pair of variables.

Description of the model

The significance of oil revenue on government spending has been recognised through numerous economic thinkers. The Keynesian model recognises the significant impact of government investment on investment in the economy, whereas classical theory neglects to include public investment as a factor affecting expansion. For example, Li et al. (2021) recognised that making investments in human capital via healthcare and schooling produces advantages that affect oneself as well as the community. He asserted that expansion was associated with the division of labour; nevertheless, he failed to explicitly connect government investment on these essential elements of growth with economic growth. Syed and Bouri (2022)observed that the productivity employees have fluctuates based on their learnt and innate talents, and their compensation reflects these variations. The theory of neoclassical growth asserts that variations in the number of manufactured components are responsible for the expansion of the economy. Evaluate the neoclassical manufacturing operate:

$$Y=f (A, K, L) \qquad\qquad (1)$$

Where Y= result; A= The degree of technology; K = physical capital stock, as well as L= the amount of work. Development happens compared to the buildup of physical capital while an enhancement in workforce with enhanced technical being lacking that work wouldn't be successful. Human capital has become a crucial factor influencing worker efficiency as it enhances the assimilation of modern technology, elevates the rate of innovation, and fosters effective management (Tala and Hlongwane, 2023).

However, for elevated productivity in labour, investing in human capital is a crucial component of technological advancement, referred to as a naturally occurring factor, as the building up of physical capital is augmented through the expertise, abilities, as well as mindsets that are engaged in this endeavour (Iyke and Ho, 2021). Consequently, increased physical accumulation or diminished population expansion results in elevated income levels and, subsequently, enhanced human capital. The equation represents production through an assortment of actual variables; however, it remains feasible to examine the relationship in nominal terms. In this context, we may also address the production process in relation to investment on acquiring inputs, whereby the revenue earned corresponds to the value of output (Y), and the investment on labour, capital, and technology represent the costs of the inputs that produce the final product. This method is a spending strategy for national output. However, equation (1) is transformed into

$$Y=f (eA, eK, eL) \qquad\qquad (2)$$

Where eK represent investment in K, eL denote investment in L, and eA signify investment on A. However, A is consistently regarded as constant, allowing us to divide Equation (2) by eL to yield the effective per capita income (Y) and the effective capital-labor ratio.

Consequently, equation (2) is transformed into

$$Y= ek$$

where the lowercase letter y represents per capita income and ek denotes per effective labour capital. Investment on inputs for variables are conducted by either the private or public sector; therefore,

$$eK= Gek + Pek \qquad (3)$$

G represents government investment, and P denotes private investment in inputs, accordingly. Traditionally, government investment on capital is referred to as investment in capital. Capital investments refer to investment on infrastructure such as transportation, communications, energy, housing, and education, while Pek pertains to investment on investing in capital. Government spending on facilities is contingent upon the degree of economic development and the intent to encourage private investment. Consequently, through reformulating the formula (3) along with integrating the formula (2), we may construct a definition for governmental facilities investment in relation to financial operation, denoted by the income level (y), along with the private funding that government investment on infrastructure is intended to encourage.

$$Gek= f (y, Pek) \qquad (4)$$

The government's capacity to expand is contingent upon its possession of financial resources. Public financing is contingent upon revenue creation. In South Africa, the production of revenue is contingent upon the income derived from the oil sector. The number of barrels released is determined by OPEC, hence the amount made up of oil is contingent upon oil prices. Consequently, oil prices must be specifically incorporated into the theoretical model.

$$Gek= f (RGDP, PCG, OILP) \qquad (5)$$

Where PCG denotes private capital growth, OILP represents the oil price, and RGDP is now substituting y. The initial assumption is that a positive correlation exists between government spending on infrastructures and oil prices. The correlation between government investment in infrastructure and private capital creation is positive. If an overwhelming out impact exists, the connection may be adverse. The model to be utilised will be based on equation (5).

$$GSI= f (RGDP, OILP, GCF, OPEN, FDI) \qquad (6)$$

The model is expressed in log-log form as follows:

$$InGSI= \beta_0 + \beta_1 InRGDP + \beta_2 InOILP + \beta_3 InGCF + \beta_4 InOPEN + \beta_5 InFDI + \mu \qquad (7)$$

GII denotes government infrastructural investment; AGDP refers to actual gross domestic product; OILP signifies the price of South African crude oil; GCF represents gross capital formation as a substitute for private capital investment; OPEN indicates the ability of trade to assess the impact of external variables on government facilities investment; and FDI captures foreign private capital investment. b1, b2, ..., b6 represent elasticities, while l denotes a stochastic error term. Other variables have been established as previously stated.

The data utilised in this research comprises secondary data from 2013 to 2023. All data, with the exception of crude oil, were obtained from the Reserve Bank of South Africa Statistical Bulletin, educational materials, and yearly reports. The price of crude oil is obtained from the Global Energy Agency.

Estimation Approach

The econometric method employed utilises the Johansen maximum likelihood estimation strategy to ascertain the cointegration rank of the model. The preference for a cointegration methodology over standard least squares methods is based on the subsequent considerations:

1. Many time series data are non-stationary, indicating that the assumptions of a constant mean, constant variance, and constant autocovariance for each consecutive lag are frequently flouted, thus rendering the OLS estimation method likely to produce false findings.

2. The cointegration strategy is an effective method for estimating long-term parameters.

3. The cointegration approach offers a direct examination of economic theory and facilitates the application of calculated long-run parameters in assessing short-run disequilibrium relationships.

4. The conventional methodology is critiqued for neglecting the issues arising from the existence of unit root variables in the data-generating process. However, both unit root and cointegration possess significant consequences for the formulation and estimation of dynamic models.

The Test for Stationarity (unit root)

The unit root test precedes cointegration analysis since most economic data demonstrate a non-stationary trend, potentially resulting in erroneous conclusions. A unit root test assesses the non-stationarity of a time series variable via an autoregressive model. The Augmented Dickey-Fuller (ADF) test and the Phillips-Perron test are commonly utilised and valid for large samples. They are utilised to ascertain the integration order of a variable.

The test indicates that if a specific series, denoted as Y, requires differencing n times (where n might be 1, 2, 3, or any integer) to achieve stationarity, then Y is classified to be combined of order n, represented as I(n). If the series is stationary at level, it is classified as integrated of order 0 (I (0)), indicating the absence of a unit root. If a variable differentiates once to achieve stationarity, it is classified as integrated of order 1, denoted as I (1). The test statistic for the estimated coefficient of Y is utilised to evaluate the null hypothesis that the series is non-stationary (possesses a unit root). If the true value of the test statistic exceeds the relative value of the critical value (which may be at 1, 5, or 10 percent), the series is deemed stationary, leading to the rejection of the null hypothesis; otherwise, it must be separated until it attains stationarity.

Johansen Cointegration Test

Cointegration posits that there is a long-term movement among trending economic data, indicating a common equilibrium relationship to which the time series tends to revert; thus, despite particular time series being non-stationary, a stationary linear combination may exist among them. Many economic series exhibit characteristics of I (1) procedures, indicating they tend to diverge rapidly but not excessively. The Johansen test, derived from Soren Johansen, is a method for assessing the cointegration of I (1) time series. This test allows for several cointegrating connections, making it more useful than the Engle-Granger test, which depends on ordinary least squares (OLS). The Johansen test comprises two variants: the Trace statistic and the Maximal Eigenvalue statistic, both of which are utilised to determine the cointegration rank or the number of cointegrating vectors. Both tests may not consistently yield identical quantities of cointegrating vectors.

Result and Discussion

Trends in oil price fluctuations and facilities investment in South Africa

The analysis commences with an evaluation of a pattern in fluctuations of the oil price, as indicated by fluctuations in crude oil prices, alongside alterations in facilities investment. Except for 2013, when facilities investment was comparatively elevated and not significantly linked with government investment on infrastructure, a notable consistent pattern emerges throughout the years (Evans, 2024). In the beginning of the 2013s, facilities investment escalated not solely due to rising oil prices, but rather because of the financial and societal imperatives of the era. It was the following the war duration, and numerous structures had been repaired and newly built.

Consequently, during the early 2013s, facilities investment exhibited a slightly greater inflation rate in relation to fluctuations in oil prices. The majority of investment throughout this time frame were enabled by monetary support (Tambari et al., 2024). Nonetheless, this pattern altered in 2013 as oil prices surged through roughly 150 percent, resulting in a substantial increase in Federal Government revenue. This provided a strong impetus for the government to increase its investments in infrastructure. This trend persisted throughout the 2013s. The oil surplus of the 2023s impeded infrastructure investment in South Africa. The authorities resorted to obtaining to support the wages of employees in the 2013s. By the mid-2013s, specifically in 2018, numerous government-funded construction initiatives were discontinued due to a decline in oil revenues, rendering infrastructure development a significant issue(Almasria et al., 2024) .

The 2020s seen an increase in oil prices, resulting in raised revenue. One would anticipate that infrastructural investment would rise concurrently with the increase in oil revenue resulting from the escalation in oil prices. This was not destined to occur. The 2020s experienced a disregard for infrastructure improvement, as the majority of allocations during this period were directed towards upkeep investment, with insufficient focus on the construction of new facilities. During this time, investment in facilities remained to drop until the 2000s. Another notable phase of rising oil prices and less commensurate increases in infrastructure spending occurred in the 2020s. As the percentages allotted to infrastructure spending continued to decline, the 2021 oil price collapse dealt a serious hit to the construction industry (Jiang et al., 2024).

Correlation analysis

To elucidate the link involving crude oil fluctuation and the levels of crude oil and government expenditure, a correlation study was conducted through the growth rates of the variables, with the results shown in Table 1. The correlation study indicates that the growth rate of government expenditure is favourably connected with fluctuation in crude oil prices, but the development rate of government expenditure on infrastructures is adversely correlated with actual economic expansion. All other factors also show a positive link with government expenditures in infrastructures. A significant finding in the second correlation study is the reduced value of the correlation coefficient. This outcome is anticipated, given the trend and changes in the seasons that have been considered.

Causality analysis

The correlation between crude oil price movements and government facilities investment was examined through causality testing. Table 2 displays the causality outcomes exclusively for those that are important. The causality test indicates that crude oil prices significantly influence investment on government in South Africa; conversely, a rise in government infrastructure investment does not result in increased crude oil prices. This is anticipated, given that the determinants of crude oil prices are external to the economy, whereas those variables affecting government investment on infrastructures encompass both internal and external elements. Although government facilities investment is unrelated to crude oil prices, it possesses a substantial relationship with actual gross domestic product, indicating that improving infrastructure is crucial for growing the economy in South Africa.

Table 1: Correlation between fluctuations in crude oil prices and increases in facilities investment

	D(LGSI)	D(LOILP)	D(LRGDP)	D(LAID)	D(LFDI)	D(LOPEN)
D(LGSI)	1.00					
D(LOILP)	0.01	1.00				
D(LRGDP)	-0.03	0.11	1.00			
D(LAID)	0.02	-0.9	0.01	1.00		
D(LFDI)	0.02	-0.7	-0.05	-0.22	1.00	1.00
D(LOPEN)	0.03	0.18	0.01	0.04	0.16	1.00

Table 2 Pairwise Granger causality tests

Null hypothesis	Obs	F-Statistic	Prob.
LOILP does not Granger effect LGSI	42	3.85	0.0110
LGSI does not Granger effect LRGDP		2.36	0.0280
LOILP does not Granger effect LRGDP		4.09	0.0085
LFDI does not Grander effect LAID	42	4.55	0.0051

A significant finding from this causality analysis reveals that crude oil prices influence government investment, which in turn influences facilities investment, thereby establishing that crude oil prices directly impact economic development via government facilities in South Africa. Consequently, the impact of crude oil fluctuation is transmitted to actual economic growth via alterations within government facilities investment in South Africa. It is being shown that crude oil prices have a considerable causal link with actual gross domestic product, indicating that crude oil exerts a dual impact on economic expansion. The immediate consequence pertains to the impact on the generation of actual results, while the longer-term impact relates to government facilities investment. Of the additional variables incorporated in the model, only foreign direct investment and foreign aid exhibit a substantial related impact. The causal relationship between the two could result from the association of certain foreign direct investment with foreign aid, as well as the linkage of specific support with an influx of foreign direct investment.

Time series characteristics of the variables

Given the instability and non-stationarity of macroeconomic variables, it is essential to conduct diagnostic tests to verify their characteristics. Two prevalent tests in the literature are the unit root test as well as cointegration testing.

Unit Root Test

The unit root test, as previously mentioned, is conducted utilising the enhanced Dickey-Fuller (ADF) test. The test results are displayed in Table 3. The outcomes indicate that none of the variables were steady with respect to their original versions. It all remains motionless at the initial change. This indicates the fact the variables can just be integrated into the model for estimation while represented in increasing representations.

Table 3 Outcomes of ADF unit root tests

Series	Levels	Initial differentiation	Remark
LGSI	0.288	-6.25	I (I)
LRGDP	-1.317	-5.725	I (I)
LOPEN	-1.995	-8.168	I (I)
LAID	-0.856	-5.804	I (I)
LFDI	-0.823	-9.251	I (I)
LOILP	0.654	-5.776	I (I)
Critical Values			
1%	-2.446	-2.455	

5%	-1.825	-1.805	
10%	-1.485	-1.485	

Cointegration Test

The cointegration test was conducted via the Johansen multiple equation methodology. Table 4 presents the results of the Johannsen multiple equations. The outcomes indicate the existence of at least one cointegration equation involving government investment on facilities and oil prices, along with additional variables incorporated in the model. The initial section of the table summarises all potential methods for doing cointegration analysis applying trace and eigenvalue statistics. The two statistics verified the existence of at least one cointegration among the variables. This further evidence suggests a long-term link between the variables.

Variance Decomposition

The variance decomposition is additionally calculated. This measures the extent to which the independent factors account for the variation in the dependent variable. This assesses the corresponding impact of oil price fluctuations and foreign direct investment on variations in government facilities investment. Table 5 indicates that oil price shocks accounted for a greater share of the fluctuation in government facilities investment, almost 13 percent, compared to the 5 percent attributed to foreign direct investment. This indicates that oil price fluctuations significantly influence government facilities investment in South Africa.

Outcomes of the Impulse Response

The alternative estimation conducted is the impulse response. The impulse response assesses the degree to which a shock in oil prices influences government investment on infrastructure.

Table 4 Johansen cointegration tests

Series: LGSI LOILP LRGDP LAID LFDI LOPEN					
Selected (0.05 Level*) Number of Cointegrating Relations by Model					
Data Trend:	**None**	**None**	**Linear**	**Linear**	**Quadratic**
Test type	No Interceptions	Interceptions	Interceptions	Interceptions	Interceptions
	No Trend	No Trend	No Trend	Trend	Trend
Trace	3	1	1	1	1
Max-Eig	1	1	1	1	1

Series: LGSI LOILP LRGDP LAID LFDI LOPEN				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesised No. of CE (s)	Eigenvalue	Trace statistic	0.05 Critical value	Prob.†
None‡	0.759215	135.4345	126.6171	0.0187
At most 1	0.477841	79.85685	99.91241	0.6354
At most 2	0.425375	53.74886	64.96521	0.8512
Unrestricted cointegration Rank Test (Maximum Eigenvalue)				
Hypothesised No, of CE (s)	Eigenvalue	Max-Eigen statistic	0.05 Critical value	Prob.†
None‡	0.759215	44.24767	33.38112	0.0012
At most 1	0.477841	19.01371	27.11354	0.4805
At most 2	0.42375	12.88412	24.22721	0.5414

The trace test reveals one cointegrating equation at the 0.05 significance level.

The max-eigenvalue test suggests 1 cointegrating equation at the 0.05 level.

1 Cointegrating Equation(s): Log likelihood = -79.58718.

*Critical values derived

† p-values.

‡ Rejection of the hypothesis at the 0.05 significance level

This impulsive response indicates that government investment on facilities favourably reacts to fluctuations in crude oil prices. This indicates that oil price shocks have a lasting effect on government investment for facilities in South Africa. The impact of oil price shocks is more pronounced and lasts longer than the effects of foreign direct investment (FDI).

Table 5 Variance decomposition

Period	S.E	LGSI	LOILP	LFDI
1	0.441515	100.0000	0.000000	0.000000
2	0.575486	78.08657	10.25442	3.654825
3	0.752001	74.77045	11.55845	4.521452
4	0.982016	72.25452	12.25465	5.254752
5	0.995243	71.88524	12.52133	5.356465
6	1.125423	71.42548	12.72154	5.521425
7	1.248564	71.35457	13.15457	5.625425
8	1.354256	71.12455	13.35458	5.725145
9	1.372548	71.10245	13.54212	5.752120
10	1.425482	70.95421	13.72451	5.775425
Cholesky Ordering: LGSI LOILP LFDI				

Conclusion

The primary aim of the research was to analyse the impact of oil price fluctuations on facilities investment in South Africa, utilising annual time series data from 2013 to 2023. The analysis of trends indicates that oil prices and government facilities investment exhibit concurrent fluctuations, with the impact of oil price fluctuation being more prominent throughout the 2013s and 2018s. It has been noted that despite a significant rise in oil prices during the 2020s, the subsequent rise in government investment on facilities hadn't been commensurate. The correlation analysis indicates that the increase of investing by the government has a beneficial correlation via fluctuation in crude oil prices, whereas the rising rate of government investment on infrastructures has a negative relationship with actual economic expansion. The data indicates that crude oil prices significantly influence government infrastructural investment in South Africa. The impulse response indicated that the influence of crude oil price shocks is significant in the near term and remains consistently elevated in the long term, suggesting that the effects of crude fluctuations in oil prices may endure through the years to come. The breakdown of difference additionally confirms that fluctuations in government investments on facilities are potentially linked to oil price fluctuations, as a significant percentage of the variation in facilities investment is elucidated by crude oil prices in South Africa. The empirical findings indicate that the government should prioritise infrastructural investment over recurring investment. The observation that domestic macroeconomic considerations do not influence oil prices, yet oil prices impact investment by the government indicates that the government must acknowledge its limited authority over revenue. Ultimately, the government must endeavour to explore alternate financing methods for infrastructure, as the fluctuation of oil prices renders reliance on uncertain revenue sources an embarrassment of the goal to achieve infrastructural adequacy.

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