Received: 24 July 2020 | Revised: 14 August 2020 | Accepted: 16 September 2020

DOI: 10.1002/bsd2.156

SPECIAL ISSUE ARTICLE

Business Strategy and Development

WILEY

# Analysis of the determinants of public capital investments on agricultural water infrastructure in Eswatini

**Sibusiso Nhlengethwa | Greenwell Matchaya | Ikhothatseng Greffiths | Bhekiwe Fakudze**

Economics Research Group, under the Water, Growth and Inclusion Strategic Program, at International Water Management Institute (IWMI) Pretoria, South Africa

**Correspondence**
Sibusiso Nhlengethwa, Economics Research Group, under the Water, Growth and Inclusion Strategic Program, at International Water Management Institute (IWMI) Pretoria, South Africa.
Email: s.nhlengethwa@cgiar.org

## Abstract

Infrastructure investment is one of the main preconditions for enabling developing countries to accelerate or sustain the pace of their development and achieve the Sustainable Development Goals. This paper examines the determinants of agricultural water infrastructure investments in the Kingdom of Eswatini. Using annual data (time series); Pearson Pair-wise Correlation, Unit-root tests and OLS regression techniques are applied to determine the relationship between public infrastructure investment and factors that influence public investments. Agricultural water infrastructure investment is found to be positively correlated to GDP, Sugar export income and FDI into agriculture. Past economic growth and sugar export values are the two critical determinants of agricultural water infrastructure investments in Eswatini. It can be safely construed that higher incomes as well as terms of trade for sugar, can improve spending on agriculture water investments. This is important because an increase in investments in water infrastructure may then help spur economic growth.

**KEYWORDS**

economic growth, public infrastructure, public investments, sugar sector

## 1 | INTRODUCTION

In Sub-Saharan Africa water infrastructure is afflicted by under-investment, this has greatly affected portable water supply let alone agricultural water supply (African Development Bank [AfDB], 2018). Infrastructure investment is amongst the foremost enabling prerequisites for developing countries to fast-track or to sustain the pace of their development whilst simultaneously allowing them to achieve their Sustainable Development Goals (SDGs) (UNCTAD, 2016). The significance of infrastructure investment to the socio-economic progress of a country cannot be overstated (Global Infrastructure Hub, 2017). Inadequate or underwhelming infrastructure limits the general publics' access to markets, as well as income opportunities and services such as clean water, education, health, transport and communication (ILO, 2010). Aschauer (1993) argues further by stating that public infrastructure such as road networks, railways, water and sewer systems and the like should be considered as a factor of production, along with labour and private capital, in the economic development process. Therefore, to raise productivity growth countries must boost the rate of both tangible and intangible capital accumulation such as plant, equipment, research and development expenditures. Scaling up infrastructure investment is thus generally perceived as a spine in national development strategies of emerging economies (Atolia, Li, Marto, & Melina, 2017).

Most African countries including Eswatini have agriculture driven economies hence they are all working towards expanding irrigated agriculture to enhance agricultural productivity and to also expand the agriculture-based industry and exports. Currently, in Sub-Saharan Africa, the area under irrigation is less than 3% of agricultural land. However, the pressing need for social investments (which are meant to mitigate hunger) overtakes the essence of investing in infrastructure that would take years to yield the required instant results of curbing poverty and hunger (AfDB, 2018). In congruence with the aforementioned assertions, Eswatini has made agricultural water infrastructure to be at the core of the agriculture sector performance. This consequently implies that agricultural water infrastructure investment has a critical

  

influence towards the economic growth and development of the country (Strategy for Sustainable Development and Inclusive Growth [SSDIG], 2016). This makes it imperative for Eswatini to emphasize agricultural water infrastructure investment because of its direct influence on the economic development, food security and livelihood of *Emaswati* (Swazi people). Agricultural water infrastructure investments are prominently known to be pivotal for ensuring food supply to cater for the growing population, increase water conservation and reduce environmental costs for agricultural production (World Bank, 2019). The abovementioned aspects are thus designated as the leading demand factors to invest in agricultural water infrastructure. The World Bank together with the African Development Bank (AfDB) advocated for infrastructure investment especially in the agriculture sector to drive the economic growth in Eswatini (AfDB, 2020; World Bank, 2020). In retrospect, the determinants of agricultural water infrastructure investments are diverse and differ from one country to another and from one economic region to another and so forth. Having confirmed the abovementioned aspects as the key leading demand factors to invest in agricultural water infrastructure in Eswatini, the same cannot be said about the determinants of agricultural water infrastructure investment. This paper, therefore, seeks to ascertain the determinants of agricultural water infrastructure investment in the Kingdom of Eswatini.

Although some of the literature identifies several factors that may drive infrastructure investments, there are disagreements on which sets of determinants are important for which conditions and over what type of period. Thus, the determinants of infrastructure are an empirical question. The paucity of studies to this extent focusing on Eswatini further implies that studying this important question within a focus on Eswatini is critical for context-specific policy guidance. Withstanding the fact that Eswatini has made water infrastructure investment with special reference to agriculture a priority through the SSDIG it thus also makes it imperative to look into the determinants of water infrastructure investment in Eswatini. Hence the objective of this paper is to investigate the factors influencing agricultural water infrastructure investments in Eswatini; these investments are meant to enhance agricultural productivity which would in turn consequently augment economic development of the country.

The rest of this paper is structured as follows; the next section presents a discussion on the economic theory on public infrastructure investments and Its determinants (literature review); followed by a discussion on Eswatini's microeconomic performance and capital spending; then a discourse on public sector infrastructure investment patterns in Eswatini; subsequent to this section is a discussion on the methodology employed by this study; then the results and discussion; and finally the last section is the conclusion.

## 1.1 | Economic theory on public infrastructure investments and its financing

Infrastructure provides a foundation for nation building (social and economic development) (AfDB, 2018). These sentiments are also echoed by Nannan and Jianing (2012), they found that public infrastructure is meant to deliver the basic framework for a country to support essential public service in order to get higher economic growth and a better quality of life. The lack of infrastructure such as water, power and transport services has been noted to be one of the major barriers to industrialization in Africa. According to economists at the African Development Bank, Industrialization (mechanization and technology use) is key to ending poverty and generate employment for over 12 million young people in Africa (ADB, 2018). Jedwab and Storeygard (2016) echo these sentiments by further stating that socially, infrastructure investment leads to increased access to essential services which are meant to reduce inequality, foster inclusion and support poverty reduction efforts. In most cases, the poorest communities benefit the most from public infrastructure development because it brings basic amenities and employment right to their door step and thus improving their standard of living (Baum-Snow, Henderson, Turner, Zhang, & Brandt, 2017). However, despite the above proclamations, the association between public infrastructure investment and economic development is an attention-grabbing subject in Southern Africa. This is because of two key reasons; first, the structural adjustments adopted by countries and their development partners that have cut back on infrastructure investments despite their potential long-term benefits; and second, the drawbacks that have been brought by inefficiencies and corruption in public infrastructure investments in these countries (IMF, 2017 and AfDB, 2018). This is notwithstanding fact that infrastructure investment is one of the key economic development pillars of the Southern Africa Development Community (SADC, 2017).

Public infrastructure is arguably a significant input into the national production function thus it is argued that there is a need for greater spending on public capital. The economic impact of Africa's inadequate and inferior infrastructure is significantly high; poor infrastructure shaves off up to 2% of Africa's per capita growth rate. Good public infrastructure has been noted to globally enable 8–10% of FDI inflows to countries. Despite infrastructure in developing countries being primarily government responsibility, it has been noted that in middle-income countries like Eswatini public infrastructure investment draws roughly between 30–35% of Public Private Partnership (PPP) Projects in infrastructure development compared to about 1–4% in low-income countries (AfDB, 2018). Bearing this in mind most economists concur that public capital investment can expand the productive capacity of an area or place (Cavallo & Daude, 2011). In the same vein, public capital investment enhances the productivity of private capital, raising its rate of return and encouraging more investment. Cohen and Morrison-Paul (2001) stated that the extent and worth of public infrastructure investment influence the costs and efficiency of private investments, and consequently on economic vigour and development. This in turn has brought about postulations that a 10% growth in infrastructure endowment increases output per worker by about 1% in the long run (Calderon, Moral-Benito, & Serven, 2015). In a nutshell, infrastructure investment shapes economic activity in a country because it can produce long-standing economic improvements by reducing trade costs and integrating markets, possibly changing the economic setting in poor, remote regions with high trade costs (Gurara, Klyuev, Mwase, &

Presbitero, 2018). Despite the flurry of evidence with regards to long-term gains from public infrastructure investment, there is also evidence that throws caution against the wind. In the 1980s, a surge of public-financed infrastructure investment delivered poor results in terms of short and long-run economic growth, this was typically due to over-spending, corruption and poor maintenance (Arezki, Bolton, Peters, Samama, & Stiglitz, 2017). This suggests that there is no guaranteed assurance of public infrastructure investment's effectiveness and efficiency; therefore, these can be achieved through appropriate institutions and policies.

The aforementioned findings imply that African countries need to accelerate their investment in infrastructure in a smarter way. With that being said, countries should, therefore, invest in public infrastructure where they have comparative and competitive advantages (Kodongo & Ojah, 2016). The public infrastructure herewith referred to in the African context includes; sea ports, hydro-electric and irrigation dams and so forth. Infrastructure affects productivity and directly as part of GDP formation and as an input to the production function. Having taken cognisance of the need and the role of public infrastructure investments in developing countries it is thus inferred upon policymakers to enact policies that are meant to increase public spending on infrastructure which would in return boost economic development; these sentiments or policies are also echoed by the IMF, World Bank and the AfDB (AfDB, 2018; IMF, 2020; Sturm, 2001; World Bank, 2019).

Against the aforementioned background that depicts the significance of public infrastructure investments and their role in economic development, it is imperative to then discuss at length how it is financed (in other words, discuss the determinants of public infrastructure investments). Sturm (2001) argues that the principles that drive private infrastructure investment in less developed countries are similar to those applied in public infrastructure investment. These principles are also confirmed by Levine and Renelt (1992); Sala-i-Martin (1997) and; Strum and De Haan (2000). One of the principles is that economic growth has a significantly positive and robust influence on infrastructure investment. In fact, the ratio to GDP of total investment is among a few variables that are robustly correlated with economic growth for a number of less developed countries. Secondly, increases in national debt (debt crisis i.e., debt overhang hypothesis) adversely influence investments. Studies carried out in Africa, Asia, the Middle East, Latin America and the Caribbean Islands depict that disparities in infrastructure investment can be clarified by the discrepancies in the macroeconomic environment, quality of governance and the government's financial capacity (Arimah, 2005). Sturm (2001) and Khumalo (2016) concur that infrastructure development in developing countries is funded through public expenditure of which a portion of the infrastructure investment is financed through loans or national debt. However, national budgets can be constrained by government debt ceiling (IMF, 2017). Gupta, Clements, Baldacci, and Mulas-Granados (2006) investigated the relationship between national budgets, their composition and economic growth; the findings showed that national budgets leaning more towards infrastructure investments are vital for economic growth thus government expenditures that lead to higher economic growth must be promoted and protected.

Furthermore, empirical evidence from studies conducted by IMF (2017); Beaton et al. (2017) and; Calderón and Servén (2004) supports the theorem and contentions of a significantly positive relationship between economic growth and infrastructure investment. Hence, it is probably to state that higher GDP accruals tends to increase public spending on infrastructure. This is confirmed by the findings of Cerra et al. (2017); they argued that country revenue surpluses tend to increase infrastructure investment. The inference thereof is that the overall influence of public investment on infrastructure hinge on how it is financed that is, new debt, tax increases or spending cuts or loans. To add on this, Helm (2009) stated firmly that the management and regulatory environment of public infrastructure provides an enabling environment to lure private investment through FDI into infrastructure development in developing economies. De Haan, Sturm, and Sikken (1996) and Sturm (1998) concluded that stints of economic severity and recurrent changes in government are associated with low public investment and that movement in public investments tend to follow those in private investment. According to Dao's (2008) hypothesis, the infrastructure indicator in a developing country is a function of the following factors; public pension expenditure as a share of GDP, public spending on education as a share of GDP, public spending on health as a share of GDP, public savings as a share of GDP, civil service wages as a share of GDP and private infrastructure spending as a share of GDP. Khumalo (2016) added interest rates and inflation rates as factors to infrastructure investment. Galí and Perotti (2003) also confirmed that public debt plays a significant role in determining infrastructure investment. They further contended that GDP per capita, GDP trend, long-term interest rates, total revenue and current expenditure influence infrastructure investment. Sturm's (2001) hypothesis on unemployment rate, interest rate, inflation rate, GDP growth, budget deficit and government debt/loans as significant economic factors influencing public investment were also echoed by both Khumalo (2016) and Dao, 2008). Turrini (2004) found that public investment (as a percentage of GDP) increases with GDP growth (in real per capita terms) and it declined with increases in public debt.

A summary of the contributing factors to infrastructure investments (explanatory variables) was classified into three by Kirchgassner and Pommerehne (1988) and Sturm (2001) (see Table 1 below).

These variables were used to test *Wagner's Law* which stresses the transformation of traditional societies into industrialised societies with their shift from the family to the public sector of services that is, education and health care (Lybeck, 1988). The hypothesis thus state that a larger degree of urbanization leads to less demand for infrastructure in rural areas at the same time the development of rural infrastructure in rural areas can halt urbanization (urban migration). However, population growth might increase the demand for infrastructure.

Public investments are expected to be restrained by escalating inflation rates whilst unemployment may prompt more public infrastructure investment (Sturm, 2001). Higher budget deficits or government debt curtail government infrastructure investment. Private investment towards infrastructure investment is thought to prompt more public investment or it can substitute for public infrastructure investment. Foreign Aid (ODA) is intended to create an enabling

**TABLE 1** The three sets of determining factors

| Structural variables | Economic variables | Politico-institutional variables |
|---|---|---|
| Degree of urbanization and population growth | Real economic growth, government budget deficit, government debt, interest payment, private investment, foreign openness to trade, foreign direct investment | Ideology, election cycle, coalition variables, economic and political freedom, political stability |

*Note:* Source: Sturm (2001) and Kirchgassner and Pommerehne (1988).

environment for sustainable economic growth (in short prompt more infrastructure investment). De Haan et al. (1996), De Haan and Sturm (1994), Oxley and Martin (1991), concurred that politico-institutional variables depict that socialist governments tend to increase public infrastructure expenditure when compared to right-wing government.

Debt ceilings are meant to control the level of country debts but this is a constraint to fiscal budgets; this is the main sources of public infrastructure investment. Therefore, governments find themselves with an ever-increasing infrastructure deficit because they cannot increase public investments due to budget caps/shortfalls or budget deficit (Khumalo, 2016). Sahoo and Dash (2009) found that there is a causality effect (positive relationship) between infrastructure investment and GDP growth. With regard to total government revenue; it is noted that it indicates the ability to fund infrastructure investment because domestic budgets mainly fund public infrastructure (Arimah, 2005). This simply implies that infrastructure investments tend to increase with increases in government revenue.

In a nutshell, the economic theory on public infrastructure investments and its determinants shows that in a much as economic growth (GDP) influences infrastructure development, infrastructure investments also stimulate economic development. In developing countries, public spending is crucial for infrastructure investment. The main factors influencing infrastructure investment are classified into three categories; structural, economic and polito-institutional variables. Furthermore, countries should invest on industry infrastructure where they have competitive and comparative advantage.

## 1.2 | Eswatini macroeconomic performance and capital spending

The economic theory above has unequivocally emphasised the importance of a country's macroeconomic performance in influencing public infrastructure investments. This section thus looks at the macroeconomic performance of Eswatini and how it has impacted the country's capital investments. In the past decade and a half, the economic stability in Eswatini has been hinging on the services, manufacturing and agriculture sectors. Consequent to the severe economic decline in 2010, Eswatini experienced a period of macroeconomic volatility (IMF, 2020). In light of the above, to mitigate these circumstances the country embarked on a fiscal consolidation through a temporary rebound in Southern Africa Customs Union (SACU) revenue, and enhancing the credibility in the peg with the South African rand. However, deteriorating private investment and dwindling external competitiveness have kept growth below the pre-2010 period and are encumbering the long-term growth prospects of the economy (AfDB, 2020). The fiscal situation has remained weak since the worldwide financial crisis of 2008–2010 compounded by the severe drought in 2015–2016 and this has led to budget deficits estimated to be around 8% of the GDP in 2019 from 6.5% in 2018. Low revenues are outpaced by elevated expenditures, particularly transfers, the public sector wage bill and capital outlays (World Bank, 2020). The IMF (2020) Eswatini country report also echoed that public spending has remained elevated despite low SACU revenues and expansionary budget policies hence widening the fiscal deficit to an annual average of 9% of the GDP. Public debt has risen sharply and rapidly (30% of GDP thus raising sustainability concerns), and financing constraints have led to the accumulation of domestic arrears. The grim picture created by the IMF, World Bank and AfDB has led to the country developing mitigating strategy derived from the SSDIG (2016). The country with the assistance of the aforementioned institutions has prioritised infrastructure development, heightened attempts to improve the business environment, including the revision and introduction of new legislation. These endeavours are meant to harness new growth opportunities, make the country to be more competitive particularly in SACU and SADC.

Delving into the public capital spending of Eswatini in the agriculture sector, it is worth comprehending that over the past two decades there have been four major public agriculture expenditures namely; (a) Capital Expenditure, (b) Goods and Services (operational expenditure), (c) Personnel Emoluments and, (d) Subsidies, Grants and Social Benefits (Musaba et al, 2014). During the aforementioned period, personnel emoluments have the largest share of the public agriculture expenditure (on average slightly above 40%), followed by capital expenditure averaging around 30% (inconsistent spread over the 20 years), then goods and services at 27% and last subsidy payments at 3% (These expenditures reveal that priority was and has been accorded to personnel emoluments and goods and services simply because capital expenditure has been very inconsistent and declining over the same period. With regards to agricultural expenditure by core function, agricultural extension has been consistently receiving a higher share averaging 35%, followed by irrigation and infrastructure with an average of 18% (this share has been consistently growing at a 10% rate over the two decades). Research and Development follows with a share of 9%. It should be taken into cognisance with grave concern that budget execution rates in the Ministry of Agriculture are low ranging from 85 to 90%.

The afore-discussion paints a clear picture that Eswatini's economic growth needs urgent resuscitation because it has been in a downward spiral. Furthermore, dissection of the capital spending shows that infrastructure investment has been very inconsistent and

that itself has not been helping the country's course to improve its microeconomic performance. Further, asserting the necessity for water infrastructure investment to boost the economic growth.

### 1.3 | Public sector infrastructure investment patterns in Eswatini

Having noted that the macroeconomic performance of the country has been lethargic and thus GDP accruals have been quite scanty. It is for this reason that infrastructure development in Eswatini is funded through credit enhancements/facilities (large loans) from the African Development Bank (AfDB), European Investment Bank, the Arab Bank for Economic Development in Africa (BADEA) and the Kuwait Fund. Eswatini still needs to intensify investments in infrastructure (i.e., transport, telecommunications and electricity) that would ease the cost of doing business. Despite the middle-income status and large infrastructure investments (echoed by the 73 out of 144 countries Global Competitive Index ranking on the quality of infrastructure), Eswatini still faces bottlenecks in all kinds of infrastructure (ADB, 2018). Lagging behind is the investment in electricity infrastructure investment because the country on generates 10% of the needed power thus the country is highly dependent on imported power from South Africa (80%) and Mozambique (10%) (Khumalo, 2016). In light of the electricity conundrum faced by South Africa is imperative that Eswatini starts investing in renewable energy generation capacity, and this will be consistent with green growth objectives, to avert potential future shortages.

The second least public sector investment goes towards telecommunication infrastructure (ICT); this sector is characterised by the existence of monopolies in the fixed telephone network (Eswatini Post and Telecommunications Corporation) a government parastatal and recently diversified mobile telephone network (Eswatini MTN and Eswatini Mobile). Mobile Network coverage has been steadily increasing in the country however fixed network coverage still stand at 4 fixed lines per 100 inhabitants (EEPARC, 2017). Transport infrastructure is the third least investment done by the Eswatini government; 58% of the national road network is in good condition bearing in mind that about 75% of the goods within the country are transported through the road network with rest through rail (ADB, 2018). The highest portion of public sector infrastructure investment goes to water and sanitation (this includes agricultural water infrastructure). Access to clean water supply stands at above 85% whilst access to sanitation stands at 70%. Irrigation has increased significantly through construction of the Maguga dam that feeds the Komati Downstream Development Programme (KDDP) and the Lubovana dam that feeds the Lower Usuthu Smallholder Irrigation Project (LUSIP) (SSDIG, 2016).

From the above discourse, Eswatini's infrastructure investments are evidently funded through international credit facilities and that investment patterns portray that agricultural water infrastructure are a priority followed by transport infrastructure, then ICT infrastructure and lastly electricity infrastructure. This further asserts that the country has a comparative and competitive advantage in the sugar cane production hence the elevated or rather enhanced investments in water infrastructure.

## 2 | METHODOLOGY

This is a descriptive empirical research paper based on collection and analysis of both qualitative and quantitative secondary data. The data collected and used for analysis is time series data of economic variables and descriptive variables which explicably explain the enabling environment for public infrastructure investments. It is, therefore, worth mentioning that from the afore-discussed economic theory on public infrastructure and its financing, the theoretical possibilities regarding the identification of the factors influencing agricultural water infrastructure investments can be empirically estimated based on a time-series approach and deductions from the OLS estimators used by Agénor and Neanidis (2015), Khumalo (2016), and Calderon & Serven (2010). The variables in their models include the following; GDP, interest payment, government debt, government budget deficit, FDI, openness to trade, annual inflation rates, GDP growth and so forth. The weakness of their models is that there is a high possibility of cointegration amongst some of the independent variables that is, government debt and government budget deficit. These models do not cater for Wagner's law. It also does not address the influence of other competing infrastructure investments that is, education and health public expenditure. The issue of cointegration, and the inclusion of variables like interest rates and other competing infrastructure investments are catered for in the model and analysis undertaken in this paper. It is also worth noting that structural and politico-institutional variables dissected in this paper satisfy Wagner's law.

The analytical framework adopted by this paper first uses quantitative descriptive analysis to determine the relationship between public infrastructure investment and factors that influence public investments provides the empirical evidence. This evocative analysis is based on the use Ordinary Least Squares (OLS). Before conducting the OLS regression, Pair-wise Pearson Correlation (10%) are computed to determine the factors that have partially stronger relationship with infrastructure investment.

The unit root tests (Augmented Dickey Fuller Test and Phillips-Perron Test) were used to determine the stationarity of the time series data used in this analysis to avoid running spurious regressions. Since the data used in this analysis is an economic and financial time series data it, therefore, exhibits trending behaviour or non-stationarity in the mean. It is thus required that the data be transformed to stationary prior to further analysis. The Null Hypothesis is that either of these variables (infrastructure investment, GDP, sugar export value, FDI into agriculture, government debt, government savings, health expenditure, interest rates and inflation rates) follow a random walk with a possible drift while the Alternative Hypothesis is that either of the aforementioned variables is stationary around a linear trend.

Ho: $\varphi = 1 => Yt \sim (1)$ with a drift.

H1: $|\varphi| < 1 => Yt \sim (0)$ with a deterministic time trend.

The Pearson pairwise Correlation (10%) was used to determine the relationship between the infrastructure investment and the following indicators/factors in the estimated model below;

$$Y_t = \beta_0 + \beta_1 \text{GDP} + \beta_2 \text{AgGDP} + \beta_3 \text{FDI} + \beta_4 \text{ODA} + \beta_5 \text{Sugar} + \beta_6 \text{Debt} + \beta_7 \text{Sav} + \beta_8 \text{Edu} + \beta_9 \text{Health} + \beta_{10} \text{Int.Rate} + \beta_{11} \text{Infl.Rate} + \mu,$$

where Yt = Infrastructure Investment, GDP = GDP (Constant $ 2010), AgGDP = Agriculture GDP, FDI = FDI to Agriculture, ODA = ODA to Agriculture, Sugar = Sugar Exports, Debt = Government Debt, Sav = Government Savings, Edu = Education Expenditure, Health = Health Expenditure, Int. Rates = Interest Rates, Infl. Rate = Inflation Rate, (all the other dependent variables are computed as a share of GDP). The expected signs given the theory and literature surveyed are that FDI, ODA, GDP, Sav and AgGDP will have positive coefficients, while Government Debt, Health Expenditure, Education expenditure, Interest Rates and Inflation Rate will have negative coefficients implying that they depress investments in water infrastructure success.

The model is estimated using a short time series data for Eswatini during 2000–2017. Data source for the agriculture water infrastructure investment, education expenditure and health expenditure is Ministry of Finance (2019); GDP (constant $ 2010) and agricultural GDP were sourced from the ReSAKSS database (2019); the Central Bank of Eswatini (2019) provided data FDI to agriculture, ODA to agriculture, interest rates and inflation rates; Eswatini Sugar Association (2019) provided data on sugar export values; and the World Bank (2019) provided data on government debt and government savings.

## 3 | RESULTS

### 3.1 | Correlation result of variables

Table 2 depicts that Agricultural Water Infrastructure Investment is correlated (at 10% significance level) to GDP (41.3%), Sugar Export Value (40.6%), FDI into Agriculture (59.1%), Government Debt (−50.1%), Health Expenditure (−49.6%), Government Savings (42.6%), Interest Rates (−51.6%) and Inflation Rates (−46.8%). It is also worth noting that GDP, Sugar Export value, FDI into agriculture and Government Savings are positively correlated to infrastructure investment whilst Government debt, Health Expenditure, Interest Rates and Inflation Rates are negatively correlated infrastructure investment. The above notations and statistics were as expected are aligned to what Agénor and Neanidis (2015); Calderon & Serven (2010); Khumalo (2016); Sahoo and Dash (2009); and Sturm (2001) found in their studies; that the above factors have an influence on infrastructure investment.

### 3.2 | Augmented Dickey-Fuller and Phillips-Perron tests

In order to avert spurious regression results, it was essential that the economic data (which is most certainly non-stationary) in this analysis be differenced and thereafter use the unit root tests (ADF and PP) to ascertain stationarity (see Tables 3 and 4). The differenced data will thereafter be used in the OLS regression to determine the linear relationship between infrastructure investments and the other variables below.

After first difference, Government Debt, Health Investment, Interest Rates and Inflation Rates were stationary at all significance level whilst Government Savings and GDP were stationary 10% significance level GDP, Sugar Export Value and FDI into Agriculture required further differentiating in order to be stationary. Testing for stationarity is important to avoid spurious regression results which may ensue from a regression of variables that are non-stationary. Where these tests confirm stationarity, OLS regressions yield reliable results, however, where this is not the case, then the variables must be differenced before OLS can provide reliable estimates.

### 3.3 | Ordinary least squares (OLS) regression

The results in Table 5 depict that the independent variables reliably predict the dependent variable (Agriculture Water Infrastructure Investment) because the *p*-value is smaller than .05. 63.2% of the variance in Agriculture Water Infrastructure investments can be predicted from GDP, Sugar export values, FDI into agriculture, Government savings and interest rates. The 44.8% of the Adjusted $R^2$ depicts the best fit of the model.

The coefficients of GDP (35.2), Sugar Export Value (6.47), FDI into Agriculture (−1.34), Government Savings (−1.56), and Interest Rates (−1.96); these coefficients are statistically significant ($p < .022$, $p < .007$, $p < .027$, $p < .036$ and $p < .036$), this implies that GDP, Sugar Exports, FDI into Agriculture, Government Savings and Interest Rates are crucial in determining agricultural water infrastructure investment in Eswatini.

Further analysis depicts that an increase of 1 % in GDP of the previous year would likely yield to 35.2% increases in agricultural water infrastructure investment; a 1% increase in the sugar export value would probably yield to a 6.47% increase in agricultural water infrastructure investment; a 1% increase in government savings of the previous year is likely to yield to a decrease of 1.56% in agricultural water infrastructure investment; and a 1% increase in interest rates is likely to yield to a 1.96% decrease in agricultural water infrastructure investment.

From the above statistical analysis, we can therefore, deduce that GDP and Sugar Export values are pivotal factors that determine Water Infrastructure Investment in Eswatini. GDP and Sugar Export Values are critical to agricultural water infrastructure investment because an efficient and developed sugar sector allows the country to services the Economic Partnership Agreement (EPA) between the EU and six members of the Southern African Development Community (SADC), including Eswatini (this EPA was recently renewed in June 2016). This alliance allows Eswatini sugar products and other products to enter the European market without tax or quota. This, therefore, serves as an incentive and a rationale for the country to use proceeds from the GDP and sugar exports to invest in agricultural water

**TABLE 2** Pearson pairwise correlation at 10% significance level results

| | Infra Inv | GDP | AgGDP | Sugar Exp | FDI Agric | ODA Agric | Gov. debt | Educ. Inv | Health Inv | Gov. Sav | Int. rates | Infl. rates |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Infra Inv | 1.0000 | | | | | | | | | | | |
| GDP | 0.4133* | 1.0000 | | | | | | | | | | |
| | 0.0882 | | | | | | | | | | | |
| AgGDP | −0.2596 | −0.7429* | 1.0000 | | | | | | | | | |
| | 0.2982 | 0.0004 | | | | | | | | | | |
| Sugar Exp | 0.4064* | −0.0573 | 0.0765 | 1.0000 | | | | | | | | |
| | 0.0942 | 0.8213 | 0.7629 | | | | | | | | | |
| FDI Agric | 0.5909* | 0.5330* | −0.4583* | 0.7791* | 1.0000 | | | | | | | |
| | 0.0098 | 0.0227 | 0.0558 | 0.0001 | | | | | | | | |
| ODA Agric | 0.0504 | −0.2651 | 0.1232 | 0.5094* | 0.1990 | 1.0000 | | | | | | |
| | 0.8426 | 0.2876 | 0.6263 | 0.0308 | 0.4287 | | | | | | | |
| Gov. debt | −0.5011* | −0.7269* | 0.3815 | −0.3395 | −0.6300* | 0.1653 | 1.0000 | | | | | |
| | 0.0342 | 0.0006 | 0.1183 | 0.1681 | 0.0051 | 0.5121 | | | | | | |
| Educ Inv | 0.1183 | 0.8149* | −0.6850* | −0.3201 | 0.2799 | −0.3042 | −0.3040 | 1.0000 | | | | |
| | 0.6400 | 0.0000 | 0.0017 | 0.1954 | 0.2607 | 0.2197 | 0.2201 | | | | | |
| Health Inv | −0.4964* | −0.8089* | 0.5060* | −0.1860 | −0.5826* | 0.2576 | 0.9632* | −0.4104* | 1.0000 | | | |
| | 0.0361 | 0.0000 | 0.0321 | 0.4600 | 0.0112 | 0.3021 | 0.0000 | 0.0907 | | | | |
| Gov. Sav | 0.4258* | 0.2823 | 0.0237 | 0.5901* | 0.5155* | 0.3801 | −0.5398* | −0.0795 | −0.3896 | 1.0000 | | |
| | 0.0781 | 0.2563 | 0.9257 | 0.0099 | 0.0286 | 0.1198 | 0.0208 | 0.7538 | 0.1100 | | | |
| Int. rates | −0.5156* | −0.7676* | 0.4375* | −0.1861 | −0.5601* | 0.3153 | 0.9682* | −0.3761 | 0.9865* | −0.3792 | 1.0000 | |
| | 0.0285 | 0.0002 | 0.0694 | 0.4596 | 0.0156 | 0.2025 | 0.0000 | 0.1240 | 0.0000 | 0.1207 | | |
| Infl. rates | −0.4682* | −0.8087* | 0.4600* | −0.2388 | −0.6014* | 0.2034 | 0.9843* | −0.4179* | 0.9746* | −0.5116* | 0.9684* | 1.0000 |
| | 0.0500 | 0.0000 | 0.0548 | 0.3400 | 0.0083 | 0.4182 | 0.0000 | 0.0844 | 0.0000 | 0.0300 | 0.0000 | |

*Note:* Source: Authors (2020).

Abbreviations: NB: AgGDP, Agricultural GDP; Educ. Inv, Education Investment; FDI Agric, Foreign Direct Investment into Agriculture; GDP, Gross Domestic Product; Gov. Debt, Government Debt; Gov. Sav, Government Savings; Health Inv, Health Investment; Infl. Rates, Inflation Rates; Infra Inv, Agricultural Water Infrastructure Investment; Int. Rates, Interest Rates; ODA Agric, Organizational Development Assistance into Agriculture; Sugar Export, Sugar Export Values.

infrastructure. It is imperative to acknowledge that the agriculture sector has remained the largest employer, accounting for 69% of total employment in 2018, down only 2% points from the share recorded in 1991. This echoes the sentiments that the Government of Eswatini need to invest in agricultural water infrastructure because this would enhance the development of the agriculture sector (the key employment sector in the country). These results concur with the economic theorem and assertions of a significantly positive relationship between economic growth and infrastructure (IMF, 2017; Beaton et al., 2017; Sahoo & Dash, 2009 and; Calderón & Servén, 2004) that Furthermore, empirical evidence from studies supports the theorem. Cerra et al. (2017) found that country revenue surpluses tend to increase infrastructure investment.

Both FDI into agriculture and government savings were actually expected to have a positive influence on agricultural water infrastructure investment. However, there are valid explanations worth considering as to why they are both significant albeit negative in determining agriculture water infrastructure investments for the period of covered by the data sample of this paper. Eswatini is considered a middle-income country, therefore, it is not eligible for budget support from EU and other international investors, for instance under the European Development Fund bilateral cooperation between the EU and Eswatini Government is mainly implemented through a programme approach rather than investments through budget support. The FDI into agriculture is meant for the pressing need of social investments to mitigate hunger that has been a result of poor economic growth and the effects of climate change that is, the 2015–2016 droughts.

The EU agricultural programmes focus on production, innovation, renewable energy, small-scale irrigation, and entrepreneurship, with the overall goal to boost employment and contribute to lasting food security, while better adapting to climate change and respecting the environment. With regards to FDI, it is worth noting that an increase in FDI reduces infrastructure investment is unexpected and it may be explained by the possibility that FDI in Swaziland appears to focus on short term investments rather than water infrastructure, but unfortunately disaggregating FDI into its composition was not achievable owing to paucity of data. Furthermore, it is worth noting that the manufacturing sector (rather than the agriculture production) has drawn the bulk of foreign investment in the country but data on the actual composition of FDI within the agricultural sector is not readily available, leaving the authors with a crude measure of FDI thereby resulting the unexpected effect as highlighted previously. The fiscal situation has remained weak in Eswatini compounded by budget deficits that has necessitated drawdowns of reserves (government savings). The current account surplus increased slightly to an estimated 2.4% of GDP between 2014–2019 (AfDB, 2020). The government also continues accumulating domestic arrears that increased from 3% of GDP in 2016 to 10.3% of GDP by July 2019. As a result, gross official reserves have been consistently below the three-month international benchmark, reaching a low of 2 months of imports of goods and

**TABLE 3** Augmented Dickey-Fuller (ADF) test results

| Variable | Level | First difference | Second difference |
|---|---|---|---|
| Infra_Inv | −3.516* | −3.151 | |
| GDP | −1.265 | −3.279* | |
| Sugar export | −1.088 | −2.817 | 4.278** |
| FDI_Agric | −1.734 | −2.928 | 4.858*** |
| Gov_Debt | −2.881 | −4.776*** | |
| Gov_ Sav | −1.536 | −3.378* | |
| Health_Inv | −3.494* | −5.231*** | |
| Int_Rates | −4.120** | −4.975*** | |
| Infl_Rates | −3.151 | −5.108*** | |

*Note:* Source: Authors (2020).

**TABLE 4** Phillips-Perron (PP) test results

| Varaible | Level | First difference | Second difference |
|---|---|---|---|
| Infra_Inv | −3.456* | −3.097 | |
| GDP | −1.466 | −3.248* | |
| Sugar export | −1.283 | −2.759 | 4.448*** |
| FDI_Agric | −1.849 | −2.891 | 5.173*** |
| Gov_Debt | −2.803 | −5.381*** | |
| Gov_ Sav | −1.639 | −3.397* | |
| Health_Inv | −3.456* | −6.079*** | |
| Int_Rates | −4.214** | −6.288*** | |
| Infl_Rates | −3.097 | −5.650*** | |

*Note:* Source: Authors (2020).

**TABLE 5** OLS regression results

| Infra investment | Coefficient | Std. error | *t* | *p* > *t* | [95% Conf. Interval] | |
|---|---|---|---|---|---|---|
| GDP (L1) | 35.21394 | 12.75079 | 2.76 | 0.022 | 6.369643 | 64.05824 |
| Sugar export value (L1) | 6.466871 | 1.843486 | 3.51 | 0.007 | 2.296616 | 10.63713 |
| FDI into agriculture (L1) | −1.339233 | .5077959 | −2.64 | 0.027 | −2.487948 | −.190519 |
| Government savings (L1) | −1.556865 | .6310776 | −2.47 | 0.036 | −2.984462 | −.1292682 |
| Interest rates | −1.95765 | .7949505 | −2.46 | 0.036 | −3.755953 | −.1593469 |
| Constant | −1.123798 | .4775201 | −2.35 | 0.043 | −2.204023 | −.0435722 |
| R-squared | | 0.7414 | | Adjusted R-squared | 0.5978 | |

*Note:* L1 = First Lag. Source: Authors (2020).

services in March 2019 (World Bank, 2020). From this macroeconomic outlook of a Eswatini we can deduce an increase in government savings is set aside to increase the country's depleted reserves, pay for the increasing public expenditure, and pay for the inflated public debt. With regards to interest rates, the international loans used to co-finance the water infrastructure investment are fixed over the repayment period and also it is worth noting that interest rates have been declining over the period of this study.

## 4 | CONCLUSION

Eswatini's macroeconomic performance over the past two decades depicts has been far from stellar, however the 2016 Strategy for Sustainable Development and Inclusive Growth's aim of increased economic development through infrastructure investment seems promising to yield the desperately needed positive results. Granting that empirical research investigating the influence of economic growth on infrastructure investments has been contentious in the region, it is worth stating that there appears to be a strong relationship between economic growth and infrastructure development. In agreement with the literature, agricultural water infrastructure investment is positively correlated to GDP, Sugar export income. Further analysis using OLS regression revealed that GDP and Sugar Export values are very significant factors that stimulate agricultural water infrastructure investment in Eswatini. It can also be conversely stated that for Eswatini to get out of the slow economic growth, it is may be important to find ways to increase investment in agricultural water infrastructure. From the macroeconomic outlook, the development of the infrastructure is still lagging between the demands of the economy. However, it is also important to emphasise that agricultural water infrastructure alone will not comprehensively expedite the economic growth, hence, there is also a need for the country to put an effort in investing in other critical infrastructures (i.e., electricity, ICT and transport [road and rail]) as well.

## REFERENCES

African Development Bank. (2018). African Economic Outlook. AfDB Abidjan, Côte d'Ivoire. Retrieved from https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/African_Economic_Outlook_2018_-_EN.pdf

African Development Bank (ADB). (2018). *Africa's infrastructure: Great potential but little impact on inclusive growth (Chapter 3)*. Côte d'Ivoire: AfDB, Abidjan.

African Development Bank. (2020). Eswatini's Macroeconomic Performance and Outlook. AfDB, Abidjan, Côte d'Ivoire.

Agénor, P., & Neanidis, K. (2015). Innovation, public capital, and growth. *Journal of Macroeconomics*, *44*, 252–275.

Arezki, R., Bolton P., Peters S., Samama F., & Stiglitz, J. (2017). From Global Savings Glut to Financing Infrastructure: The Advent of Investment Platforms. Forthcoming in Economic Policy.

Arimah, B. C. (2005). What drives infrastructure spending in cities of developing countries? *Urban Studies*, *42*(8), 1345–1368.

Aschauer, D. (1993). Genuine economic returns to infrastructure investment. *Policy Studies Journal*, *21*(2), 380–390. https://doi.org/10.1111/j.1541-0072.1993.tb01830.x

Atolia, M., Li, B. G., Marto, R., & Melina, G., (2017). Investing in Public Infrastructure; Roads or Schools? IMF Working Papers 17/105, International Monetary Fund.

Baum-Snow, N., Henderson, V., Turner, M., Zhang, Q., & Brandt, L. (2017). Roads, railroads, and decentralization of Chinese cities. *The Review of Economics and Statistics*, *99*(3), 435–448.

Beaton, K., Cebotari, A., & Komaromi, A. (2017). *Revisiting the link between trade, growth and inequality: Lessons for Latin America and the Caribbean (IMF Working Paper 17/46)*. Washington, DC: International Monetary Fund.

Calderon, C., Moral-Benito, E., & Serven, L. (2015). Is infrastructure capital productive? A dynamic heterogeneous approach. *Journal of Applied Econometrics*, *30*(2), 177–198.

Calderón, C., & Servén, L. (2004). The effects of infrastructure development on growth and income distribution (World Bank Policy Research Working Paper No. 3400). Washington, DC: World Bank.

Calderón, C., & Servén, L. (2010). *Infrastructure and Economic Development in Sub-Saharan Africa*. *Journal of African Economies*, *19*(suppl 1), i13–i87.

Cavallo, E., & Daude, C. (2011). Public investment in developing countries: A blessing or a curse? *Journal of Comparative Economics*, *39*(1), 65–81.

Cerra, V., Cuevas, A., Góes, C., Karpowicz, I., Matheson, T., Samaké, I., & Vtyurina, S. (2017). *Highways to heaven: Infrastructure determinants and trends in Latin America and the Caribbean (IMF Working Paper WP/16/185)*. Washington, DC: International Monetary Fund.

Cohen, J. P., & Morrison-Paul, C. J. (2001). *Public Infrastructure Investment, Costs, an Inter-State Spatial Spillovers in U.S. Manufacturing*, 1982-96.

Dao, M. (2008). The determinants of infrastructure development in developing countries. *Journal for Studies in Economics and Econometrics*, *32*(3), 43–54.

De Haan, J., Sturm, J., & Sikken, B. (1996). Government capital formation: Explaining the decline. *Weltwirtschaftliches Archiv*, *132*(1), 55–74.

De Haan, J., & Sturm, J. E. (1994). Political and institutional determinants of fiscal policy in the European Community. *Public Choice*, *80*(1–2), 157–172.

Eswatini Economic Policy Analysis and Research Centre (EEPARC) (2017). *Eswatini Economic Policy Analysis and Research Centre Performance 2017/18*: Annual Report. EEPARC: Mbabane, Eswatini

Eswatini Sugar Association. (2019). Integrated Annual Report 2018/2019. ESA: Mbabane, Eswatini.

Galí, J., & Perotti, R. (2003). Fiscal policy and monetary integration in Europe. *Economic Policy*, *October*, *2003*, 533–572.

Global Infrastructure Hub. (2017). Global Infrastructure Outlook: Forecasting Infrastructure Investment Needs for 50 Countries, 7 Sectors through 2040. Oxford Economics and Global Infrastructure Hub. Sydney, Australia.

Gupta, C., Clements, B., Baldacci, E., & Mulas-Granados, C. (2006). Fiscal Policy, Expenditure Composition, and Growth in Low-Income Countries. International Monetary Fund Supported Programs. 84-100.

Gurara, D., Klyuev, V., Mwase, K., & Presbitero, A. (2018). Trends and challenges in infrastructure investment in developing countries. *International Development Policy*, *10*, 1–30. https://doi.org/10.4000/poldev.2802

Helm, D. (2009). Infrastructure investment, the cost of capital, and regulation: An assessment. *Oxford Review of Economic Policy*, *25*(3), 307–326.

ILO. (2010), *Local Development through Infrastructure Investments and Jobs - Advisory Support, Information Services and Training Programme (ASIST-AP)*, ILO Regional Offices for Asia and the Pacific. Available at: http://www.ilo.org/asia/whatwedo/projects/lang–en/WCMS_098915/index.htm. Accessed on March 24, 2010.

International Monetary Fund. (2020). Eswatini's IMF Country Report No. 20/41. IMF Publication Services. Washington DC, United States of America.

International Monetary Fund (IMF). (2017). *Restarting the Growth Engine*. Regional Economic Outlook: Sub-Saharan Africa. Washington, DC.

Jedwab, R., & Storeygard A. (2016). The Average and Heterogeneous Effects of Transportation Investments: Evidence from Sub-Saharan Africa 1960 – 2010. Mimeo, Tufts University.

Khumalo, S. (2016). Infrastructure Financing in a Developing Economy: Addressing the Electricity Supply Deficit in Swaziland. Master of Management in Finance & Investment Management Dissertation, Wits Business School. Johannesburg, South Africa.

Kirchgassner, G. (1988). Government spending in federal systems: A comparison between Switzerland and Germany. In J. A. Lybeck & M. Henrekson (Eds.), *Explaining the growth of government*. Amsterdam: North-Holland.

Kodongo, O., & Ojah, K. (2016). Does infrastructure really explain economic growth in sub-Saharan Africa? *Review of Development Finance*, *6* (2016), 105–125.

Levine, R., & Renelt, D. (1992). *A Sensitivity Analysis of Cross-Country Growth Regressions*, *American Economic Review*, September 1992, *82*(4), 942–963.

Lybeck, J. (1988). Comparing government growth rates: The non-institutional vs. the institutional approach. In J. A. Lybeck & M. Henrekson (Eds.), *Explaining the growth of government*. Amsterdam: North-Holland.

Musaba, E., Pali-Shikhulu, J., Matchaya, G., Chilonda, P., & Nhlengethwa, S. (2014). *Monitoring Agriculture Sector Performance in Swaziland: Investment, Growth and Poverty Trends, 2000—2011, ReSAKSS-SA Annual Trends and Outlook Report 2012*. International Food Policy Research Institute (IFPRI) and the International Water Management Institute (IWMI).

Nannan, Y., & Jianing, M. (2012). *Public infrastructure investment, economic growth and policy choice: evidence from China*. In *ICPM-2012*. Crisis: Management in the Time of Changing World.

Oxley, H., & Martin, J. (1991). Controlling government spending and deficits: Trends in the 1980s and prospects for the 1990s. *OECD Economic Studies*, *17*, 145–189.

SADC. (2017). Summary of the SADC Revised Regional Indicative Strategic Development Plan 2015-2020. Gaborone, Botswana, 2017.

Sahoo, P., & Dash, R. (2009). Infrastructure development and economic growth in India. *Journal of the Asia Pacific Economy*, *14*(4), 351–365.

Sala-i-Martin X. (1997). *I Just Ran Two Millions Regressions*, American Economic Review, May 1997, *87*(2), 178–183.

Strategy for Sustainable Development and Inclusive Growth (SSDIG). (2016). The Eswatini We Want. Ministry of Economic Planning and Development, Government of the Kingdom of Eswatini. Mbabane, Eswatini.

Sturm, J. E. (1998). Public Capital expenditure in OECD Countries. The Causes and Consequences of the Decline in Public Capital Spending. Edward Elgar.

Sturm, S. (2001). Second Generation Employment Discrimination: A Structural Approach. 101 Colum. L. Rev. 458. Retrieved from https://scholarship.law.columbia.edu/faculty_scholarship/217

Sturm, J. E., & De Haan, J. (2000). *No need to run millions of regressions*, Munich: CESifo Working Paper No. 288, April.

Turrini, A. (2004). Public Investment and the EU Fiscal Framework. European Commission, Directorate-General for Economic and Financial Affairs, Economic Papers. 202.37.

UNCTAD. (2016). *World Investment Report 2016: Transnational Corporations and the Infrastructure Challenge: Overview*. New York and Geneva: United Nations.

World Bank. (2019). Ending Hunger, Investing in Opportunity. World Bank Annual Report. Washington DC, United States of America.

World Bank. (2020). Macroeconomic Overview of Eswatini. World Bank Group. Washington DC, United States of America.

**How to cite this article:** Nhlengethwa S, Matchaya G, Greffiths I, Fakudze B. Analysis of the determinants of public capital investments on agricultural water infrastructure in Eswatini. *Bus Strat Dev*. 2021;4:49–58. https://doi.org/10.1002/bsd2.156