Secondary education spending and school attendance in South Africa: An ARDL approach

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Abstract: The education system in South Africa is perceived to be expensive, inefficient, and under-performing relative to its peers. Hence, this study aims to investigate the relationship between secondary education spending and school attendance in South Africa through econometric modelling. The ARDL Bounds test revealed that the variables have long-run relationship. Furthermore, the long run estimates indicate that both secondary education spending, household incomes, and urbanisation are statistically significant in explaining variations in school attendance. Granger Causality test indicates uni-directional causality from secondary education spending to secondary school attendance. Thus, to close the gap in providing quality education in SA, a wide range of interventions are needed. The focus should be on increasing enrolment rates and narrowing dropout rates, more especially those that are due to lack of funding. In addition, school officials should be provided with the necessary financial and administrative skills to receive, distribute, and utilise funds efficiently.

Subjects: Education - Social Sciences; Econometrics; Public Finance; Education Studies; Research Methods in Education; Secondary Education; Theory of Education

Keywords: education outcomes; school enrolment; government spending; ARDL Bounds testing

Subjects: A21; B41; H520; I28

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PUBLIC INTEREST STATEMENT
The manner by which governments raise and spend public funds affects the financial, social, and economic well-being of citizens. Public expenditure on education is of paramount importance to national development and plays a crucial role in fostering economic growth and knowledge deepening. Moreover, an education system of quality, that is easily accessible to all, is crucial, not only to ensure that the citizenry is well knowledgeable, but also for human development as well as the maintenance of socially responsive economic and political systems. For nations to achieve sustainable and inclusive growth, human capital, amongst others, needs to be in place, through substantial investments in education. Against this backdrop, this study assessed the relationship between public spending and school enrolment in South Africa. The findings indicate that the South African government has been correct in spending the bulk of its budget on education. From a quality perspective, there remains room for improvement.
1. Introduction

“An education system of quality is crucial, not only to ensure that the citizenry is well knowledgeable, but also for human development as well as the maintenance of socially responsive economic and political systems” (Modisaotsile, 2012, p. 1). Public expenditure on education is of paramount importance to national development and plays a crucial role in fostering economic growth and knowledge deepening (Obi et al., 2016). The education system in South Africa (SA) is perceived to be expensive, inefficient, and under-performing when compared to education systems of other developing and under-developed countries. Even worse, the system remains in poor condition, having not lived up to the problems of the day nor benefited from international developments (Booyse et al., 2011). Despite the large amounts spent on education, a multitude of problems have been identified that undermine the success-level of the South African education system and these include, amongst others: a shortage of skilled and well-trained teachers, lack of community aid and parental support as well as a shortage of resources (South African Government, 2015). Moreover, classrooms remain overcrowded while the dropout rate is increasing at an alarming rate. It is for these reasons, that this study aims to investigate the relationship between government spending and school attendance in South Africa. The rest of the study is structured as follows: Section 1 provided an introduction and background to the topic. Section 2 provides an overview of education performance in SA while Section 3 provides a discussion of the literature. Section 4 details various econometrics techniques utilised while section 5 highlights findings of the study. Section 6 summarizes the most important findings of the study as well as the policy implications.

2. Trends in school enrolment, expenditure and outcomes

It has been two decades since the attainment of democracy in SA, yet levels of educational attainment remain relatively low owing to the earlier-mentioned issues. This became apparent in 2000 when domestically performing learners performed poorly in international tests, deeming them to be illiterate and innumerate (Spaull, 2013). Moreover, the country’s level of educational attainment does not compare favourably with those of other developing countries who spend only a fraction of what SA spends on education (Adowaa, 2014). Corruption is one of the key issues facing the South African education system. According to Steenkamp (2009), corruption ranges from pay-offs and bribes in the appointment and promotion of teachers to illegal monetary payments for school admission. While the annual-per-learner public expenditure on education rose from R6,300 in the 2005/6 financial year to R9,160 in the 2008/9 financial year, the number of learners who passed matric decreased from 351,503 in 2006 to 344,794 in 2008 (Steenkamp, 2009). In August 2009, more than 43 directors of the North-West Province Education Department went on a spa-extravaganza, costing the department R2 000 per director (Rademeyer, 2009).

Language remains a controversial issue, bringing about its own complexities and challenges (Meier & Hartell, 2009). Fleisch (2008) notes that most South African learners are taught in English but hardly speak English outside the classroom. This phenomenon limits their fluency in English. Notwithstanding, issues of inadequate feedback on learner pass-rates and performance have been at the centre of debate. This stems from the fact that the government focuses on the number of learners who pass matric and ignore the proportion of learners who started grade 1 and successfully completed grade 12. For example, in 2014, the matric pass rate was reported to be 75.8% (Department of Basic Education) whereas in actual terms—incorporating those learners who dropped out over the past 12 years—only 41.7% of learners successfully obtained a matric certificate (Spaull, 2013). On the upside, several attempts have been made by the Department of Basic Education (DBE) to ensure the success of the education system. These include high concentrations on Early Childhood Development (ECD) and the introduction of a no-school fee system in some public schools to increase enrolment (Department of Basic Education: Department of Basic Education). Figure 1 below illustrates trends in government spending on education.
As indicated in Figure 1, public spending on education in SA remains relatively high contrast to Czech Republic, Finland, and Japan. The Czech Republic, Finland, and Japan have, globally, the three most efficient educational systems of which the performance and results exceed that of SA by far, irrespective of the fact that their percentage spending per capita is only a fraction of SA’s percentage spending per capita. In the 2011 Trends in International Mathematics and Science Study (TIMSS), grade 9 South African learners wrote the grade 8 TIMSS 2011 test instead of grade 8 learners, since grade 8 learners found the 2002 TIMSS test extremely challenging (see Spaull, 2013). The 2002 grade 8 group was criticised for performing at guessing level on multiple choice questions, decreasing the reliability and accuracy of the study (Ina et al.) SA also participated in the Southern and East African Consortium for Monitoring Educational Quality (SAMCEQ) test which began in 2006 and was completed during 2011 (Series, 2015). Of the approximately 9071 grades 6 learners that were tested, 27% were deemed to be illiterate while an additional 40% of the learners was classified as functionally innumerate (Spaull, 2013). Figure 2 below highlights results from the 2007 SAMCEQ study. The study was aimed at determining the functional literacy rate of grade six learners as per country.

In 2007, SAMCEQ evaluated grade six learners in 14 African countries, namely, “Botswana, Kenya, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, SA, Swaziland, Tanzania, Uganda, Zambia, And Zimbabwe” (Series, 2015, p. 2). As can be seen in Figure 2, SA performed worse than Namibia and Zimbabwe, which are regarded as low-income countries spending less than SA towards education. Disturbingly, SA spends 5 times more per learner (R17 700) compared to Kenya (R3 741) (Spaull, 2012). Furthermore, SA has the same ranking as Uganda, yet Uganda spends less in comparison. These findings confirm that the spending of additional financial resources does not guarantee better academic performance. To ensure a value for money education system, the government should ensure that funds fulfil their desired objectives and outcomes. Similar to education attainment, education enrolment remains challenged. Figure 3 shows trends in primary and secondary school enrolment rates for the period 2000–2014.

It is undoubtedly clear, as indicated in Figure 3, that primary enrolment rates outperformed secondary enrolment rates between the periods 2000–2014. While this holds, secondary enrolment rates seem to be catching up with primary enrolment rates. Primary enrolment decreased from 103.7% in 2000 to 99.7% in 2014 while secondary enrolment increased from 87.3% to 98.3%
during the same period (Index-Mundi, 2017). More disturbingly, StatsSA in their 2011 Census, found evidence of increased preference of private schools over public schools, more especially in urban areas (Stats SA, 2011). Gustafsson (2012) adds that there exists a gap in school enrolment and population in SA and this is due to inaccuracies in reporting as in the case of matric results.

3. Literature review

3.1. Theoretical framework
The theoretical framework of this study is based on theories of growth in public expenditure. This in turn, informs the methodological framework of this study, which relates government spending on education with education outcomes, specifically school enrolment.

3.1.1. Wagner’s law of increasing state activities
Under Wagner’s law, growth in per capita income and output are associated with increases in state activities and thus increases in state expenditure. State expenditure increases both extensively and intensively (Muritala & Taiwo, 2011). Extensive increases refer to coverage of new welfare functions by the state whereas intensive increases refer to improvements in traditional functions of government (Guandong & Muturi, 2016). State expenditure increases due to three reasons: firstly, the state continuously expands its traditional functions (i.e., defence, provision of social overheads, and maintaining law and order) (Edame & Fonta, 2014). Secondly, because the state plays a broad role as a market regulator and eliminator of market failures, state services have to increase through the provision of public goods and services, which include, amongst others: healthcare basic education services, water and sanitation, and the provision of low-cost housing. Lastly, state expenditure increases as a result of the expansion and maintenance of public goods and services (Mthethwa, 1998).

3.1.2. Peacock and Wiseman’s theory of public expenditure
This theory is based on the political-social idea that governments like to spend while citizens find tax as a burden (Edame & Fonta, 2014). Additionally, a large portion of government revenue comprises of tax revenue, and because taxes create a burden for citizens, this often creates a constraint for the government. Moreover, the government serves citizens and thus should pay attention to the needs of the citizens, which include lower tax rates. As the economy and incomes rise, tax revenue at constant tax rates would increase, allowing the government to spend more, which would be illustrated by a gradual trend in government expenditure. However, the trend is often disturbed by unforeseen social disturbances in the economy, which result in a downward trend in government spending due to state repairs. Thus, government spending does not increase smoothly and continuously but in steps like fashion (Guandong & Muturi, 2016).

3.1.3. Berger’s human capital investment theory
Berger developed a theory for human capital investment in which he outlines the channels through which income-expenditure and human capital development interact (Amparo, 2008). This theory emphasises that individuals decide on the optimal amount of education they want to invest in by weighing the costs and benefits associated with additional school (Lauer, 2002). Higher-income
earners can invest more financial resources into the quantity of education and stand greater chances of buying quality education, which affects not only current educational performance but also future demands for education (Obi et al., 2016). However, the case is otherwise for low-income earners as they often push their children into the labour market with the intention of earning some income, thereby helping the family out. Often these children work while they are still studying, and this affects their performance (Jacobs et al., 2010). Hence, this necessitates increases in government spending in the form of grants and subsidies for poor families. The reasoning is that better educated persons are more likely to get employment and are less likely to lose their jobs, if they are permanently employed (Obi et al., 2016).

3.1.4. Education production function
One needs to understand the production of knowledge to evaluate policy debates surrounding education (Dewey et al., 1998). Rajimon (2010) defines a production function as a function representing the relationship between inputs and other intervening factors to produce a certain product, considering its quality. One of the few ways in which a nation can build human capital is through educating its citizens. Education is thus a dominant input in the production of human capital. Hanushek and Woessmann (2008) identify the commonly purchased inputs to schools, which include: class size, teacher experience, and teacher education, although they bear little systematic relationship to learner outcomes. Interestingly, economists use econometrics techniques to quantify the efficiency of an education production function. However, the results often become spurious when a certain variable that affects school success significantly is omitted from the model. Because the education production function is not well known, measuring the efficiency of the schooling system remains a challenge. Dewey et al. (2000)’s education production function is given by:

\[ L = f(S, t_i, E) \]  

where \( S \) is the quality of the school system, \( t_i \) is the amount of time spent by the parent teaching the child, and \( E \) is the parent’s educational attainment used as a proxy for quality of time. However, the model has some drawbacks as it does not incorporate learning overtime.

3.2. Empirical literature
Due to the unavailability of school enrolment data within the literature on education spending and attendance, few researchers have conducted quantitative studies on the relationship between school enrolment and spending on education. Hence, the existing body of literature is scant in most countries. This limit and reduces the reliability and accuracy of findings provided by existing empirical studies. Nonetheless, Bergh and Fink (2006) evaluated the effects of public education spending on student enrolment in tertiary education. Using cross-sectional data for 132 countries, they found that public spending on primary and secondary education positively affects tertiary enrolment rates. Anyanwu and Erhijakpor (2007) studied the relationship between government spending and education enrolment using panel data of African countries spanning from 1990 to 2002. Based on findings, government spending on education has a positive and statistically significant impact on education enrolment both at primary and secondary level. Dauda (2011) employed several econometrics techniques to examine the impact of educational spending and macroeconomic uncertainty on educational outcomes in Nigeria. The findings revealed that educational spending impacts positively on schooling performance while macroeconomic instability impacts negatively.

Devi and Devi (2014) used time series data spanning from 2001 to 2010 to investigate the determinants of school enrolment in Pakistan. The results indicate that government spending is positively associated with school enrolment. Carsamer and Ekyem (2015) investigated the impact of government expenditure on enrolment at primary and secondary school level using a sample of 20 African countries for the period 1998–2012. The core finding is that educational expenditure positively increases school enrolments at both primary and secondary school levels with greater impact at the secondary level. Obi et al. (2016) using Ordinary Least Square (OLS) technique for
Nigeria for the period 1970–2013, found that public education spending has a positive and significant effect on education outcomes in Nigeria. The study further revealed that public health expenditure and urban population growth have positive effects on education outcome but are not significant in determining education outcome. A similar study by Ojewumi and Oladimeji (2016) employed the OLS multiple regression econometric technique for Nigeria for the period 1981–2013. The study revealed that the impact of both capital and recurrent expenditure on educational growth were negative in Nigeria for the period under study, owing to the high level of corruption apparent in the education sector. A recent study by Longe and Omitogun (2017) adopted VECM approach to estimate the effects of government spending on school enrolment. They found that government spending on education and health positively influences school enrolment in Ghana.

4. Methodology

4.1. Data and model specification

The study made use of annual time series data spanning from 1999 to 2015. The data were collected from secondary servers. A list of secondary data sources utilised is provided in the appendix. The model and variable selection are informed by recent works of (Obi et al., 2016) and (Dauda, 2011), with some few modifications. In empirical form, our model is written as:

\[ LSENRI_t = \mu + \phi_1 LSEE_{t-1} + \phi_2 LGNI_{t-1} + \phi_3 LPHET_{t-1} + \phi_4 LURB_{t-1} + \epsilon_t \]  

(2)

where \( \mu \) is the intercept, \( \phi_{1-4} \) are slope coefficients of explanatory variables, \( LSENRI_t \) is the secondary enrolment rate, \( LSEE_t \) is secondary education spending as a percentage of total government spending, \( LGNI_t \) is household income proxied by GNI per capita, \( LPHET_t \) is public health spending as a percentage of total government spending and \( LURB_t \) is urbanisation. \( \epsilon_t \) is a white noise stochastic error term with usual properties, i.e., \( N(0, \sigma) \). Log transformation was applied to normalise the data and avoid scaling issues.

A priori expectation:

\[ LSEE, \ LGNI, \ PHE, \ LURB > 0 \]  

(3)

All variables concerned are expected to have positive signs as theory suggests. However, that does not mean that if variables do not meet the a priori expectation the model is somewhat invalid, as theory doesn’t always hold. We (the authors) began by performing non-stationarity tests of Augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1979, p. 1981) and Philips—Perron (PP) (Phillips & Perron, 1986, p. 1988). Testing for stationarity is important when dealing with time-series data as non-stationary variables might lead to spurious results. The ADF and PP were chosen because they are simple to perform and there is no uniformly better test (Sjö, 2011). After detecting the order of integration, we performed the Autoregressive Distributed Lag (ARDL) Cointegration test by Pesaran and Shin (1995). The ARDL approach has the added advantage of yielding reliable estimates of the long-run coefficients that are asymptotically normal irrespective of whether the underlying regressors are I(0) and/or I(1). Additionally, the ARDL technique is more robust when dealing with small sample data. In the ARDL estimation, Equation (2) can be written as:

\[ LSENRI_t = \mu + \phi_1 LSENRI_{t-1} + \phi_2 LSEE_{t-1} + \phi_3 LGNI_{t-1} + \phi_4 LPHET_{t-1} + \phi_5 LURB_{t-1} + \sum_{p=1}^{P} \gamma_p \Delta LSENRI_{t-i} + \sum_{p=1}^{P} \gamma_2 \Delta LSEE_{t-i} + \sum_{p=1}^{P} \gamma_3 \Delta LGNI_{t-i} + \sum_{p=1}^{P} \gamma_4 \Delta LPHET_{t-i} + \sum_{p=1}^{P} \gamma_5 \Delta LURB_{t-i} + \epsilon_t \]  

(4)

In which case \( \gamma_{1-5} \Delta \) are short-run coefficients to be estimated. Furthermore, we estimate the ARDL Error Correction Model (ECM) to derive the speed of adjustment to equilibrium. The ECM, which encompasses short-run coefficients, can be expressed as follows:

\[ \Delta LSENRI_t = \mu + \sum_{p=1}^{P} \gamma_1 \Delta LSENRI_{t-i} + \sum_{p=1}^{P} \gamma_2 \Delta LSEE_{t-i} + \sum_{p=1}^{P} \gamma_3 \Delta LGNI_{t-i} + \sum_{p=1}^{P} \gamma_4 \Delta LPHET_{t-i} + \sum_{p=1}^{P} \gamma_5 \Delta LURB_{t-i} + \text{ECT}_{t-1} + \epsilon_t \]  

(5)
where $E_{Ct-1}$ is the error correction term. Lastly, because correlation does not imply causation, we tested the variables for causality by means of the Granger-Causality approach (Granger, 1969, 2004), complemented by Variance Decomposition and Impulse Response Function. The former allows us to determine the direction of causation, if any exists, while the latter enables us to investigate the responsiveness of endogenous variables to shocks.

5. Empirical results and discussions
This section provides a summary of findings for all econometric tests performed to estimate the relationship between secondary education spending and school attendance.

5.1. Descriptive statistics
We begin by providing the descriptive statistics of the variables. This includes the mean, standard deviation, minimum and maximum values. The output is provided in Table 1 below.

As can be observed from Table 1, secondary school enrolment (LSENR) averaged 6.67 between 1995 and 2015 while secondary education expenditure (LSEE) and public health expenditure (LPHE) averaged 4.51 and 13.67, respectively, over the same period. In addition, urban population (LURB) has the highest average in the dataset, amounting to 60.6 between 1995 and 2015. All variables, with the exception of urban population, have lower standard deviation values, which implies that the data points are close to the mean. Since the variables have been linearized, normality does not seem to be an issue since the Kurtosis values are approaching 3.7. In addition, the p-values of the Jarque-Bera are above 5% for all variables.

5.2. Unit root results
We tested selected variables for unit root to avoid spurious results and also to ensure that no second difference I(2) variables exist as this might crash the ARDL estimator. The results are presented in Table 2. Notably, an automatic lag selection (max 1 lag) was utilised for all variables as recommended by the Schwarz Information Criterion (SIC).

Our findings reveal that household income is stationary at level while the remaining variables are stationary after first differencing. In other words, the former is integrated in order I(0) while the latter are integrated in order I(1). The results also indicate that no I(2) variables exist as this would crash the ARDL estimator. In comparison to our study, Dauda (2011) found secondary enrolment stationary after first differencing while (Obi et al., 2016), also found public health expenditure stationary after first difference. Given these results, the next step was to select an optimal-lag length using the unrestricted Vector Autoregressive (VAR) estimator. The results

| Table 1. Summary statistics | LSENR | LSEE | LPHE | LGNIP | LURB |
|-----------------------------|-------|------|------|-------|------|
| Mean                        | 6.67  | 4.51 | 13.67| 4.59  | 60.60|
| Median                      | 6.67  | 4.45 | 13.63| 4.62  | 60.62|
| Maximum                     | 6.73  | 4.81 | 14.56| 4.86  | 64.81|
| Minimum                     | 6.62  | 4.23 | 12.79| 4.28  | 56.41|
| Std. Dev.                   | 0.03  | 0.20 | 0.55 | 0.19  | 2.68 |
| Skewness                    | 0.11  | 0.19 | 0.05 | -0.20 | -0.01|
| Kurtosis                    | 2.51  | 1.60 | 1.73 | 1.75  | 1.76 |
| Jarque-Bera                 | 0.21  | 1.49 | 1.14 | 1.21  | 1.09 |
| Probability                 | 0.90  | 0.47 | 0.56 | 0.55  | 0.58 |
| Sum                         | 113.37| 76.61| 232.44| 78.15 | 1030.20|
| Observations                | 17    | 17   | 17   | 17    | 17   |
indicated that the optimal-lag length for our model is 1, as recommended by the Akaike Information Criteria (AIC) and SIC.

### 5.3. ARDL cointegration results

The formal procedure following unit root testing and lag length selection is to test for long-run relationship amongst the variables in question. The technique exploited (i.e., ARDL Bounds) offers several advantages, including the strong ability to handle small sample data and accommodate series integrated of different orders (Pesaran & Shin, 1995). The results are summarized in Table 3 below.

As can be seen in Table 3, the F-statistic value of 5.26 is greater than the lower bound value of 3.74 and upper bound value of 5.06 at the 1% significance level. This leads to a rejection of the null hypothesis of no-cointegration against the alternative hypothesis of cointegration. That is to say, secondary enrolment, proxied by public spending on education, public spending on health, GNI per capita and urbanisation, have equilibrium condition that keeps them in proportion to each other in the long run.

### 5.4. Error correction model

Having established a long-run relationship, the next step was to estimate the speed of adjustment to equilibrium and long-run coefficients. The results are summarised in Table 4 below.

Based on findings, the speed of adjustment to equilibrium is 98%, implying that 98% of past disequilibria are corrected today. Additionally, we find that the value is negative and statistically significant. For Dauda (2011) the speed of adjustment was 39%. The speed of adjustment usually

#### Table 2. Unit root tests results

| Variable | Augmented-Dickey-Fuller test | Phillip-Perron test |
|----------|-------------------------------|---------------------|
|          | Intercept | Trend and | Order of | Intercept | Trend and | Order of |
| D(LSEN)  | -3.12**   | -2.91     | | 3.74** | -2.95     | | (1) |
| LSEN     | 0.10      | -2.16     | | 0.12     | -2.16     | | (1) |
| D(LSEE)  | -3.95**   | -3.74***  | | 3.74**   | -3.74     | | (1) |
| LGNI     | -3.06***  | 0.71      | | -3.59**  | 0.40      | | (0) |
| LPHE     | -1.37     | -1.75     | | -1.43    | -1.82     | | (0) |
| D(LPHE)  | -3.92**   | -3.83**   | | -3.92**  | -3.85**   | | (1) |
| LURB     | -2.16     | -1.9736   | | 0.15     | -2.37     | | (1) |
| D(LURB)  | -4.23**   | -2.02     | | -2.22    | -3.88**   | | (1) |

Asterisks (*, **, ***) denote significance at the 1%, 5% and 10% level, respectively.

#### Table 3. ARDL Bounds test results

| Significance | F-statistic | 5.26* |
|--------------|-------------|-------|
| 10%          | 2.45        | 3.52  |
| 5%           | 2.86        | 4.01  |
| 2.5%         | 3.25        | 4.49  |
| 1%           | 3.74        | 5.06  |

Asterisks (*, **, *** denote significance at the 1%, 5% and 10% level, respectively.
Table 4. Long-run coefficients

| Variable | Coefficient | S.E  | t-Statistic | Prob. |
|----------|-------------|------|-------------|-------|
| C        | 6.16        | (0.08)| 78.05       | 0.00* |
| LSEE     | 0.25        | (0.08)| -3.27       | 0.01* |
| LGNI     | 1.01        | (0.23)| -4.34       | 0.00* |
| LPHE     | 0.01        | (0.01)| -0.52       | 0.62  |
| LURB     | -0.10       | (0.02)| 5.57        | 0.00* |
| ECT (-1) | -0.98       | (0.26)| -3.72       | 0.00* |

LSENR—Secondary School Enrolment LSEE—Secondary Education Spending.
LGNI- Gross National Income per capita LPHE—Public Health Spending.
LURB—Urban Population ECT—Error Correction Term.
Asterisks (*, **, ***) denote significance at the 1%, 5% and 10% level, respectively.

varies due to geographical factors, techniques used and choice of variables. Our long-run equation can be written as:

\[ LSENR = 6.16 + 0.25 \cdot LSEE + 0.01 \cdot LPHE + 1.01 \cdot LGNI - 0.10 \cdot LURB \]  

(5)

The equation implies that, in the long run, a 1% increase in government spending on education will lead to an increase in school enrolment by 25% while a 1% increase in government spending on health will lead to a 0.33% increase in school enrolment. These findings are in line with Anyanwu and Erhijakpor (2007), Devi and Devi (2014), Carsamer and Ekyem (2015), and Obi et al. (2016). The impact of health expenditure on school enrolment is found to be minimal since there is no direct link but rather an indirect link. Even worse, health expenditure is found to be statistically insignificant. Nonetheless, changes in household income are found to be statistically significant in explaining variations in school enrolment. As household income rises, better quality education and educational resources can be afforded, which in turn leads to increases in school enrolment and performance.

Contrast to health expenditure and household income, urbanisation is found to have a negative impact on school enrolment. The reasoning is that, urban-based households prefer private schools to public school, given the quality of services provided in private schools. The positive correlation between school enrolment and education spending in the long run implies that the government has been correct in spending a larger proportion of its budget on education. However, considering the fraction spent on education, the system can perform way better, implying that there is still room for improvement.

5.5. Residual diagnostics

Time series analysis is not without risk, and chief among those risks is the risk of heteroskedasticity and serial correlation. Thus, it is of paramount importance for one to perform residual diagnostics to ensure that heteroskedasticity and serial correlation are not present in the model. The results are provided in Table 5.

Table 5. Residual tests results

| Type           | Test                  | Obs*R-squared | Prob. Chi-square |
|----------------|-----------------------|---------------|------------------|
| Heteroskedasticity | Breusch-Pagan-Godfrey | 2.61          | 0.63             |
| Heteroscedasticity | White                 | 2.54          | 0.64             |
| Serial correlation | Breusch-Godfrey       | 2.79          | 0.10             |
| Kurtosis       | 2.28                  |               |                  |
| Jarque-Bera-Prob | 0.77                  |               |                  |
It is apparent from Table 5 that the corresponding p-value for the serial correlation test is 10%, which is above the 5% significance level. This implies that the model is free from serial correlation. Furthermore, we can observe in Table 5 that the corresponding p-values for the White and Breusch-Godfrey heteroskedasticity tests are 64% and 63%, respectively. This simply implies that the model is also free from heteroskedasticity since the corresponding p-values are above 5%. In terms of normality, we find that the Jarque-Bera p-value is 76% while the kurtosis is 2.28. Both values indicate that the data is normally distributed. We also ran residual stability tests to ensure that the residuals are stable over time. The output is provided in Figure 5. It is clearly apparent in Figure 5 that the residuals are stable overtime, given that the residual lines fall within the cusum bounds at the 5% significance level.

5.6. Granger causality analysis
In this subsection, we present findings from the Granger-causality test. Granger (2004) states that if time series X Granger-causes time series Y, then past values of X can be used for the prediction of future values of Y. The results are provided in Table 6.

The pairwise Granger-causality test indicates that there exists uni-directional causation from spending on secondary education to secondary school enrolment. This implies that education

| Variable       | F-value | P-value | Result       |
|----------------|---------|---------|--------------|
| LSEE, SENR     | 7.56    | 0.01    | Uni-directional |
| SENR, LSEE     | 2.14    | 0.16    |              |
spending causes school enrolment. However, secondary school enrolment does not Granger-cause secondary education spending.

5.7. Variance decomposition

Variance decomposition indicates the forecast error variance of each variable attributable to its innovations and those of other variables (Brooks, 2008). The findings are provided in Table 7 below.

The results as summarised in Table 7, indicate that in the short run (2 year period), school enrolment accounts for 94% of its own shock while the value for government spending is 0.48%, for GNI Per capita is 0.66%, for health expenditure is 5% and for urbanisation is 0.003%. In the long run, typically a period of 10 years, school enrolment accounts for 63% of its own shock whereas the figures for explanatory variables are 0.79% for government spending, 22% for GNI Per capita, 13% for health expenditure and a relatively low value of 0.16% for urbanisation.

5.8. Impulse response function

Impulse response is a shock to the VAR system. It identifies the responsiveness of endogenous variables in a VAR system if a one standard deviation shock is added to the error term. One standard deviation shock of school enrolment to school enrolment gradually goes down from period 1–10. Initially the reaction is positive and after 7 years it will be negative. GNI Per capita is initially at zero, thereby remaining negative the entire period.

Health expenditure reveals an upward trend from period 1–2, thereby declining gradually until it reaches zero in the last period. As for urbanisation, there is somewhat a constant trend from period 3 to the last period following an initial start at zero. Government spending falls below zero in the first period, thereby gaining momentum from period 2 towards the last period. Given these results, school enrolment accounts for its own shock both in the short and long run.

6. Conclusion

This study investigated the relationship between public spending and school attendance at an aggregate level in South Africa. The study made use of time series data spanning from 1999 to 2015 as well as various econometric techniques to achieve its objective. The findings indicate that a long-run relationship exists among the variables in question. Furthermore, secondary education spending and household income are statistically significant and positively correlated with secondary school attendance while urbanisation on the contrary, is negatively correlated with school enrolment. Uni-directional causality from secondary education spending to secondary enrolment has also been identified. As an econometric procedure, the study also conducted various residual diagnostic tests to ensure that the findings obtained in this study do not suffer from spurious regression. Based on the findings obtained and conclusions reached, this study recommends that

| Period | S.E. | SENR | LSEE | LGNI | PHE | LURB |
|--------|------|------|------|------|-----|------|
| 1      | 0.01 | 100.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2      | 0.01 | 93.74  | 0.49 | 0.66 | 5.11 | 0.00 |
| 3      | 0.01 | 87.12  | 0.57 | 4.22 | 8.07 | 0.02 |
| 4      | 0.01 | 79.93  | 0.50 | 9.27 | 10.25 | 0.05 |
| 5      | 0.02 | 73.10  | 0.45 | 14.41 | 11.97 | 0.07 |
| 6      | 0.02 | 67.64  | 0.44 | 18.71 | 13.10 | 0.10 |
| 7      | 0.02 | 64.16  | 0.50 | 21.61 | 13.61 | 0.13 |
| 8      | 0.02 | 62.67  | 0.59 | 22.96 | 13.63 | 0.15 |
| 9      | 0.02 | 62.69  | 0.70 | 23.09 | 13.36 | 0.16 |
| 10     | 0.02 | 63.46  | 0.80 | 22.58 | 12.99 | 0.17 |
in order to close the gap in providing quality education in South Africa, a wide range of interventions are needed. The focus should be on increasing enrolment rates and narrowing dropout rates, more especially those that are due to lack of funding. In addition, school officials should be provided with the necessary financial and administrative skills to receive, distribute and utilise funds in the most efficient and economical way.

7. Limitations
Due to the unavailability of secondary data on school enrolment, this study only investigated the relationship between education spending and school enrolment over a short horizon. An overview analysis of education spending and school enrolment over a long horizon would have provided more credible and concrete results for policy making since econometric modelling functions more efficiently over longer observations. Also, the study only focused on one segment of basic education in South Africa, which is secondary schooling than on both primary and secondary schooling. Thus, the findings obtained can only be used to inform policy making in secondary schooling.

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Notes
1. TIMSS “is an international study which evaluates learners’ content knowledge in Science and Mathematics all around the world. The participants come from different educational systems in terms of the standard of living, geographical factors and population size.
2. SACMEQ “is a cross-national initiative consisting of 14 countries in Southern and Eastern Africa. SACMEQ tests the numeracy and literacy skills of Grade Six learners in each of the participating countries.”

Cover image
Source: Author.

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Appendix

Table A1. Data description and sources

| Variable                          | Description                                                                                                                                                                                                 | Source                                                                                           |
|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| Secondary School Enrolment       | Gross enrolment ratio is the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown.                                          | World Bank Open Data and Statistics South Africa                                              |
| Secondary Education Spending by Government | General government expenditure on education (current, capital, and transfers) is expressed as a percentage of total general government expenditure on all sectors (including health, education, social services, etc.). It includes expenditure funded by transfers from international sources to government. | National Treasury of South Africa, Statistics South Africa and World Bank Open Data               |
| Government Spending on Health    | Public health expenditure consists of recurrent and capital spending from government (central and local) budgets, external borrowings and grants (including donations from international agencies and nongovernmental organizations), and social (or compulsory) health insurance funds. | World Health Organization Global Health Expenditure database                                   |
| Gross National Income per capita | GNI (formerly GNP) is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad | World Bank Open Data                                                                          |
| Urban Population                  | Urban population refers to people living in urban areas as defined by national statistical offices. The data are collected and smoothed by United Nations Population Division | World Bank Open Data                                                                          |
