Effect of government spending on total factor productivity in South Africa

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Abstract

Current discourse shows that South Africa is failing to unlock long run growth because government spending on fixed capital has been declining since the mid-1990s. Existing South African literature does not examine the effect government spending on total factor productivity (TFP). The effect of government consumption and capital spending on TFP is examined using data for the period 1960-2019. The paper employs a non-linear autoregressive distributed lag modelling framework. Private fixed capital, government fixed capital and government final consumption spending have asymmetric effects on TFP. Private fixed capital has a positive relationship with TFP, but government fixed capital has mixed effects on TFP – distinctly positive effects in the short run and mixed effects in the long run. Government final consumption expenditure has an inverse relationship with TFP in both the short run and the long run. Further, findings show that increases in private fixed capital have increasing multipliers on TFP over time, while government final consumption has decreasing multipliers over time. Decreases in government fixed capital spending have increasing multipliers on TFP, suggesting that the solution to unlocking TFP lies in improving the productivity and efficiency of existing public capital rather than expanding the scale of investment.

Keywords: government final consumption, government fixed capital, non-linear autoregressive distributed lag, private fixed capital, total factor productivity.
JEL Codes: D24, H53, H54

1. Introduction

The question of how South Africa can unlock long run productivity using the public purse has exercised the minds of public economists lately. Empirically, the consensus is that government can increase long run productivity of the economy by reallocating resources from consumption spending to fixed capital spending (Burger, Stuart, Jooste, & Cuevas, 2012; Burger, Siebrits, & Calitz, 2016; Burger & Calitz, 2020). For example, Burger et al. (2016) and Calitz, Du Plessis, and Siebrits (2014) have shown that during the first twelve or so years of democracy, the government of South Africa managed to create healthy fiscal finances but this came at the cost of falling government fixed capital spending. There was also sustained reallocation of resources from defence spending to social spending (Calitz et al., 2014). The sustained decrease in government spending on fixed capital has undermined the possibility of improved productivity in the long run and has increased threats to fiscal sustainability. Further, Burger and Calitz (2020) show that the government expenditure to GDP ratio has exceeded its optimal level of 29%, a level that is associated with an economic growth rate of about 0.9%. Further increases in government expenditure only work to

undermine economic growth and fiscal sustainability. Endogenous growth theories show that government spending on fixed capital enhances economic growth in the long term (Evans, 2010). Makhoba, Kaseeram, and Greyling (2019) have established that gross fixed capital formation had a positive effect on economic growth in South Africa.

Figure 1 shows a negative correlation between government final consumption expenditure to GDP and total factor productivity, even though before the mid-1980s both variables exhibited a positive association. TFP rose and fell with government expenditure on fixed capital as Figure 1 illustrates, suggesting a positive correlation between the two. Some scholars have argued that in a country exhibiting high levels of inequality, government consumption spending can increase profitability of private business thus causing them to invest more in productivity growth (Kelton, 2020; Mbeki, 2009; Patrick, 2000). According to this inference, both fixed capital and consumption spending by government have a positive influence on national productivity. South Africa, in general, experienced rising TFP between 1960 and late 1970s, after which it has been struggling with falling TFP, which eventually recovered and stabilised at a much lower level after mid-1990s than the pre-democracy level. Ndulu (2008) explains the falling TFP between the late 1970s and mid-1990s through the lens of policy syndromes such as the redistributive syndrome, the regulatory syndrome and the looting of the state syndrome. After, the global financial crisis, however, TFP has continued to decline. These trends raise an important question. Has government expenditure on fixed capital, consumption, or both influenced the evolution of total factor productivity?

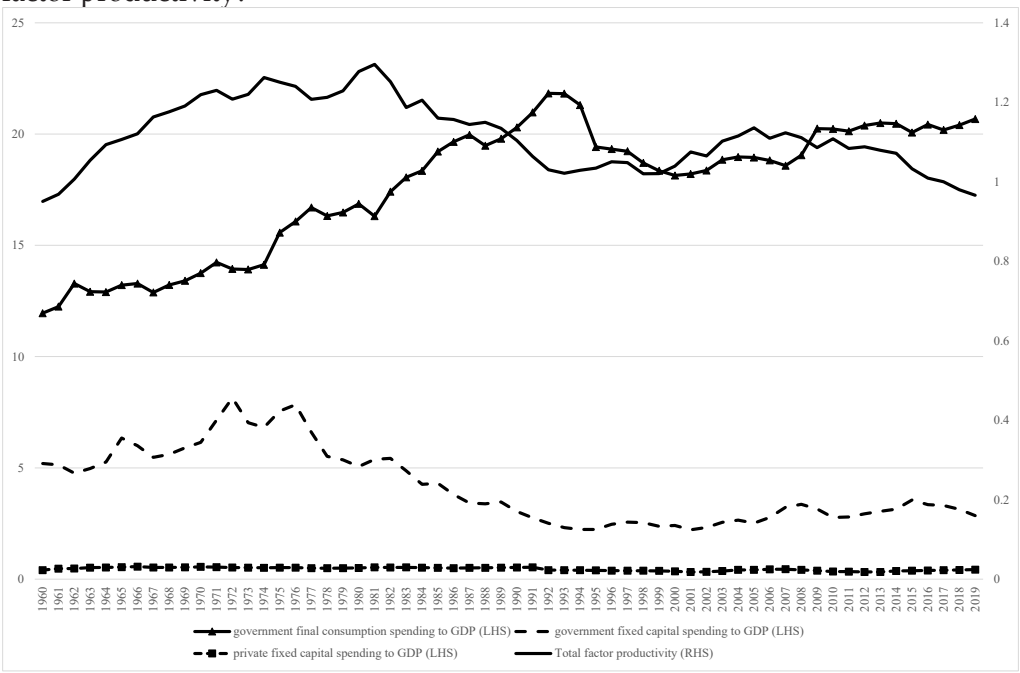

Figure 1: Evolution of total factor productivity, government consumption, and government and private fixed capital spending in South Africa

Source: South African Reserve Bank and Federal Reserve Bank of St. Louis

The present paper contributes to the debate on the role of fiscal policy in influencing long run productivity by linking government capital and consumption spending to total factor productivity (TFP). The paper contributes to the evolving discussion by directly modelling national TFP on government spending on both consumption and fixed capital. Further, the paper approaches the modelling within a non-linear autoregressive distributed lag modelling framework, which relaxes the restrictive assumption that positive and negative changes in an explanatory variable have identical effects on the dependent variable. This alternative modelling assumption helps answer more directly whether changing a government spending category will have the intended practical effects, otherwise failing to control for non-linearities can result in perverse policy inferences.

2. BRICS and selected African country TFP trends

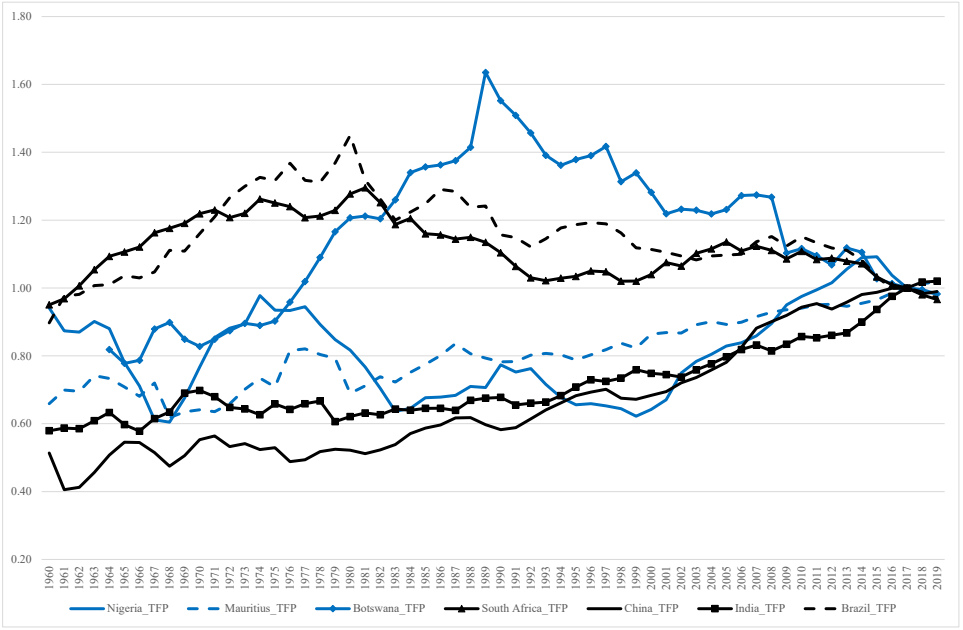

Figure 2: BRICS and some African country TFP trends 1960-2019
Source: Federal Reserve Bank of St. Louis

Figure 2 sets South Africa's TFP evolution within a broader context of its BRICS and some African peers. South Africa and Brazil share similar trends in the evolution of their TFPs. Despite investing in National Systems of Innovation, with significant government investment in research and development and human capital accumulation (Kahn, de Melo, & Pessoa, 2013; Kahn, 2014; Scerri, Lastres, Cassiolato, & Couto Soares, 2013), their TFP has continued to decline after the late 1970s. However, their TFPs have largely remained above unity suggesting that these countries, most likely,

are experiencing technical progression. On the other hand, China and India provide a polar opposite of low but rising level of productivity, which still hovers below unity. This suggests China and India might be operating below their efficiency frontiers.
Figure 2 also demonstrates that in the African context, Botswana and South Africa share similar TFP trends although the latter's TFP began a sustained decline after the late 1980s. Yet, Nigeria (the largest African economy only rivalled by South Africa) and Mauritius started with low but rising levels of total factor productivity. In fact, Nigeria and Mauritius tend to share similar trends with other BRICS countries excluding South Africa and Brazil. The general trend of TFP decline for South Africa despite considerable efforts at setting up a national system of innovation raises the question of whether government spending could probably have an influence on TFP. Marire (2021), and Rooks and Oerlemans (2005) have shown that the South African national system of innovation has proven to be less productive since the global financial crisis or slightly much earlier. Could the behaviour of government spending on fixed capital and consumption have had a bearing on the evolution of TFP?

3. Literature sketch

The Solow growth model explained total factor productivity as residuals of a typical Cobb-Douglas production function (Romer, 1990; Solow, 1956). Subsequent generations of growth theories – falling in the camp of endogenous growth models – showed that total factor productivity was endogenous (Romer, 1990; Romer, 1998). Total factor productivity (TFP) growth can be decomposed into change in technical efficiency, technical change and change scale efficiency (Marire, 2020). Shifts in the production function – also measured as technical change – have become a significant point of discussion both theoretically (Romer, 1990) and methodologically (Coelli, Rao, O'Donnell, & Battese, 2005; Greene, Khalaf, Sickles, Veall, & Voia, 2015). Shifts in the production function represent economic growth driven by technological change. Growing total factor productivity is a barometric measure of the long run health of an economy. Reduction of poverty, inequality and unemployment often is hinged on stimulating TFP (Barhoumi, Vu, Towfighian, & Maino, 2018).
Accumulating fixed capital tends to induce increases in TFP. Barro (1990), Barro and Sala-i-Martin (1992), and Bleaney, Gemmell, and Kneller (2001) have shown that fiscal policy can have both transitory and long-term effects on economic growth and productivity. Batina (1998) has shown that shocks in public fixed capital have enduring positive effects on productivity in the economy in the long run. Devadas and Pennings (2018) have shown that for economies that have severe scarcity of fixed capital, a growth in fixed capital has strong effects on economic growth and productivity, especially if fixed capital is an important input in the production function. To the extent that private fixed capital is much more relatively scarce than public fixed capital in developing countries, Devadas and Pennings (2018) argue that private fixed capital will have a greater effect on growth and productivity than government fixed capital. Their findings are interesting in that they also show that developing countries tend to have both low quality and inefficient public capital stock, because of which increasing public fixed capital is not always a panacea to low TFP. Pritchett (2000) ar-

rives at a similar conclusion, noting that while government spending on fixed capital in developing countries might be increasing, it is, nonetheless, of very low productive value. The solution might lie in improving the efficiency and productivity of already existing public capital stocks (Barhoumi et al., 2018). Gupta, Kangur, Papageorgiou, and Wane (2014) adjusted public capital for quality and efficiency and found that its impact on growth and productivity was very large, even after controlling for policy lags.

The link between fixed capital and total factor productivity has been examined to some extent. Lynde and Richmond (1993) found that nearly two-fifths of the decline in productivity could be explained by declining fixed capital in the economy. Destefanis and Sena (2005) found similar results in the context of Italy, establishing that core infrastructures such as highways and roads, road ports, seaports and airports, railroad, telecommunications, water, and electricity improved TFP significantly and were weakly exogenous. Bronzini and Piselli (2009) also confirmed the weak exogeneity of public fixed capital; causality ran from fixed capital to TFP. While Bonaglia, La Ferrara, and Marcellino (2000) concurred with Bronzini and Piselli (2009), and Destefanis and Sena (2005), they found mixed evidence on which types of public infrastructures have large effects on TFP; transport infrastructure had both productivity and efficiency enhancing effects. Everaert and Heylen (2001) also established the existence of a long run relationship between public capital and TFP, indicating that causality ran from public capital to TFP. On the contrary, Garcia-Mila, McGuire, and Porter (1996) found public capital to had no effect on TFP, but jurisdiction level fixed effects and private capital had an effect. Lai, Shieh, and Chang (2002) focused on defense spending, which they found to have long run growth enhancing effects. In an endogenous growth model, Angyridis (2015) demonstrated that increasing the share of national output allocated to public fixed capital not only induced sustained growth but also reduced inequality and poverty.

Given the foregoing review, the paper asks whether government spending on fixed capital, final consumption, or both influences the evolution of total factor productivity in South Africa. South Africa, more or less, is suffering from a secular stagnation problem, in which there is coexistence of rising corporate cash holdings, falling private investment, low to negligible growth rate, and rising unemployment, poverty and inequality (Diaw, 2020; Dudley & Zhang, 2016; Kelton, 2020; Palley, 2012). Even though significant resources are being directed to pubic investment and consumption, growth has remained unresponsive. It is a credible endeavour, therefore, to test the effect of government spending on TFP.

4. Methods and data

Under the assumption that government spending has lagged effects on total factor productivity (TFP), the study adopts an autoregressive distributed lag modelling framework. The link between TFP and government fixed capital and consumption spending can be represented as:

$$TFP_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i} TFP_{t-i} + \sum_{j=0}^{q} \beta_{2j} PFK_{t-j} + \sum_{h=0}^{r} \beta_{3h} GFK_{t-h} + \sum_{4g=0}^{s} \beta_g GFC_{t-g} + \mu_t \quad (1)$$

Equation (1) explains that TFP can be explained by its own history and the current

and past values of private fixed capital (PFK), government fixed capital (GFK) and government final consumption (GFC). The optimal lag structure of the ARDL is to be established using information criteria. The error term is assumed to follow the normal distribution.

An F-bounds test applied to (1) can be used to test for the existence of a long run relationship, which paves way for an ARDL error correction representation (Pesaran, 2015). However, equation (1) presumes that positive and negative changes in PFK, GFK and GFC have identical effects on TFP. This is an overly restrictive assumption. A better assumption is to say positive and negative shocks in the explanatory variables have asymmetric effects on TFP. This assumption transforms equation (1) into (2), a non-linear ARDL (NARDL) model, as follows:

$$TFP_t = \beta_0 + \sum_{i=1}^{p} \rho_{1i} TFP_{t-i} + \sum_{j=0}^{q} \beta_{2j}^{+} PFK_{t-j}^{+} + \sum_{j=0}^{q} \beta_{2j}^{-} PFK_{t-j}^{-} + \sum_{h=0}^{r} \beta_{3h}^{+} GFK_{t-h}^{+} + \sum_{h=0}^{r} \beta_{3h}^{-} GFK_{t-h}^{-} + \sum_{t=g}^{s} \beta_{4g}^{+} GFC_{t-g}^{+} + \sum_{t=g}^{s} \beta_{4g}^{-} GFC_{t-g}^{-} + \mu_t \quad (2)$$

In equation (2), each explanatory variable is decomposed into positive and negative shocks so that a test of asymmetric effects can be carried out. In general, therefore, the optimal lags for each decomposed variable do not necessarily have to be the same for positive and negative shocks even though in the representation in (2) they might appear to be. The test for asymmetric effects is carried out on the hypotheses that

$$-\frac{\beta_{2j}^{+}}{\rho_{11}} = -\frac{\beta_{2j}^{-}}{\rho_{11}}; -\frac{\beta_{3h}^{+}}{\rho_{11}} = -\frac{\beta_{3h}^{-}}{\rho_{11}}; -\frac{\beta_{3g}^{+}}{\rho_{11}} = -\frac{\beta_{3g}^{-}}{\rho_{11}}; \forall j = 0, \dots, q; h = 0, \dots, r; g = 0, \dots, s \quad (3)$$

The test in (3) is an F-test based on the linear restrictions imposed on coefficients in (2).

Further, an F-bounds test can be carried out to examine the existence of a long run relationship between TFP and the explanatory variables, finding which paves way for an error correction representation. The error correction mechanism can be expressed as (4), following (Pesaran, 2015):

$$\Delta TFP_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta TFP_{t-i} + \sum_{j=0}^{q} \alpha_{2j}^{+} \Delta PFK_{t-j}^{+} + \sum_{j=0}^{q} \alpha_{2j}^{-} \Delta PFK_{t-j}^{-} + \sum_{h=0}^{r} \alpha_{3h}^{+} \Delta GFK_{t-h}^{+} + \sum_{h=0}^{r} \alpha_{3h}^{-} \Delta GFK_{t-h}^{-} + \sum_{t=g}^{s} \alpha_{4g}^{+} \Delta GFC_{t-g}^{+} + \sum_{t=g}^{s} \alpha_{4g}^{-} \Delta GFC_{t-g}^{-} + \theta ECT_{t-1} + \varepsilon_t \quad (4)$$

The coefficient of the error correction term (ECT), for convergence to occur. If statistically significant, it also indicates that the three (six disaggregated) explanatory variables Granger-cause TFP. Further, short run dynamics can also have asymmetric effects on change in TFP, which can be tested in much the same way as in equation (3). The data on fixed capital expenditures and government final consumption for the paper was obtained from the South African Reserve Bank for the period 1960-2019. Data on total factor productivity was obtained from the Federal Reserve Bank of St. Louis's Economic Research Data. The TFP measure was estimated using an index numbers approach. Both the standard Augmented Dickey-Fuller and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests were employed to test for unit roots in the data.

5. Results and analysis

Table 1: Unit root tests

	Levels	First difference	Order of integration
ADF:			
TFP_t	-2.938‡	-5.826***	One
PFK_t	-2.664‡	-6.597***	One
GFK_t	-0.746	-6.651***	One
GFC_t	-1.747	-6.051***	One
KPSS:			
TFP_t	0.133		Zero
PFK_t	0.112		Zero
GFK_t	0.668***	0.128	One
GFC_t	0.770***	0.212	One

Note: *means p<0.10; **means p<0.05; ***means p<0.01; ‡means trend is significant

Table 1 shows that the variables have mixed orders of integration, I(0) and I(1). The mixed orders of integration make the ARDL/NARDL approach a preferred option for establishing the existence of a long run relationship (Nkoro & Uko, 2016). Table 2 presents both the linear ARDL and non-linear ARDL models. It is observed that based on the linear ARDL, there is no evidence of cointegration between TFP, private fixed capital, and government spending on capital and consumption since the ECT term has a positive sign and despite the F-bounds test showing existence of a long run relationship. The presence of non-linearities hides the cointegration (Yilanci, Ozgur, & Gorus, 2019). However, the NARDL regression shows that there is a long run relationship with about 15.4% of the equilibrium in the previous period being corrected in the current period. It is a slow speed of adjustment.

Table 2: Linear and Non-linear autoregressive distributed lag model results

TFP_t	ARDL (4, 0, 0, 0)	ARDL-ECM (4, 0, 0, 0)	NARDL (4, 0, 4, 1, 0, 4, 1)	NARDL-ECM (4, 0, 4, 1, 0, 4, 1)
TFP_{t-1}	0.881*** (0.123)		0.814*** (0.122)	
TFP_{t-2}	0.015 (0.170)		0.076 (0.163)	
TFP_{t-3}	-0.173 (0.167)		-0.455** (0.167)	

TFP_{t-4}	0.303** (0.116)		0.410*** (0.120)	
PFK_t	-0.082 (0.056)			
GFK_t	-0.012*** (0.004)			
GFC_t	-0.015*** (0.003)			
PFK_t^+			0.170 (0.107)	
PFK_t^-			-0.251* (0.133)	
PFK_{t-1}^-			0.282 (0.170)	
PFK_{t-2}^-			-0.395** (0.164)	
PFK_{t-3}^-			-0.469** (0.206)	
PFK_{t-4}^-			0.777*** (0.208)	
GFK_t^+			0.023* (0.013)	
GFK_{t-1}^+			-0.026** (0.013)	
GFK_t^-			-0.041*** (0.010)	
GFC_t^+			-0.057*** (0.010)	
GFC_{t-1}^+			0.036*** (0.013)	
GFC_{t-2}^+			-0.018 (0.012)	
GFC_{t-3}^+			-0.019 (0.012)	

GFC_{t-4}^{+}			-0.017** (0.007)	
GFC_{t}^{-}			0.036*** (0.013)	
GFC_{t-1}^{-}			-0.045*** (0.013)	
ΔTFP_{t-1}		-0.144 (0.117)		-0.031 (0.104)
ΔTFP_{t-2}		-0.130 (0.109)		0.045 (0.098)
ΔTFP_{t-3}		-0.303*** (0.108)		-0.410*** (0.100)
ΔPFK_{t}^{-}				-0.251** (0.108)
ΔPFK_{t-1}^{-}				0.087 (0.113)
ΔPFK_{t-2}^{-}				-0.308*** (0.111)
ΔPFK_{t-3}^{-}				-0.777*** (0.152)
ΔGFK_{t}^{+}				0.023** (0.010
ΔGFC_{t}^{+}				-0.057*** (0.007)
ΔGFC_{t-1}^{+}				0.020** (0.007)
ΔGFC_{t-2}^{+}				0.002 (0.007))
ΔGFC_{t-3}^{+}				-0.017** (0.006)
ΔGFC_{t}^{-}				0.036*** (0.010)
ECM_{t-1}		0.025*** (0.004)		-0.154*** (0.019)

Constant	0.330*** (0.060)	0.330*** (0.050)	0.210*** (0.090)	0.210*** (0.025)
R^2	0.956	0.514	0.979	0.761
F-stat	148.996 [0.000]	13.472 [0.000]	80.799 [0.000]	9.098 [0.000]
Serial correlation LM test, χ^2, [prob]	4.132 [0.127]		3.851 [0.146]	
Normality test, χ^2, [prob]	0.127 [0.939]		5.186 [0.075]	
Heteroscedasticity test, χ^2, [prob]	11.281 [0.127]		13.909 [0.835]	
Ramsey Reset test, t, [prob]	0.044 [0.965]		0.679 [0.502]	
Form & Bounds test, F, @5% (F_L, F_U)	10.348 (3.23 4.35)	10.348 (3.23 4.35)	8.401 (2.45 3.61)	8.401 (2.45 3.61)
Test of asymmetric effects:				
$PFK_t^+ = PFK_t^-$, t, [prob]			-2.283 [0.029]	Asymmetric
$GFK_t^+ = GFK_t^-$, t, [prob]			-2.614 [0.013]	Asymmetric
$GFC_t^+ = GFC_t^-$, t, [prob]			3.804 [0.001]	Asymmetric
$GFC_{t-1}^+ = GFC_{t-1}^-$, t, [prob]			-3.471 [0.001]	Asymmetric
Causality tests:				
All coefficients of PFK = 0			4.758 [0.013]	
All coefficients of GFK = 0			5.974 [0.002]	
All coefficients of GFC = 0			8.364 [0.000]	

Model significance:				
PFK_{t-1}^{-} = PFK_{t-1}^{-} = PFK_{t-1}^{-} = PFK_{t-1}^{-} = 0, F [prob]			5.297 [0.002]	

Note: *means p<0.10; **means p<0.05; *** means p<0.01; (…) are standard errors; […] are p-values; † means lower bound F critical value and § means upper bound F critical value.

Table 2 shows significant autoregressive effects that agree with the explanation of endogenous growth theories that technology has its own production function with previous stock of knowledge as a significant input into the production of new knowledge (Evans, 2010; Romer, 1990; Romer, 1998).

In general, Table 2 (the NARDL model) shows that private fixed capital has a positive effect on TFP because for decreases in private fixed capital, TFP also decreases and for increases in private fixed capital, TFP increases. However, the lagged effects of decreases in private fixed capital have both positive and negative values. Table 2 further shows that changes in private fixed capital have asymmetric effects on TFP, significant at the 5% level of significance. Negative shocks in private fixed capital dominate positive shocks. Figure 3 also reveals that both positive and negative changes in private fixed capital tend to positively correlate with TFP. This fits well into what economic theory predicts. In general, empirical and theoretical analysis confirm that private fixed capital spending has a positive effect on TFP because the profit motive ensures efficient use of the capital stock. The NARDL-ECM model shows that in the short run private fixed capital has current and lagged positive effects on changes in TFP to the extent that decreases in private capital stock are associated with decreases in TFP. According to causality tests in Table 2, private fixed capital Granger causes TFP.

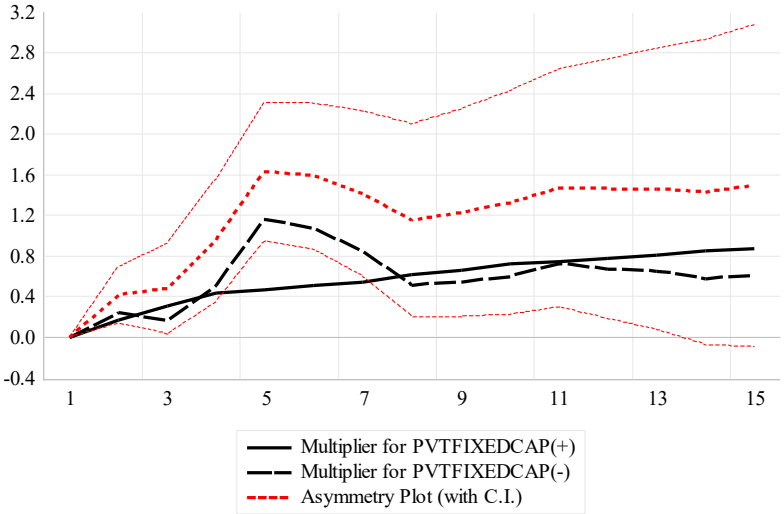

Figure 3: NARDL multiplier analysis for private fixed capital

The results in Table 2 show that government spending on fixed capital has asymmetrical effects on TFP. Increases in government spending on fixed capital are associated with increases in TFP but only at the 10% level of significance. The effects, however, are mixed in that current decreases in government spending on fixed capital lead to decreases in TFP, while the first lag of increases in government spending on fixed capital has negative effects. This contrast seems to have an economic justification. Some public fixed investments in South Africa have proven to be productive in their current period of investment, but over time their productivity declines, with some degenerating into white elephants. A good example is the mega soccer stadia that were constructed for the FIFA 2010 world cup which are now a burden on the taxpayer because they cannot generate enough revenue to maintain themselves (Du Plessis & Venter, 2010; Humphrey & Fraser, 2016; Molloy & Chetty, 2015). They have not been filled to capacity for at least twice for any given premier league season (Humphrey & Fraser, 2016; Molloy & Chetty, 2015). Given this interpretation, it is not surprising that increases in government spending have positive short run effects on TFP. Figure 4 shows that decreases in government spending on fixed capital have larger and increasing multipliers than increases in government spending on fixed capital. This finding suggests that the solution to unlocking long run economic performance in South Africa does not lie with ever increasing the size of government fixed capital spending. Perhaps, policymakers must also look into efficiency and quality of the fixed capital spending more than they focus on the scale of public investment. The asymmetric effects are very large. The causality tests in Table 2 reveal that government spending on fixed capital Granger causes TFP.

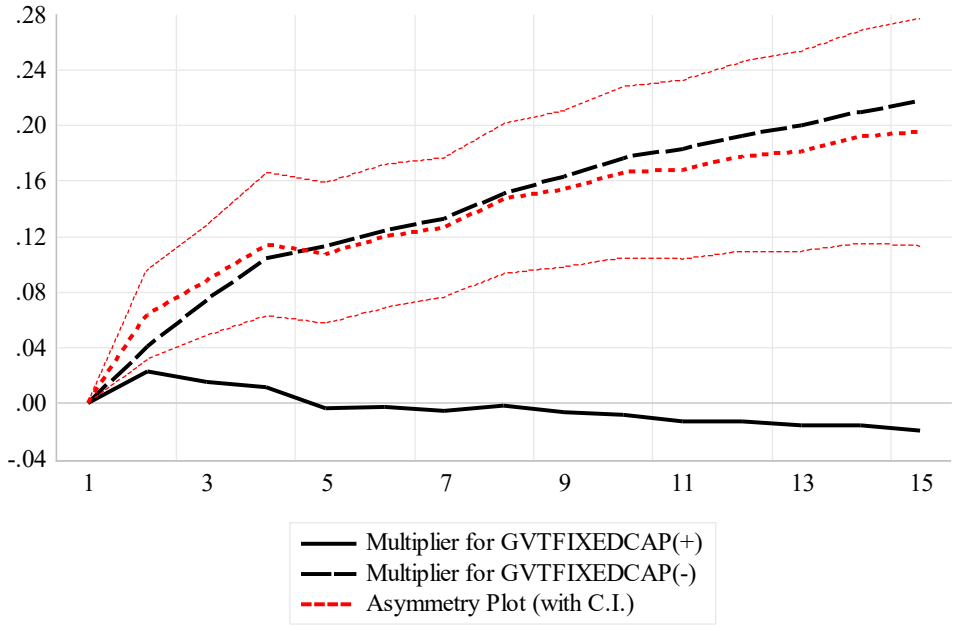

Figure 4: NARDL multiplier analysis for government fixed capital

Table 2 shows that changes in government final consumption have a negative effect on TFP. With the exception of the first and fourth lags of increases in government final consumption, which show a significant positive effect on TFP, the second and third lags have insignificant effects. The results show that both the current and first lag of increases in government final consumption have an inverse relationship with TFP. Increases in government final consumption spending tend to reduce TFP, while decreases in government final consumption spending tend to increase TFP. These results conform to contemporary arguments to the effect that government must re-allocate resources from consumption to fixed capital spending to improve the long run performance of the economy (Burger et al., 2016; Burger & Calitz, 2020). Figure 5 confirms this understanding, showing that multipliers for decreases in government final consumption spending increase over time, while multipliers for increases in government final consumption spending are decreasing over time. The implications of this result are immense for an economy that is struggling to unlock long run productivity. Table 2 also confirms that the short run effects of changes in government final consumption spending mimic long run effects of changes in government final consumption spending. Causality tests in Table 2 show that government consumption Granger causes TFP.

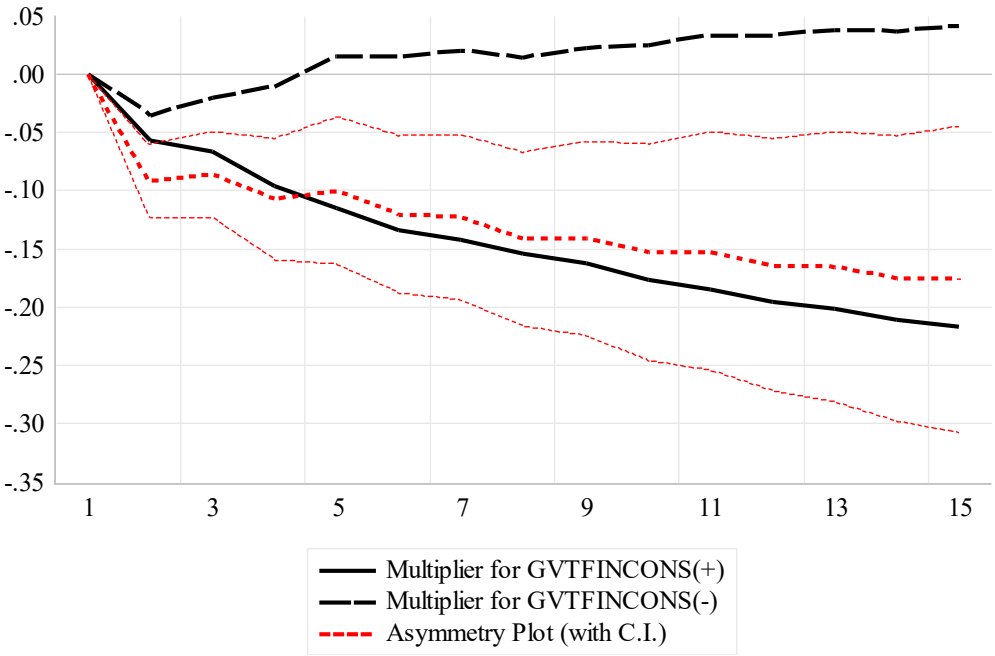

Figure 5: NARDL multiplier analysis for government final consumption

6. Diagnostic tests

Table 2 shows that the model does not suffer from serial correlation, heteroscedasticity and misspecification as tested by the Breusch-Pagan-Godfrey test, Breusch-Pagan-Godfrey test and the Ramsey Reset test respectively. The residuals are normally distributed according to the Jarque-Bera normality test. The CUSUM test (Figure 5) and CUSUM of Squares test (Figure 6) also confirm that the parameters of the model are stable. Based on these diagnostic tests, the results can be judged to be reliable and useable in informing public policy.

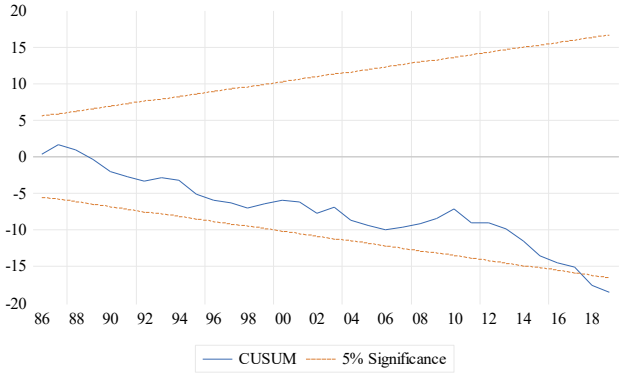

Figure 6: Parameter stability CUSUM test

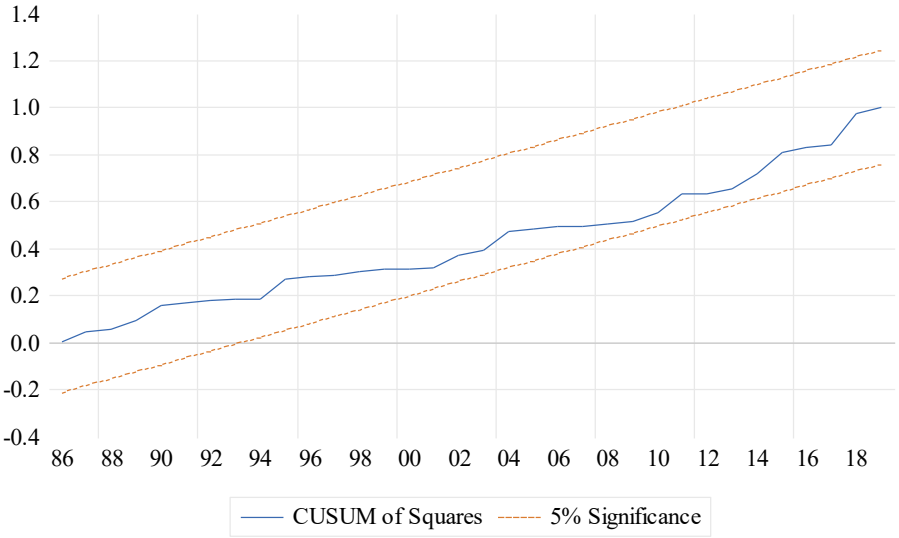

Figure 7: Parameter stability CUSUM of Squares test

7. Discussion and conclusions

The paper set out to test the effect of government spending on fixed capital and consumption on total factor productivity. Moreover, the test sought to assess whether the relationship exhibited asymmetric effects. The findings confirm that private fixed

capital, government fixed capital and government final consumption spending have strong asymmetric effects on TFP, although the direction of the effects varies considerably. In particular, we find that private capital is positively related to TFP, and government fixed capital is unambiguously positively related to TFP in the short run but the relationship is mixed in the long run. Government final consumption spending has negative effects on TFP in general. Further, private fixed capital, government fixed capital and government final consumption were found to Granger cause total factor productivity.

The findings of the study are confirmed by existing literature. Destefanis and Sena (2005), and Lynde and Richmond (1993) confirm that causality runs from fixed capital to total factor productivity. Further, Angyridis (2015), Bronzini and Piselli (2009), and Everaert and Heylen (2001) confirm our findings, having established that causality runs from government fixed capital to total factor productivity. Like our findings, Everaert and Heylen (2001) also found that a long run relationship existed between government fixed capital and total factor productivity. Batina (1998), and Devadas and Pennings (2018) confirm, as we did, that private fixed capital has huge asymmetric effects on TFP.

The implication of our study is that running a deficit on the capital budget as propounded by John Maynard Keynes seems to be counterproductive in the South African context because the problem lies not in underinvestment in fixed capital but in inefficient utilisation, and poor quality, of public fixed capital. The recent revelations at the State Capture Inquiry processes and indeed, in processes leading to the inquiry, massive economic waste in construction of sub-optimal thermal power plants (Department of Public Enterprises, 2000; Department of Public Enterprises, 2019; Fundudzi Forensic Services, 2018), underutilised stadia (Humphrey & Fraser, 2016; Molloy & Chetty, 2015; Schulz-Herzenberg, 2010), and idle Transnet locomotives, just to name a few, suggest that the quality-efficiency dimensions matter more than the scale of investment. The line of reasoning followed here partially contradicts the view expressed in Burger et al. (2016) and Burger and Calitz (2020), who maintain that capital spending must increase significantly.

Since the inauguration of President Ramaphosa, he has been trying everything to stimulate private investment. An increase in private fixed investment would undoubtedly increase TFP. One way of dealing with problems of inefficient and poor quality public capital is to engender public-private partnerships. The profit motive would ensure that efficiency in the utilisation of fixed capital is enhanced. This institutional arrangement would unlock idle corporate cash holdings and exploit the latent potential of the private sector to deliver innovative solutions.

The further implication of the findings is that fiscal health can be created by cutting on government final consumption spending. Scholars such as Burger et al. (2016) and Burger and Calitz (2020) have explored this theme recently. Decreases in government final consumption tend to have large positive effects on TFP. The drive towards fiscal consolidation must be enhanced but it should be to ensure that the current budget is financed fully by tax revenue and the capital budget by deficits.

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