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# The interaction between private sector investment in transport infrastructure and economic growth in South Africa: a joinpoint regression analysis

Rose Luke<sup>a</sup>, Noleen Pisa<sup>a\*</sup>

<sup>a</sup>*University of Johannesburg, Department of Transport and Supply Chain Management,  
P.O Box 524, Auckland Park, Johannesburg, South Africa, 2006.*

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## Abstract

This paper aims at exploring the interaction between private transport infrastructure investment and economic growth in South Africa. Annual percentage changes (APC) in private investment in transport infrastructure and GDP were determined using the joinpoint regression. To quantify the magnitude of change in investment in transport and GDP over time the APCs and p-values are presented. A p-value <0.05 indicates a significant change in trend. Private sector investment in transport infrastructure was assessed using the following indicators: Logistics Performance Index: quality of trade and transport-related infrastructure; ii. Public-Private Partnership (PPP) investment in transport and iii. Investment with private participation. Economic growth was assessed using annual real gross domestic products (GDP). The results indicate that there is a slight increase in the perception of the quality of trade and transport-related infrastructure, despite varying levels of investment in such infrastructure. PPP investment in transport declined at an annual rate of 6.45%, while investment with private investment increased by 1.45% in the period of review. An overall increase is observed for GDP (at constant 2010 US\$) between 1996 and 2016. The results reveal that private sector investment in transport infrastructure appears largely unassociated with economic growth implying that this type of investment may be impacted by other factors.

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\* Corresponding author. Rose Luke Tel.: +27115594951; fax: +27 11 559 2029.  
E-mail address: [rlope@uj.ac.za](mailto:rlope@uj.ac.za)

## 1. Introduction

Economic growth is generally considered to be an increase in the capacity of an economy to produce goods and services, compared from one period of time to another (Investopedia, n.d.). This definition is enhanced by the Intelligent Economist (2018) that considers it to be the increase in the market value of the goods and services produced by an economy over time. These definitions thus not only consider the ability of the economy to produce goods and services, but whether that ability has enabled an actual shift in value to the economy. Generally these changes are measured over time by the increase in the output of the economy or Gross Domestic Product. Because economic growth is seen as an increase in a country's total income, output and expenditure, it is commonly regarded as a critical measure of economic health. As economic growth is usually associated with an increase in the standards of living within a country, it is also regarded as essential for the alleviation of poverty (Roemer & Gugerty, 1997). A DFID report (Department for International Development, n.d.) states that "Economic growth is the most powerful instrument for reducing poverty and improving the quality of life in developing countries". Both cross-country research and country case studies provide overwhelming evidence that rapid and sustained growth is critical to making faster progress towards the Millennium Development Goals". For this reason, economic growth deserves particular attention in developing countries.

Achieving economic growth is dependent on a number of factors. These can be described as the discovery of new or better economic resources, the growth of the labour force, the creation of superior technology or other capital goods or the enhancement of specialisation (Investopedia, n.d.). The Intelligent Economist (2018) expands this by identifying six areas which impact the economy and states that improvements in any of the areas would thus result in economic growth, i.e. natural resources, physical infrastructure, population or labour, human capital, technology or law. It is evident from the factors identified as having an impact on economic growth that, whether directly or indirectly, the provision of physical infrastructure is critical to achieving such growth. Munnell (1992, p. 197) concludes directly that "...the evidence suggests that, in addition to providing immediate economic stimulus, ... infrastructure investment has a significant, positive effect on output and growth." In South Africa, Vukeya (2015, p. 1) finds that "in the long run, economic infrastructure investment is an important determinant of growth" and Perkins (2011, p. 32) asserts that "...it would be difficult to find another category of expenditure of comparable size (aside from infrastructure investment) that is of equal importance in promoting economic growth."

Rietveld & Bruinsma (1998, p. 1) stated that "Economic development is not only the result of a proper combination of private production factors such as labour and capital, but also of infrastructure in general and transport infrastructure in particular." Numerous studies have investigated the relationship between transport investment and economic growth. Badalyan, et al. (2014) "showed that gross capital formation and road/rail goods transported have a positive and statistically significant impact on economic growth in the short-run." Pogorletchi (2014, p. 2) finds that "stock of roads makes larger distribution to economic growth in counties with lower quality of government." Pradhan & Bagchi (2013, p. 139) also suggest "that expansion of transport infrastructure (both road and rail) along with gross capital formation will lead to substantial growth of the Indian economy." There thus exists sufficient evidence to confirm that there is a significant positive relationship between transport investment and economic growth.

This relationship is however complex. Although common wisdom (and many studies, as cited above) suggests that transport investment leads to economic growth, this may not necessarily always be the case, particularly in the short-run. Ecola & Wachs (2012, p. 22) state that "... it is not clear whether high-productivity transportation investments reduce or increase either economic growth ... Sound investments lead to reductions in expenditures on moving people and goods per unit of economic output, so in the short term they might reduce both economic growth .by making travel less circuitous while increasing economic efficiency." Whilst Pradhan & Bagchi (2013) found a bidirectional relationship between road transport and economic growth and Pradhan, et al. (2013) as well as Geet, et al (2016) in Ramesh (2017) confirm the bi-directional causality between transport investment and GDP, evidence from New Zealand (Ministry of Transport, 2014) suggests that the more likely scenario there is that "changes in economic growth causes changes in transport activity." Although this pertains to transport activity, there are instances where this pertains to transport investment. In Pakistan, Mohmand, et al. (2017) found that in the short run, there was no causality between the two variables at the national level. Additionally, there was only a unidirectional causality from economic development to infrastructure investment exists in the long run. Notably, at a provincial level, the findings indicated a

bidirectional causality in the rich and developed provinces, but a unidirectional causality from economic growth to transportation infrastructure in the underdeveloped provinces. The direction of this causality suggests that transport investment may not necessarily result in economic growth, but more importantly, that economic growth is required for transport investment to follow.

Major transport investments tend to be financed through the public sector, however there is an increasing call for private sector involvement, as resources tend to be constrained, particularly in developing countries. Although Kandenge (2010), Nwakoby & Bernard (2016), Khan & Reinhart (1990) and Makuyana & Odhiambo (2016) all suggest that private sector investment is critical for economic growth in developing countries, may be more important than public investment and may even result in catalytic growth, Panayiotou & Meddaa (2014) suggest that private investors are cautious about transport investments and that financial mechanisms need to support the needs of private investors and regulatory conditions need to be favourable to enabling investment and attracting private sector investment. Mustefa (2014) and Mohsen (2015) find unidirectional causalities between GDP and private investment and, together with Kalu & Onyinye (2015), suggest that macro-economic policies need to be in place to attract this type of investment. These findings suggest that private sector investment can be enormously beneficial to economic growth, but that these may only happen if there is already a healthy economic environment in which private investment is encouraged and returns on investment likely to be made.

The literature reveals that there are observable relationships between transport investment and economic growth, however the nature of the relationship appears to be dependent on the environment within which the phenomenon is observed. Although there always appears to be some relationship between transport infrastructure investment and economic growth, the extent to which private sector participation impacts this relationship is less clear, with results varying from country to country. These observations suggest that these relationships need to be observed at country-level to determine their nature and extent. In South Africa, it is estimated that, despite high levels of investment in infrastructure, the country still lags considerably in terms of infrastructure requirements. The Global Infrastructure Hub (GIH), an organisation affiliated with the G20 bloc of nations, estimates that “South Africa – like other Africa nations – is still faced “significant investment gaps” and would need “very large” infrastructure investments moving towards 2040. For example, currently South Africa’s infrastructure bill topped US\$289-billion, with US\$441-billion still needed to meet the expectations of its increasing population” (SABC News, 2017). As transport investment is considered to be critical to economic growth and development in the country (Gabara, 2012), yet is still inadequate to meet the country’s mobility and accessibility needs (Schoonraad, 2010), private sector investment is becoming increasingly important (Creamer, 2017). Although a few studies have investigated the linkage between transport infrastructure investment and economic growth in South Africa (Hlotywa & Ndaguba, 2017; Moeketsi, 2017), little has been done to investigate the relationship between private sector investment in transport infrastructure and economic growth. This paper therefore seeks to further explore this association.

## 2. Research methodology

This study is exploratory in nature and seeks an initial determination of the association between private transport investment and economic growth. The research firstly considers the quality of transport-related infrastructure to provide context to the study. Private sector investment in transport is then considered to determine trends over the period under review. Finally trends in GDP growth is considered and compared to trends in private investment in transport infrastructure. The data used and data analysis techniques are described below.

### *Data*

Private sector investment in transport infrastructure was assessed using the following indicators:

- i. Logistics Performance Index: Quality of Trade and Transport-related Infrastructure,
- ii. Public Private Partnership Investment in Transport and
- iii. Investment with Private Participation.

Annual real gross domestic product (GDP) figures (constant at 2010 prices) were used as a measure of economic growth. Data was obtained from the World Bank’s world development indicators for the period 1996 to 2016.

### Data analysis

Annual percentage changes (APC) for investment in transport infrastructure and GDP were computed in a joinpoint regression model using the formula:

$$\log (rate_y) = b_0 + b_1y$$

where  $\log (rate_y)$  is the natural log of investment in transport infrastructure/ GDP in year  $y$ .

Investment in infrastructure and GDP trend data were fitted to the simplest joinpoint model. The model subsequently tested whether statistically significant joinpoints exist in the data and should be added to the model (up to a maximum number). A series of straight lines was joined and fitted to investment/ GDP using the formula:

$$(e^{b_1} - 1) \times 100$$

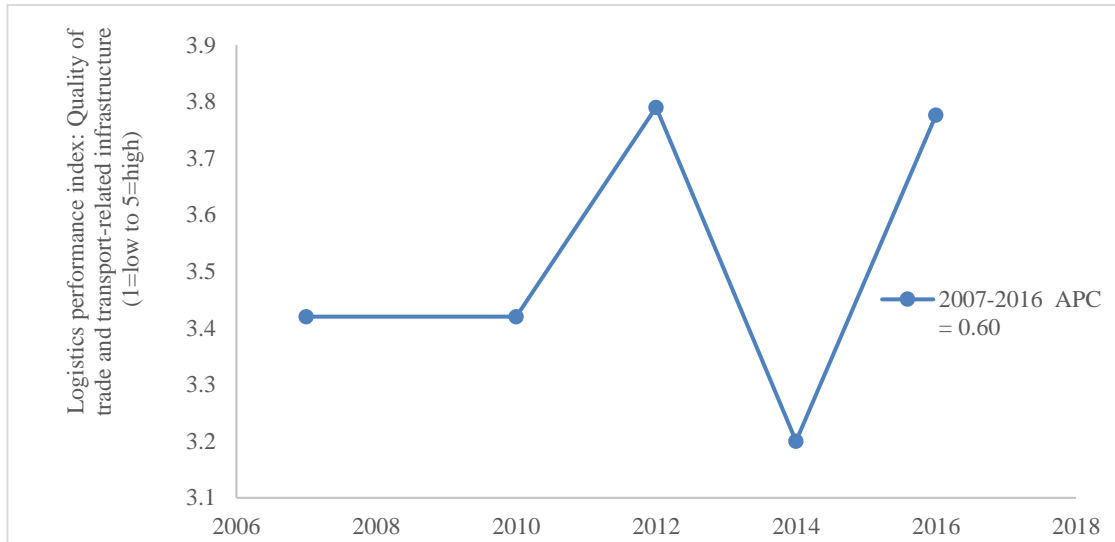
The joinpoint regression program version 4.6.0.0 was used. The linear on the log of the GDP for example was used in the joinpoint regression model for calculating annual percentage rate change (Joinpoint Regression Program, 2018). The maximum number of joinpoints was set to three in order to avoid capturing unstable trends due to relatively small number of data points for the investment data. To quantify the magnitude of change in private investment and GDP overtime the APCs and p-values are presented. A p-value <0.05 indicates a significant change in trend. The model output is presented in graphs depicting the number of joinpoints in each series.

### 3. Presentation of results

The analysis was initiated by using the World Bank's Logistics Performance Index (World Bank, 2016). The measurement regarding the "Quality of trade and transport-related infrastructure (1=low to 5=high)" was used. Although the measure is criticized as being inadequate in providing information on the actual quality of infrastructure, but rather just provides the users' view of the quality of infrastructure, it nonetheless provides a perspective that sets the base for the discussion. The results of the joinpoint regression analysis are shown in Figure 1 below.

Data on the quality of trade and transport-related infrastructure in the Logistics performance index (LPI) was available for the period 2007 to 2016. During this period the highest score, 3.7, was recorded on this LPI sub-index in years 2007 and in 2016 respectively. The overall LPI trend for the quality of trade and transport-related infrastructure, for the period show three distinct non- significant phases: an initial constant between 2006 and 2010, followed sharp rise in 2012, sharp decline in 2014 and a subsequent improvement in 2016. Overall an increase or improvement in the LPI of 0.6% was observed.

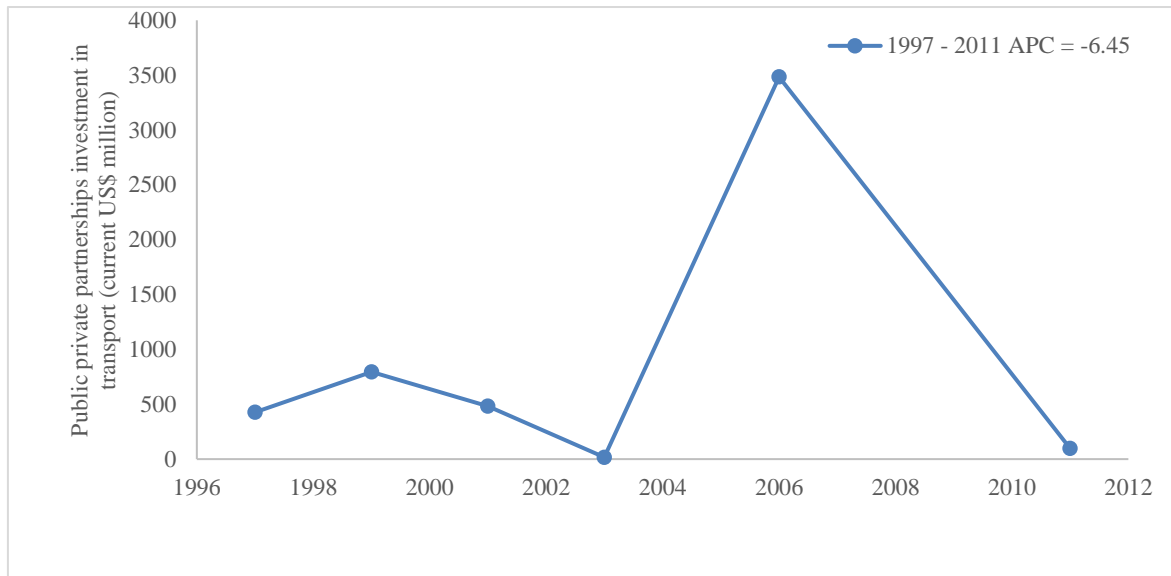
Although the joinpoint regression analysis indicates that there is a slight increase in the perception of the quality of trade and transport-related infrastructure, the figures are read with caution. The analysis averages the figures over the years, but these vary considerably over the years with wide standard deviations to both the positive and negative sides of the curve. Of greater importance is that the analysis does not reveal any joinpoints. This implies that the perception of the quality of trade and transport-related infrastructure has not changed significantly in the period under review. Also, although the curve appears to show a slight rise, it should generally be regarded as relatively flat. The user perception of infrastructure has thus not changed in any significant way, despite varying levels of investment in such infrastructure.



Final selected model: 0 joinpoints

Figure 1: Logistics Performance Index: Quality of Trade and Transport-related Infrastructure

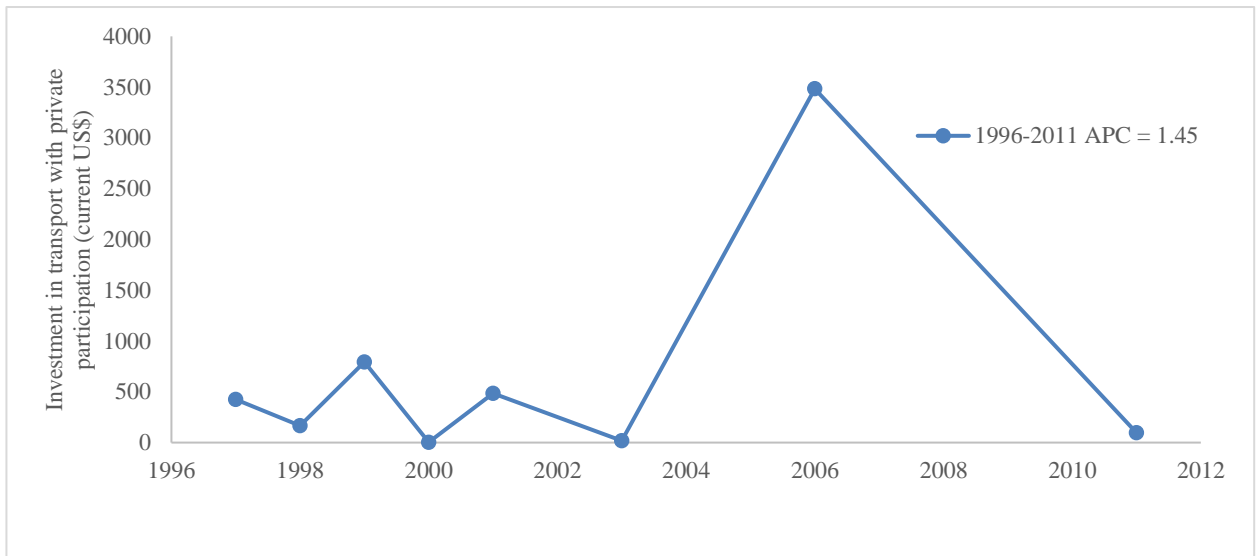
In the second part of the analysis, private investment in transport infrastructure was considered. Two World Bank indicators were used for this analysis, the first of which was the measure for Public-Private Partnership (PPP) investment in transport in current US dollars. The results are shown in Figure 2 below. Data on PPP investment in transport was available for six time periods namely; 1997, 1999, 2001, 2003, 2006 and 2011. PPP investment in transport shows a sharp increase 5 years after South African independence in 1994. However, a sharp decline is observed in 2003. A subsequent all-time high in PPP investment is observed in 2006 followed by a sharp decline in 2011. Overall PPP investment in transport declined at an annual rate of 6.45% in the period under review. The joinpoint regression analysis reveals zero joinpoints and declining levels of public-private partnership investment, even at current US\$ values. According to Trevor Manuel, erstwhile Minister of Finance in South Africa, “Since 1999, public private partnerships (PPPs) in South Africa have been regulated under the PFMA (Public Finance Management Act), providing a clear and transparent framework for government and its private sector partners to enter into mutually beneficial commercial transactions, for the public good” (PPP Unit: National Treasury, 2007). In terms of the PFMA, the National Treasury should issue practice notes from time to time. The first of these was issued in 2004 (PPP Unit: National Treasury, 2004) and deals with the core PPP issues and how they should be approached to achieve the PPP principles of risk transfer, value for money and affordability (Norton Rose Fulbright, 2015). Subsequent notes dealing with various stages of the PPP process are issued, as modules forming part of the PPP Manual (Norton Rose Fulbright, 2015). Despite increasing emphasis from government on public-private partnerships in investment, the figure indicates a decline in the levels of this type of investment. Notably, the enactment of legislation and subsequent issue of notes by National Treasury appears to have no significant impact on these levels of investment, and the analysis indicates no joinpoints. It is also noted that plotting of the levels of investment over time shows some years with relatively high levels of public-private partnership investment. In 2006, for example, the partnership investment level appears particularly high. It is assumed that this level of investment is associated with the building of the Gautrain Rapid Rail Link, a PPP investment of R32 billion concluded in 2006 (National Treasury, 2017). Despite this major investment, the analysis still reveals that this has made no significant difference to the overall pattern of declining public-private investment in transport infrastructure in the country.



*Final selected model: 0 joinpoints*

Figure 2: Public Private Partnership Investment in Transport

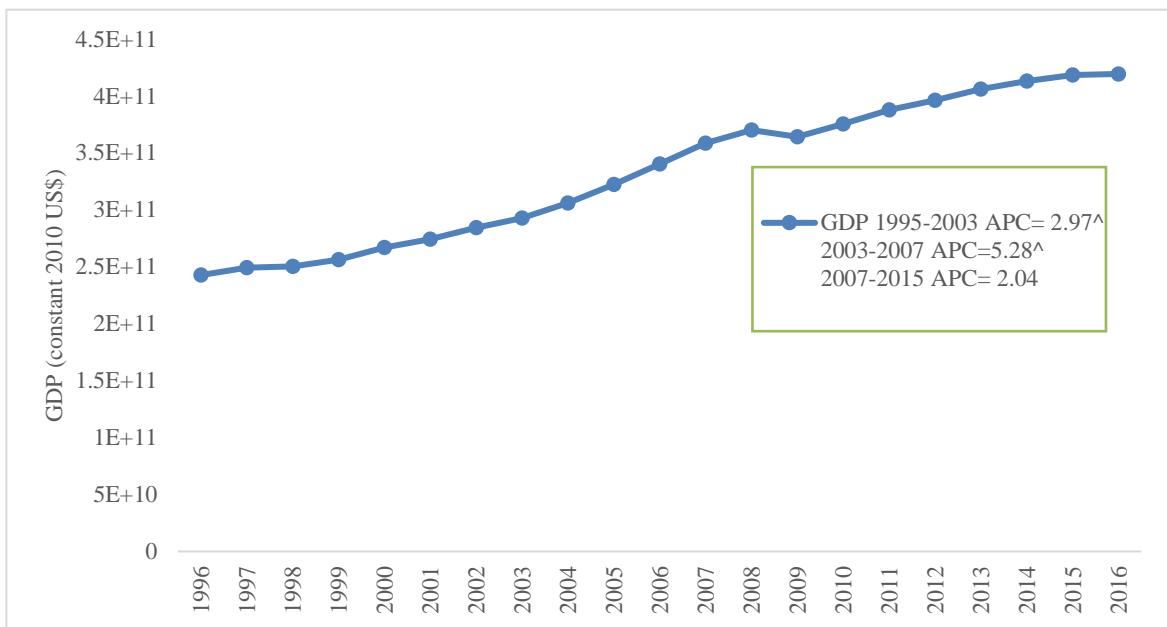
The second part of the analysis regarding private participation in transport infrastructure considered the World Bank's measure on Investment with Private Participation. The results of the joinpoint regression analysis are shown in Figure 3 below. Plotted, the points are similar to those shown in Figure 2. Contrary to PPP investment in transport, investment with private investment increased by 1.45% in the period of review. This reflects some improvement in investment levels after the enactment of the PFMA. Additionally, the same high investment is shown in 2006, when the PPP for the Gautrain Rapid Rail Link was concluded. This reflects the last major PPP investment, but was not significant enough to alter the trajectory of the linear plotted joinpoint regression analysis. This relationship reflects that no joinpoints were indicated over the period.



Final selected model: 0 joinpoints

Figure 3: Public Private Partnership Investment in Transport

The final part of the analysis considered the country's Gross Domestic Product (GDP) over the period 1996 to 2016. The joinpoint regression analysis reveals three distinct jointpoints, reflecting four periods. Analysis of the GDP shows periods of growth and decline. Although consideration of the GDP in current US\$ terms shows increases between 2002 and 2012, and complete contraction since 2012. In constant US\$ terms, the economy has been declining since 2008. An overall increase is observed for GDP between 1996 and 2016. In the period from 1999 to 2008, South Africa, on the back of high commodity prices and political stability, experienced relatively high economic growth rates, with the GDP reflecting 36 consecutive months of positive economic growth. The end of this period was however marked by the removal of the president, as well as a global economic recession. This led to negative economic growth over the nine-month period under the caretaker president at the time. From 2009, volatile commodity prices, the slow recovery from the global recession and political uncertainty have hampered economic growth significantly. Although hosting the 2010 FIFA world cup boosted economic for South Africa during the global recession, growth since then has steadily declined (Trading Economics, 2018; South African Market Insights, n.d.).



<sup>^</sup> indicates that the Annual Percentage change is significantly different from zero at alpha = 0.05 level

Final selected model: 3 joinpoints

Figure 4: South Africa's Gross Domestic Product

As stated above, legislation enabling public-private partnerships for investment in infrastructure was first enacted in 1998. Practice notes from National Treasury followed from 2004. The PFMA and subsequent practice notes were issued during periods of political stability and relatively strong economic growth. Around the time of the enactment of the PFMA, two PPPs were concluded for the provision of transport infrastructure in South Africa, i.e. the in 1998 and the SANRAL N3 Toll Road in 1999. The SANRAL N4 West Toll Road was concluded in 2001. Four smaller projects were concluded between 2001 and 2006, i.e. the Northern Cape fleet, Chapman's Peak Drive Toll Road, Fleet management Eastern Cape and national fleet management. Notably, two of these are not infrastructure related. Finally the PPP for Gautrain Rapid Rail Link was concluded in 2006. This was the last PPP concluded in transport in the country (National Treasury, 2017), with no further public-private investment in transport infrastructure since then.

The results appear to reflect firstly that private investment in transport infrastructure appears to be only slightly associated with GDP growth. The few public-private partnerships that were concluded in the country occurred during periods of economic growth. This association is however tenuous as there were very few PPPs that were concluded, despite relatively strong economic growth. It is also difficult to establish a relationship between negative economic performance and private investment in transport infrastructure, as no PPPs have been concluded in 12 years in South Africa. Whilst this appears to indicate that private investment in transport infrastructure is associated with economic performance and that when GDP growth is declining, investment slows, the low level of private investment in periods of relatively strong economic growth appears to indicate that other issues impact the level of investment.

There are several other factors that may impact the level of private investment and PPPs in transport infrastructure in the country. An overview of the PPPs in the country indicate that a large portion of them are in social infrastructure, are relatively low value projects and are concluded over the medium term. Literature generally suggests that PPPs are more suited for economic infrastructure and high value projects where the likelihood of return on investment is higher (Spiegel & Verougstraete, 2018). This suggests that the projects that are available for private participation are perhaps not attractive to private investors. In addition, although government supports public-private partnerships for infrastructure investment, delays and cancellations of many projects has "raised the ire of major construction groups, because of the high costs of preparing bids for the PPPs" (Cokayne, 2017), thereby probably reducing the appetite for private sector involvement. A report by KPMG (Govender, 2018) suggests that PPPs can assist in relieving the



infrastructure backlog in South Africa, but requires political certainty and commitment, transparency and accountability in respect of local content rules as well as tax incentives. The implication is that there has been inadequate levels of transparency as well as uncertain political commitment, thereby further discouraging the private sector from investment with government in infrastructure.

#### 4. Conclusion

This paper has aimed at establishing the relationship between private sector investment and public-private partnerships in transport infrastructure investment and economic growth. The first aspect that was considered was the quality of transport infrastructure, as measured by the World Bank's Logistics Performance Index. Although the linear regression indicates a slightly increasing trend line, it is also noted that the figures are to be read with caution, partially because of the methodology used in establishing the index and partially because of the wide range of deviation within the figures. The second and third analyses consider public-private participation in transport infrastructure and investment with private participation in transport infrastructure. These are similar indices and both reflect linear relationships with no joinpoints identified over the period under review, suggesting that, despite enabling legislation and treasury notes, there has been little significant private investment in transport infrastructure projects over the last 25 years. The level of private sector investment does also not appear to be associated with economic growth as the period under review reflected some years with high levels of growth which did not show increases in private sector investment and some periods of sharp economic decline, which was also not associated with sharp decreases in private sector investment. The period under review rather showed flat private sector investment and a generally declining level of public-private partnerships. The latter is supported by the fact that there were some PPPs concluded for transport between 1998 and 2006, but none since then.

The results reflect that, in South Africa, private sector investment in transport infrastructure appears largely unassociated with economic growth, which suggests that this type of investment must therefore be impacted by other factors. Cokayne (2017) alluded to government indecision having a major impact on private sector investment, whilst Govender (2018) suggested that political stability and transparency were critical to attracting private sector investment. This suggests that, whilst the private sector may be able to play a far bigger role in the provision of transport infrastructure, government has not created an appropriate enabling environment for investment. Instability, in particular, is a major impediment as transport infrastructure projects and PPPs in particular tend to be long term projects, which therefore require a reasonable chance of achieving a return on investment over a longer period. Without this, it is unlikely that the private sector would risk investment at these kinds of levels.

A limitation of this study is that it does not provide inferences into the causal relationship between GDP growth and private sector investment in transport infrastructure. Future research can explore causality between these variables. Another area for future research would be to investigate the private sector perspective of factors inhibiting their participation in transport infrastructure investment, with the purpose of informing government policy going forward and enabling wider levels of private participation in the future.

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