The effects of education on economic growth and global competitiveness: A statistical approach

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By

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Abstract

This thesis investigates whether there is a relationship between education, economic growth and global competitiveness and whether there is a relationship between South Africa's current throughput rates in institutions of higher education, and its economic growth and global competitiveness. Economic growth is defined as a country's ability to improve the life of its average citizen based on the strength of its economy. As such, it is increasingly important for a country to assess the factors that contribute to the improvement of their economy, which will ultimately result in its economic growth. Global competitiveness is an indication of how countries are able to provide for their people internally, as well as participate in the international market. To this end, economic growth and global competitiveness are two proxies that can be used to demonstrate the economic wellbeing of a country. Considering that prosperity under economic growth and global competitiveness of a country are driven by its people, one of the aims of this thesis was to investigate whether there is a relationship between education and economic growth and global competitiveness.

Considering the recent demand in free education in South Africa, it is also important to understand whether there is a relationship between South Africa's current throughput rates at higher education institutions and its economic growth and global competitiveness. Bearing in mind the political past which has led to inequality in the country, it is important to understand which types of education contribute to the economy and which types need to be further supported in order to increase the country's economic productivity. Therefore, an additional aim of the thesis was to determine the relationship between South Africa's current throughput rates in institutions of higher education, and its economic growth and global competitiveness.

To address the aforementioned aims, data were collected from various open access online repositories. All the data were collated and numerous general linear models were constructed and tested to determine the different relationships as per the two aims. The results reveal that secondary school education had the highest impact on economic growth and global competitiveness on a global scale. This could be attributed to the fact that secondary school graduates tend to make up the largest part of the general workforce and as such, would make up a substantial proportion of the economy. Regarding South Africa, the only significant relationships were between green cluster universities (universities that focus on both research and technical training) and global competitiveness. Overall average throughput rates in all academic institutions were low; this could indicate that perhaps there are issues within the higher education system itself that need to be addressed in order to increase the throughput rate.

From a managerial perspective, the results of this research stress the importance for the government to further investigate this area of study, as the call for free education becomes more prominent. The low throughput rates seem to suggest that the government is spending substantial amounts of money on students who do not always complete their studies. More research needs to be done to assess the root of the problem in South Africa's tertiary education system, in order to ensure that this aspect increases its positive contribution towards the country's economic growth and global competitiveness.

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List of abbreviations

AIC	Akaike Information Criterion
ATPRI	Primary school education attainment
ATSEC	Secondary school education attainment
ATTER	Tertiary school education attainment
ENPRI	Enrolment at primary school level
ENSEC	Enrolment at secondary school level
ENTER	Enrolment at tertiary school level
EXPRI	Government expenditure on primary school education
EXSEC	Government expenditure on secondary school education
EXTER	Government expenditure on tertiary school education
GCI	Global Competitiveness Index
GDP	Gross domestic product
GDPPC	Gross domestic product per capita
GLM	General linear model
HEDA	Higher education data analyser
POPGRO	Population growth rate
POPSI	Population size
TPNUMB	Higher education institutions throughput rates (number of graduates)
TPPERC	Higher education institutions throughput rates (percentage of graduates)
UNEMP	Unemployment
VRIN	Valuable, Rare, Inimitable, Non-Substitutable

Preface

This thesis consists of seven chapters. The **chapters 1 and 2** provide insight into the current literature and background into the rationale behind the research. **Chapter 3** describes the methodologies used to determine the effects of education on economic growth and global competitiveness on a global scale, and the effects of tertiary education on South Africa's economic growth and global competitiveness. **Chapter 4** discusses the results from the various statistical analyses performed. **Chapter 5** discusses the findings from the data and contextualises these results. **Chapter 6** concludes the thesis and **chapter 7** synthesises the first six chapters and provides institutional and managerial recommendations. A combined reference list is included at the end of the thesis to avoid the repetition of references. The following papers will be submitted for publication from this thesis:

1. **Da Silva EIT**, Knoesen E (*In prep.*). The effects of education on economic growth and Global competitiveness: A statistical analysis.
   Proposed journal for publication: *Quarterly journal of economics*
2. **Da Silva EIT,** Knoesen E (*In prep.*). Factors affecting economic growth and development: A statistical model comparing South Africa to the world.
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3. **Da Silva EIT**, Knoesen E, Mapatagane NL (*In prep.*). The effects of throughput rates of higher education institutions on South Africa's economic growth and global competitiveness: A statistical analysis.
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The following conference presentation has also occurred as a result of work produced in this thesis:

1. International Business Conference, Le Meridien Hotel, Mauritius, 2018. **Da Silva EIT**, Knoesen E. The effects of education on economic growth and Global competitiveness: A statistical analysis.

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and always encouraging me. You are testament to the fact that it takes a village to raise a child and you have been instrumental in making my dreams a reality, so thank you!!

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Declaration

I, Erica Isabel Tavares Da Silva Mbatha, hereby declare that this thesis is being submitted for a degree at Rhodes University (Grahamstown, South Africa), under the supervision of Mr Evert Knoesen. The various components of this thesis comprise of original work done by the author unless otherwise stated, and has not been submitted to any other university.

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Erica Isabel Tavares Da Silva Mbatha

Date: 1 April 2019

Chapter 1: Introduction

Economic growth can be defined as the improvement of the living conditions of the "average" citizen of a country based on the strength of a country's economy (Rodrik, 2014). Similarly, Kuznets (1973) defines economic growth as the long term rise in capacity of a country to supply economic goods to its population. Several factors have been stated as drivers of economic growth: including specialisation and diversity (Simonen, Svento and Juutinen, 2015), policy and governance (Rodrik, 2014), population dynamics (Mankiw, Romer and Weil, 1992) and economic freedom (Easton and Walker, 1997). At the root of these drivers of economic growth are the impacts of investment in human capital and the subsequent effects of the varying degrees of these investments.

Organisations are constantly seeking ways to invest in their human capital, as they recognise this form of capital as one of the most important drivers of economic growth and sustainability (Crook et al., 2011). This type of investment occurs mostly in the form of training and education, as these have been identified as the most important types of investments in human capital (Becker, 2009). Human capital is classified by three main components, namely; early or intrinsic ability, qualifications obtained through formal education, and skills obtained through on-site training (Blundell et al., 1999). The returns on investment from obtaining these different levels accrue on both the micro- and macro-economic level (Blundell et al., 1999). As such, numerous countries are moving towards building an education system that can produce individuals who can contribute towards a knowledge-based economy (Riley, 2004). Literature has shown that countries with high levels of technological development tend to have higher levels of economic development (Simonen, Svento and Juutinen, 2015). The assumption here is that in order for there to be high levels of technological development within an economy, there needs to be a sufficient amount of human and knowledge capital available to produce and absorb the innovations required for the technological development to occur. Furthermore, another assumption is that a country's level of innovation is also a contributing factor to its global competitiveness.

There has been a stated commitment within post-apartheid South Africa to increase participation in higher education (Smit, 2012). Although this has been a commitment made by higher education institutions and government, there is still a high level of skewness with regards to the racial groups currently enrolled, with 60% of the 20 – 24 year old age cohort belonging to the white population and 12% belonging to the black population (Scott, Yeld and Hendry, 2007). Subsequently, various institutions of higher educations have implemented numerous strategies to address this equity issue (Smit, 2012).

Numerous authors have examined the impacts of education on economic growth on a global scale (Saint-Paul and Verdier, 1993; Krueger and Lindahl, 2001; Dale, 2005; Keller, 2006; Hanushek and Woessmann, 2010; Barro, 2013). The overall objective of the research by the previously mentioned authors has been to determine the potential role (if any) that education plays in creating long-term and sustainable economic growth (Barro, 2013). Ideally, a country's economic growth should improve overtime through investment in its human capital (Becker, 2009). This is as a result of increased education leading to increased levels of technological absorption that results in the growth of the country's total factor productivity over time, in theory (Benhabib and Spiegel, 1994).

South Africa currently has one of the world's highest inequality rates, with a Gini coefficient of 63.0 (Leibbrandt et al., 2010; World Bank, 2018c). This has been attributed to the various socio-economic policies implemented during the Apartheid era, and their persistent effects thereafter (Leibbrandt et al., 2010). A subsequent effect of the Apartheid era has been the inaccessibility of resources, such as education, to people of all socio-economic statuses (Badat, 2010). The South African government has developed and implemented various policies to address the systemic transformation required, further emphasising the importance of skills development and the need to produce graduates that contribute positively towards the economy (Badat, 2010). Even so, there are various elements at play, such as historical socio-economic inequality, which currently limit the accessibility of higher education to all South Africans (Smit, 2012).

Considering the construct suggested by economics theory that educated human capital subsequently improves a country's economic growth, there are two main aims which were addressed in this thesis. The first aim was to determine the effects of education on economic growth and global competitiveness using the top 10 and bottom 10 ranked globally competitive countries. The second aim of this investigation was to determine whether the current throughput rates in South African universities is playing a significant role in the improvement of its economic growth and global competitiveness in South Africa. The first aim was addressed by collecting data from various reputable online data repositories and constructing general linear models to determine whether the education enrolment and attainment levels of the top and bottom 10 globally competitive countries (according to the Global Competitiveness Index) had an impact on economic growth and global competitiveness between 2006 and 2016. The second aim was addressed by gathering data on South Africa only and constructing general linear models to determine whether the throughput rates (for bachelor's degrees only) overall and in the various Higher Education Institution clusters (red, green and blue) had an impact on South Africa's economic growth and global competitiveness between 2005 and 2017.

Chapter 2: Literature review

The following literature review will be focusing on the existing literature that was used to develop the rationale for the two aims of this thesis. Furthermore, a section has been included to explain the various indices that were used in the study. Finally, the problem statement, aims and objectives of the thesis are stated.

Importance of human capital within an economy

Human capital is comprised of three main parts: early ability, knowledge and qualification obtained through formal education and skills obtained through practical work experience (Blundell et al., 1999). The number of individuals that fit into each of these categories within a country could potentially influence the economic growth of the country. A high number of skilled and experienced people results in a country's increased ability to absorb superior technologies from other countries which could in turn have positive effects on the country's economic growth (Barro, 2001). Countries that invest in their human capital in terms of education and healthcare have been shown to have higher economic growth (Schultz, 1961; Crook et al., 2011). Some of the critical attributes of human capital as defined by Schultz (1993) are as follows:

1. Human capital cannot be taken away from the person who possesses it. This differs from physical capital, which can be gained and lost in a multitude of ways.
2. Human capital is obtained through investing in people. This can be done through social benefits provided through government institutions.
3. Human capital is either innate, such as skills that are naturally possessed or acquired through formal education.
4. The benefits from the investment in human capital accrue to the individual, by means of allowing them access to better jobs, which in turn results in improved income and access to better goods and services.
5. The benefits of human capital investment can also have larger positive consequences on economic growth.
6. Improvements in human capital allows for better absorption of advanced technologies, which directly affects economic growth.

It is important to understand the attributes of human capital, so as to make the linkage between these attributes and the contribution that individuals make to the overall macroeconomic environment of a country. Considering these attributes, it follows that economic growth is at least in part, dependent on the standard of living and social standing of a country's human capital.

Resource-based theory and human capital

The basis of resource based theory is that the sustained competitive advantage of a firm is reliant on its resources and capabilities (Barney, Ketchen and Wright, 2011). A company's competitive advantage is further secured if its resources are valuable, rare, inimitable and non-substitutable (VRIN principle) (Barney, 1991). These resources can be subdivided into two categories: tangible resources (which include assets such as buildings and financial resources) and intangible resources (which include aspects such as brand equity and human capital) (Hitt et al., 2001). Tangible resources are defined as aspects of the firm which can be measured or quantified, as they have physical or financial value (Galbreath, 2005). Intangible resources are defined as aspects of the firm which are non-physical or non-financial in nature, but contribute immaterial value to the firm and its competitive advantage (Galbreath, 2005). Intangible resources have three main characteristics which differentiate them from tangible resources. Firstly, depletion and deterioration of intangible resources does not occur with use over time (Cohen, 2005). Secondly, intangible resources can be used by multiple managers concurrently (Marr and Roos, 2005). Intangible resources are most likely to contribute most to a company's competitive advantage, as the VRIN principles are more applicable to these resources (Barney, 1991). Finally, intangible resources are immaterial, meaning that they often cannot be detached from their owner (Marr and Roos, 2005). The human capital of an organisation includes the experience, judgement and intelligence of its managers and workers (Wright, McMahan and McWilliams, 1994). Therefore, it is beneficial for a firm to invest in its human capital (Crook et al., 2011). This investment in human capital benefits both the individual, as they are now more learned and thus more valuable, as well as the organisation, as the individual has more knowledge and skills to impart, and these could contribute towards the improvement of the company's triple bottom line (Crook et al., 2011). The triple bottom line is a framework that focuses primarily on the incorporation of three dimensions of performance within a firm, namely; social, environmental and economic (Slaper and Hall, 2011). The triple bottom is also commonly referred to as the 3P's, which stand for people, planet and profits (Slaper and Hall, 2011).

The value of human capital is influenced by the level of education attained by the majority of the workforce, and thus a company with a highly educated workforce is more likely to be more competitive (Blundell et al., 1999). These principles can be applied on a larger scale to a country. A country's human capital is one of its most important intangible resources. Having a highly educated populous increases the ability for the country to absorb new technologies, which directly impacts its Gross Domestic Product (GDP) and ultimately, its global competitiveness (Blundell et al., 1999).

Factors that drive global competitiveness

Competitiveness at the national level is defined as a country's ability to provide goods and services to its population, as well as being an active participant in the international market (Buckley, Le Pass and Prescott, 1988). The most accepted measure of a nation's competitiveness is the Global Competitiveness Index (Porter et al., 2008; Schwab, 2017), however various authors have questioned its validity in terms of how it is measured (Buckley, Le Pass and Prescott, 1988), as well as how accurately the selected parameters represent a country's competitiveness (Lall, 2001). As it is the most widely recognised index of global competitiveness, it will be used in the statistical models contained in this thesis.

Relevance of education

Countries such as South Korea (Duncan, 2010), Hong Kong (Mok, 2015), the United States (Duncan, 2010; Palmer et al., 2010) and the United Kingdom (Robertson, 2010) are amongst many who have recognised the importance of education in a country's ability to be globally competitive. This relates directly to a country's economic growth as an educated nation has a higher ability to absorb technology which increases economic growth which ultimately contributes to a country's global competitiveness. The education of a country's population is largely dependent on the policies set in place by the government of a country (Mok, 2015).

Barro (1991) conducted a study to examine the effects of education on GDP, however, this study focused primarily on the enrolment levels of children into schools. The use of enrolment levels could be indicative of the accessibility of education, however it is also important to examine the number of individuals who obtain these qualifications (primary, secondary and tertiary level), as these are most likely to contribute to the economy. Therefore, it is important to examine both enrolment (as an indicator of accessibility) and attainment (as an indicator of individuals who might potentially contribute towards the economy) when determining whether education influences global competitiveness and economic growth. Numerous other studies have also examined the effects of education, economic freedom and population dynamics on GDP (Psacharopoulos, 1985; Benhabib and Spiegel, 1994; Crenshaw, Ameen and Christenson, 1997; Keller, 2006; Azman-Saini, Baharumshah and Law, 2010), however the use of different models and methodologies in these studies makes their comparison cumbersome. Although there could be various contributors to economic growth and competitiveness, it is important to try and narrow down the largest contributors in order to make high impact policy changes.

Bearing this in mind, the aim of this thesis is to understand the overall impact of education on economic growth and global competition on a global scale using 20 countries ranked as the highest and lowest globally competitive countries in the world. An additional aim is to determine the impacts of tertiary education on South Africa's economic growth and global competitiveness. Please note that for both studies, the only level of tertiary education that was considered was undergraduate level (bachelor's degree) enrolment and attainment.

Indices

Indices are used as tool by policymakers to assess the shortcomings of their economies (Lall, 2001). These indices can then be used to inform the policies that are created and implemented to help improve the overall functioning of economies (Lall, 2001). Furthermore, indices can provide policymakers with information that guides the manner in which they allocate resources within the country (Lall, 2001). The following is a discussion of indices that are commonly used in econometrics studies and are used as tools to guide the decisions made by policymakers for the improvement of world economies.

Global competitiveness index (GCI)

This index is used to quantify the competitiveness of a country based on its strengths and weaknesses (Porter et al., 2008). In this index, competitiveness is measured by looking at the productivity of a country, as productivity depends on the value of a nations products and services and the price they command in open markets (Porter et al., 2008). Competitiveness in accordance with the World Economic Forum, is defined as the set of institutions, policies and factors which ultimately determine the productivity level of a country (Sala-i-Martin et al., 2007). A country's productivity is an indicator of its ability to provide higher levels of income for its citizens, as well as its growth potential (Sala-i-Martin et al., 2007). The World Economic Forum has gathered data on different components, which are referred to as the 12 pillars of competitiveness, and the weighted average of these components are then used to assign GCI values to different countries (Sala-i-Martin et al., 2007). The 12 pillars of competitiveness are: institutions, infrastructure, macroeconomy, health and primary education, higher education and training, goods market efficiency, labour market efficiency, financial market sophistication, technological readiness, market size, business sophistication and innovation (Sala-i-Martin et al., 2007). This index will be used to assess whether a country's competitiveness is affected by the level of education enrolment and attainment of its population.

Gross domestic product (GDP)

The gross domestic product (GDP) is the monetary value of all the products and services rendered by a country over a given period (Callen, 2008). The GDP of a country is an indicator of the growth and performance of its economy (Callen, 2008), as well as its total production (OpenStax, 2016). In some cases, potential GDP is also used in order to ascertain the effects of the Utopian situation in which the economy is performing at optimal capacity because the entire population is employed and producing at full capacity (De Jager and Smal, 1984). For the purposes of this study, actual recorded GDP will be used in order to fully ascertain the effects of education on the true GDP output.

Population dynamics

There is a large array of literature currently available on the effects of population dynamics on economic growth (Bloom and Freeman, 1988; Bloom and Williamson, 1997; Higgins and Williamson, 1997; Bloom, 1998; Bloom and Sachs, 1998; Bloom, Canning and Malaney, 2000). Understanding the relationship between a country's population dynamics and its economic growth can result in the ability to predict the effect of a sudden increase or decrease in the population on the country's economy (Bloom, Canning and Malaney, 2000). During the 20th century, Africa as a continent had the lowest overall economic growth rate (Bloom and Sachs, 1998). Bloom and Sachs (1998) state the following as contributing factors to Africa's overall poor economic performance:

1. External conditions: Slave trade and colonial rule resulted in the manipulation of African politics which has an influence on the continents' economic growth
2. Primary exports: Africa had developed a heavy dependence on a small number of primary exports, which declined over time and were subject to the volatility of the market.
3. Internal politics: The continent and its leaders are infamous for authoritarianism, corruption and political instability, which hinder the growth of economies as well as potential foreign investment.
4. Economic policy: The economic policies in a large number of African countries are viewed to be riddled with protectionism, statism and fiscal profligacy.
5. Demographic change: Africa had seen rapid population growth during this period, and as such, conditions were unable to maintain the increased populations.
6. Social conditions: Africa was seen as a continent riddled with deep ethnical divisions, and these divisions often resulted in the hinderance of progress.

As per the list above, Bloom and Sachs (1998) list demography as a contributing factor. Therefore, when trying to understand what aspects affect economic growth, it is important to consider the population dynamics throughout the world, relate and compare them to the Africa and South African context and determine what measures need to be put in place to accommodate the existing populations and provide for any possible growths and declines. Furthermore, it is important to understand whether the current state of the economy is able to accommodate for said provisions in the cases of population growths and declines.

Unemployment rate

Traditionally, unemployment is studied at a national level (Marelli, Patuelli and Signorelli, 2011). However, there is importance in examining unemployment rates on a larger scale (i.e. internationally), as there are various factors (such as economic policy and economic shocks which can result from international factors, e.g. sanctions), which differ from country to country, and could potentially have an impact on a country's unemployment rate (Marelli, Patuelli and Signorelli, 2011).

Post-apartheid, the unemployment rates in South Africa have increased, particularly amongst people with university degrees (Bhorat, 2004; Pauw, Oosthuizen and Van der Westhuizen, 2006; Moleke, 2010). Moleke (2006) demonstrated that graduate unemployment and opportunity is also different amongst different racial groups, stating that African and Coloured people have lower prospects for employment in comparison to their White and Indian counterparts. Furthermore, graduates from historically black institutions are absorbed into the labour market at a slower rate than their counterparts at historically white institutions (Moleke, 2006).

Another factor that needs to be taken into consideration is the type of labour that is required by the market. The world is currently moving into the 4th industrial revolution, which is characterised by digitisation and automation of work (Schwab, 2016). As such, it is important to understand whether the graduates that are being produced from higher education institutions have qualifications which are compatible with the current and future labour market, in order to understand the possible cause of graduate unemployment (Selamat et al., 2017). In the second study in this thesis, the throughput rates of South Africa's higher education institutions as they are categorised by Boshoff (2010) are compared to the economic growth of the country to determine whether there is a relationship between the type of degree obtained (i.e. research, technical or a combination of research and technical) and the country's economic growth and global competitiveness.

Education enrolment and attainment

The enrolment rates are defined as the number (or percentage) of students that enrol at an institution at the beginning of a set period, and attainment rates are defined as the number (or percentage) of students who complete and obtain the qualification that they were studying towards (Barro, 1991). It is important to examine both the enrolment and attainment, as enrolment is an indication of the accessibility to said education level, and attainment is an indication of the number (or percentage) of qualified individuals that could possibly become active participants in a country's economy (Barro, 1991).

Percentage of government expenditure on education

The composition of public spending is of particular interest to policy makers, as the belief is that high investment in sectors such as education and health care can result in increased economic growth, the promotion of income equality and a reduction in poverty (Barro, 1991; Tanzi and Chu, 1998; Gupta, Verhoeven and Tiongson, 2002). The increased spending on education is justified by the social rate of returns brought back to a country by educated individuals (Gupta, Verhoeven and Tiongson, 2002). Previous literature has shown that the highest rates of returns come from individuals with primary education, followed by secondary and tertiary education in that order (Psacharopoulos, 1994). It is important to understand whether this trend is still relevant using current data, in order to understand which levels of education governments should be investing in, in order to yield the highest rates of return.

Throughput rates in South African universities

Education has not always been accessible to all segments of the South African population, as laws during the apartheid era imposed limitations on who could get education, as well as what type and level of education they were allowed to receive (Akoojee and Nkomo, 2007). The policies that govern accessibility to education in South Africa are currently under reform, allowing equal accessibility to education for all South Africans (Akoojee and Nkomo, 2007). However, other factors such as financial status have also been cited as barriers to entry (Badat, 2015). Numerous authors have shown that South African higher education institutions have exhibited low throughput rates (less than 40%) (Department of Education, 2005; Mouton, 2007; Letseka, Maile and Human Sciences Research Council, 2008; Steenkamp et al., 2010; Wadesango and Machingambi, 2011; Mdepa and Tshiwula, 2012). Various causes for the low throughput rates have been cited. These include poorer levels of adjustment by previously disadvantaged students at previously white institutions (Sennett et al.,

2003), high dropout rates (Akoojee and Nkomo, 2007; Letseka, Maile and Human Sciences Research Council, 2008), poor class attendance or absenteeism (Steenkamp et al., 2010; Wadesango and Machingambi, 2011), lack of preparation by students for assessments (Steenkamp et al., 2010) and inadequate preparation for university during secondary schooling (Steenkamp et al., 2010).

Based on the literature, the importance of adequately understanding the factors that influence economic growth and global competitiveness becomes apparent. Previous studies in other regions of the world have indicated that education has an impact on a country's global competitiveness (Duncan, 2010; Palmer et al., 2010; Robertson, 2010; Mok, 2015). It is important to understand whether education would thus have an impact on a country's economic growth, and whether this relationship differs based on the country's socio-economic standing. Within the South African context, it is important to understand whether the current throughput rate in higher education institutions has an effect on South Africa's economic growth and global competitiveness, as heavy emphasis has been placed on the provision of free tertiary level education in the country in recent times (Langa et al., 2017). The purpose of understanding these relationships is to determine whether policy needs to be reformed in order to increase or decrease government spending on particular sectors in order to achieve increased economic growth and global competitiveness.

Therefore, two studies were conducted for this thesis, with the following aims and objectives:

Aim 1: To determine the effects of education on economic growth and global competitiveness, based on the top and bottom 10 globally competitive countries (20 countries in total).

Objective: This was done by gathering data from the top 10 and bottom 10 globally competitive countries between 2006 and 2016. Subsequently, the relationship between population size, population growth, unemployment rates, education enrolment and attainment rates (for primary, secondary and tertiary education), and percentage of government expenditure on education, and economic growth and global competitiveness were assessed

Aim 2: To determine the relationships between the current overall and cluster (red, blue and green clusters) throughput rate of South African higher education institutions and South Africa's economic growth and global competitiveness

Objective: This was done by gathering data for the throughput rates of all South African Higher Education Institutions, South Africa's population size and growth and determining the relationship between these factors and South Africa's economic growth and global competitiveness. The data used for this study ranged between 2005 and 2017.

Chapter 3: Materials and methods

The following section is divided into two sections. The first section describes the method used to determine the effects of education on economic growth and global competitiveness on a global scale, while the second section describes the method used to determine the effect of tertiary education on South Africa's economic growth and global competitiveness. Please note that as two different aims were being tested, two different datasets were used to address the two separate aims. The dataset used for aim 1 ranged between the years 2006 and 2016 and the dataset used for aim 2 ranged between the years 2005 and 2017. The years were selected based on which years had the highest density of data available to provide the most accurate results once the general linear models were constructed**.** Furthermore, the first dataset is focused specifically on the top 10 and bottom 10 globally competitive countries. The second data set specifically focuses on South African data and no international comparisons were made in the models. All of the data collected for the international studies were standardised by the World Bank in terms of the various education levels presented. Please note that all of the data used in both studies were quantitative in nature.

Aim 1: The effects of education on economic growth and global competitiveness on a global scale

Data collection

The data for this study were collected from various online sources (*Table 3.1*). The data that was used included enrolment and attainment primary (Grade 0 – 7), secondary (Grade 8 – 12) and tertiary (bachelors' degrees) education statistics from the World Bank (World Bank, 2015a), unemployment rates (World Bank, 2018d), population statistics (i.e. population size and growth rate (World Bank, 2018a; b), gross domestic product per capita (GDPPC) (World Bank, 2015b), annual government expenditure on primary, secondary and tertiary education as a percentage of government expenditure on education (World Bank, 2016) and the Global Competitiveness Index (Schwab, 2017). Data were compiled for a ten-year period between 2006 and 2016 in order to demonstrate the trends and relationships over this time period.

Data sources

The data set used to address aim 1 was obtained from the repositories compiled by the World Bank and the World Economic Forum (*Table 3.1*). The Development Data Group is a subdivision of the World Bank which is dedicated to collecting, compiling and disseminating data according to standardised global practices and professional standards, to ensure that data users are able to have confidence in the integrity of the data that they are using (World Bank Group, 2019). Furthermore, the World Bank

ensures that they provide capacity, efficiency and effectiveness to the data collection systems in various countries in order to ensure that the quality of the data produced is in line with their professional standards (World Bank Group, 2019). The Global Competitiveness index is calculated from data which is compiled by the World Economic Forum (Schwab, 2017). The Global Competitiveness Index is calculated by using a multivariate linear regression from data collected from various reputable sources as listed in the technical notes of the report (Schwab, 2017). The 10 highest and lowest ranked countries in the 2017 Global Competitiveness Report were used for this study (*Table 3.2*).

Table 3.1. Datasets (with references) that were used for this study for the statistical models, to address aim 1.

Dataset	**Source**	**Reference**
Global competitiveness index	World Economic Forum	Schwab (2017)
Gross domestic product	World Bank	World Bank (2015b)
Population Size	World Bank	World Bank (2018b)
Population Growth	World Bank	World Bank (2018a)
Unemployment rates	World Bank	World Bank (2018d)
Education (Enrolment and attainment)	World Bank	World Bank (2015a)
Percentage of government expenditure on education	World Bank	World Bank (2016)

Table 3.2. The ten highest and lowest ranked Globally Competitive countries according to the Global Competitiveness Index (Schwab, 2017).

Top 10 Globally Competitive Countries			**Bottom 10 Globally Competitive Countries**		
Country	**Ranking**	**Score**	**Country**	**Ranking**	**Score**
Switzerland	1	5.86	Haiti	128	3.22
United States	2	5.85	Burundi	129	3.21
Singapore	3	5.71	Sierra Leone	130	3.20
Netherlands	4	5.66	Lesotho	131	3.20
Germany	5	5.65	Malawi	132	3.11
Hong Kong SAR	6	5.53	Mauritania	133	3.09
Sweden	7	5.52	Liberia	134	3.08
United Kingdom	8	5.51	Chad	135	2.99

Japan	9	5.49	Mozambique	136	2.89
Finland	10	5.49	Yemen	137	2.87

Statistical analysis

All the data were collected and arranged according to the countries and data categories listed in *Tables 3.1* and *3.2*. A general linear model (GLM) was used to determine the relationships between the various indices, economic growth and global competitiveness. General linear models are used in cases where the variance is not constant, irrespective of whether or not the errors within the data are normally distributed (Crawley, 2007). The two most important properties of a GLM are the error structure, as well as the link function (Crawley, 2007). GLM's allow the user to specify the error distribution unlike ANOVA's which simply assume normal distribution with equal variance (Crawley, 2007). In this particular case, the error distribution was tested and found to be normal. The link function defines the relationship between the values of the response variable and the linear predictor (Crawley, 2007). The relationship between the response variables and linear predictors in both datasets used in the two studies was normal and thus the identity link was used. The GLM's used only tested the main effects (i.e. the effect of each linear predictor on the response variable) as opposed to multiple level interactions (i.e. the effect of each linear predictor on the response variable as well as their interaction with one another), as multiple level interactions were not relevant to the constructs being tested.

Four different models were constructed. The models had economic growth or global competitiveness scores as response variables with either enrolment or attainment levels of education and all the other indices as linear predictors (*Table 3.1*). Akaike's information criterion (AIC) is a tool used to measure the goodness of fit of a model (Crawley, 2007). During the comparison process to determine which model is the best fit, the smaller AIC denotes the better fitting model (Crawley, 2007). Therefore, during the process of determining which models had the best fit, models were tested against one another using an analysis of variance test and the resulting AIC values compared. Thereafter, the models with the lowest AIC values would be selected. The minimum adequate model (or the best fitted model) was achieved through stepwise deletions, starting from the highest order non-significant interactions to the least, followed by model comparisons using AIC and analysis of variance. The specific terms that were eliminated during the deletion process are described more explicitly in the results section.

All of the above mentioned statistical tests were done using R software, version 3.2.2, using the MASS package (R Core Team, 2017).

Aim 2: The effects of tertiary education on South Africa's economic growth and global competitiveness

The following section outlines the data collection process, the various indices used in this study, as well as the methods used to conduct the statistical analysis used to address aim 2.

Data collection

The data for this study was collected from various sources according to the different South African Higher Education Institutions and data categories listed in *Table 3.3*. The data used for this study included the throughput rates in South African institutions of higher education (IDSC and University of Johannesburg, 2018), as well as the gross domestic product per capita (World Bank, 2017), Global competitiveness index (Schwab, 2017), population size (World Bank, 2018b) and population growth (World Bank, 2018a) for South Africa for the period between 2005 and 2017. The universities used in the study were those currently classified as either red, green or blue cluster universities with throughput rates available for the period between 2005 – 2017 (*Table 3.4*).

Data sources

The data used to address aim 2 was collected from PowerHEDA, the World Bank and the World Economic Forum (*Table 3.3*). PowerHEDA (Higher Education Data Analyzer) is a data repository created by IDSC Consulting Pty (Ltd) (IDSC, 2013). The PowerHEDA tool was created in order to provide higher education institutions in South Africa with a standardised database, from which data can be acquired for all South African Higher Education Institutions (IDSC, 2013). Furthermore, from the acquisition and analysis of this data, institutional research and planning, institutional policy and various other aspects can be devised in order to improve the overall quality of South African Higher Education Institutions (IDSC, 2013). The information for the use of data from the World Bank and World Economic Forum are provided under aim 1 "Data sources".

Table 3.3. Datasets (with references) that were used for this study for the statistical models, to address aim 2.

Dataset	**Source**	**Reference**
Throughput rates in South African Universities	PowerHEDA	IDSC and University of Johannesburg (2018)
Gross domestic product per capita	World Bank	World Bank (2017)
Global competitiveness index	World Economic Forum	Schwab (2017)
Population size	World Bank	World Bank (2018b)
Population growth	World Bank	World Bank (2018a)

South African universities are grouped into three clusters based on the knowledge productivity or function of the university (Boshoff, 2010; Dube et al., 2017). The three clusters are red, blue and green clusters (Boshoff, 2010; Dube et al., 2017). The red clusters consists of the top research-intensive universities, the blue cluster comprises of technical training institutions and the green cluster comprises of institutions which focus on both research and technical training (Dube et al., 2017).

Table 3.4. Universities used in this study, as well as their classifications according to their institutional focus.

Higher Education Institution	**Cluster classification**	**Definition of cluster classification**
Rhodes University University of Cape Town University of Pretoria Stellenbosch University University of the Witwatersrand	Red Cluster Institutions	Research-oriented institutions McGregor (2010)
Western Cape University University of the Zululand University of Limpopo University of KwaZulu-Natal University of Johannesburg University of the Free State	Green Cluster Institutions	Research and technical institutions McGregor (2010)

Higher Education Institution	Cluster classification	Definition of cluster classification
University of Fort Hare North West University Nelson Mandela University		
Walter Sisulu University Vaal University of Technology University of Venda Tshwane University of Technology Mangosuthu University of Technology Durban University of Technology Central University of Technology Cape Peninsula University of Technology	Blue Cluster Institutions	Technical institutions McGregor (2010)

Statistical analysis

Once the data were collected and arranged, a general linear model was constructed in order to determine the relationships between the various indices and South Africa's economic growth and global competitiveness within the period between 2005 and 2017. Four initial models were constructed to determine the overall impact of all of the higher education institutions in this study on South Africa's economic growth and global competitiveness. In addition to this, twelve more models were constructed to determine the overall impact of the three institutional clusters on South Africa's economic growth and global competitiveness. The same process for the construction of the models outlined in the first study was used for this study. The throughput data used included number of students graduated, as well as throughput rate percentage, therefore both of these parameters were tested. The minimum adequate model was achieved through stepwise deletions, starting with the highest order non-significant interactions to the least, followed by model comparisons using Akaike information criterion (AIC) and analysis of variance.

All of the abovementioned statistical tests were done using R software, version 3.2.2, using the MASS package (R Core Team, 2017).

Chapter 4: Results

The following section describes the results obtained from the statistical analyses done in order to address the two aims; the first, addressing the effects of education on economic growth and global competitiveness on a global scale and the second, addressing the effects of the current throughput in South African higher education institutions on South Africa's economic growth and global competitiveness. The p-value used to denote significance in all of the models was p=0.05.

Aim 1 (Results): The effects of education on economic growth and global competitiveness on a global scale

The effects of primary, secondary and tertiary education enrolment on gross domestic product per capita and Global Competitiveness.

The government expenditure at all levels was removed, as it did not add any variation to the model ($p<0.05$). The results showed that unemployment ($p<0.05$), population growth ($p<0.05$) and enrolment at tertiary level ($p<0.05$) are significant factors influencing GDPPC (*Table 4.1*). The results also showed that unemployment and population growth were inversely related to GDPPC, whereas tertiary level enrolment was directly related to GDPPC (*Table 4.1*). GDPPC denotes gross domestic product per capita, UNEMP denotes unemployment, POPSI denotes population size, POPGRO denotes population growth, ENPRI denotes enrolment at primary school level, ENSEC denotes enrolment at secondary school level and ENTER denotes enrolment at tertiary level.

Table 4.1. GLM results for the effects of the unemployment (UNEMP), population size (POPSI), population growth (POPGRO), primary school enrolment (ENPRI), secondary school enrolment (ENSEC) and tertiary level enrolment (ENTER) on gross domestic product per capita (GDPPC) for 20 countries between 2006 and 2016. Bolded values indicate significance ($p<0.05$).

	Estimate	**Std. Error**	**df**	**t-value**	**Pr(>|t|)**
Intercept	6.355×10^{4}	4.358×10^{3}	-	14.536	**$<2 \times 10^{-16}$**
GDPPC: UNEMP	-9.208×10^{2}	3.804×10^{2}	1	-2.421	**0.01767**
GDPPC: POPSI	-2.915×10^{-4}	1.671×10^{-4}	1	-1.745	0.08473
GDPPC: POPGRO	-1.194×10^{4}	2.019×10^{3}	1	-5.917	**7.1×10^{-8}**
GDPPC: ENPRI	-3.117×10^{-3}	2.219×10^{-3}	1	-1.405	0.16382

GDPPC: ENSEC	2.555×10^{-3}	2.374×10^{-3}	1	1.076	0.28493
GDPPC: ENTER	5.499×10^{-3}	2.020×10^{-3}	1	2.723	**0.00789**
Residual	-	15633	83	-	-

All the indices were included in the enrolment and global competitiveness model and the model was significant ($p<0.05$). The results showed that primary school government expenditure ($p<0.05$) and secondary school government expenditure ($p<0.05$) were significant to global competitiveness (*Table 4.2*). The results also show that primary school level government expenditure has an inverse relationship to global competitiveness whereas secondary school level government expenditure is directly related to global competitiveness (*Table 4.2*).

Table 4.2. GLM results for the effects of the unemployment (UNEMP), population size (POPSI), population growth (POPGRO), primary school enrolment (ENPRI), secondary school enrolment (ENSEC) tertiary level enrolment (ENTER), government expenditure on primary school education (EXPRI), government expenditure on secondary school education (EXSEC) and government expenditure on tertiary education (EXTER) on Global Competitiveness Index scores (GCI) for 20 countries between 2006 and 2016. Bolded values indicate significance ($p<0.05$).

	Estimate	**Std. Error**	**df**	**t-value**	**Pr(>|t|)**
Intercept	5.775	8.900×10^{-1}	-	6.489	**6.97×10^{-9}**
GCI: UNEMP	-1.014×10^{-3}	9.960×10^{-3}	1	-0.102	0.9192
GCI: POPSI	8.341×10^{-9}	4.700×10^{-9}	1	-1.774	0.0798
GCI: POPGRO	-1.343×10^{-1}	7.388×10^{-2}	1	-1.817	0.0730
GCI: ENPRI	-8.895×10^{-9}	6.096×10^{-8}	1	-0.146	0.8844
GCI: ENSEC	-6.938×10^{-8}	6.627×10^{-8}	1	-1.047	0.2984
GCI: ENTER	6.324×10^{-9}	5.926×10^{-8}	1	0.107	0.9153
GCI: EXPRI	-6.356×10^{-2}	1.055×10^{-2}	1	-6.027	**5.03×10^{-8}**
GCI: EXSEC	3.387×10^{-2}	1.085×10^{-2}	1	3.123	**0.0025**
GCI: EXTER	-2.414×10^{-3}	1.323×10^{-2}	1	-0.182	0.8557
Residual	-	0.384216	79	-	-

The effects of primary, secondary and tertiary education attainment on gross domestic product per capita and Global Competitiveness

All the indices were included in the attainment and gross domestic product per capita model and the model was significant ($p<0.05$). The results showed that secondary school education attainment ($p<0.05$) and government expenditure on primary school education ($p<0.05$) were significant to gross domestic product per capita (*Table 4.3*). The results also show that secondary school education attainment and government expenditure on primary school education were directly related to gross domestic product per capita (*Table 4.3*).

Table 4.3. GLM results for the effects of the unemployment (UNEMP), population size (POPSI), population growth (POPGRO), primary school attainment (ATPRI), secondary school attainment (ATSEC), tertiary level attainment (ENTER), government expenditure on primary school education (EXPRI), government expenditure on secondary school education (EXSEC) and government expenditure on tertiary education (EXTER) on gross domestic product per capita (GDPPC) for 20 countries between 2006 and 2016. Bolded values indicate significance ($p<0.05$).

	Estimate	**Std. Error**	**df**	**t-value**	**Pr(>|t|)**
Intercept	-2.148×10^5	7.081×10^4	-	-3.033	**0.01140**
GDPPC: UNEMP	1.671×10^3	2.436×10^3	1	0.686	0.50705
GDPPC: POPSI	-2.847×10^{-3}	2.792×10^{-3}	1	-1.020	0.32975
GDPPC: POPGRO	2.754×10^4	2.042×10^4	1	1.348	0.20465
GDPPC: ATPRI	4.463×10^2	6.642×10^2	1	0.672	0.51555
GDPPC: ATSEC	1.861×10^3	5.411×10^2	1	3.451	**0.00542**
GDPPC: ATTER	1.802×10^{-1}	2.438×10^{-1}	1	0.739	0.47521
GDPPC: EXPRI	2.300×10^3	1.024×10^3	1	2.246	**0.04623**
GDPPC: EXSEC	1.821×10^1	5.548×10^2	1	0.033	0.97440
GDPPC: EXTER	-9.239×10^2	1.210×10^3	1	-0.764	0.46114
Residuals	-	6891.054	11	-	-

Population size and growth and all forms of government expenditure on education were removed as they did not add any variation to the model ($p<0.05$) (*Table 4.4*). The results show that secondary school education attainment ($p<0.05$) had a significant effect on the Global Competitiveness Index

(*Table 4.4*). Furthermore, secondary school education attainment is directly proportional to Global competitiveness.

Table 4.4. GLM results for the effects of the unemployment (UNEMP), primary school attainment (ATPRI), secondary school attainment (ATSEC), and tertiary level attainment (ATTER) on global competitiveness for 20 countries between 2006 and 2016. Bolded values indicate significance ($p<0.05$).

	Estimate	**Std. Error**	**df**	**t-value**	**Pr(>|t|)**
Intercept	3.060	4.691×10^{-1}	-	6.524	**7.01×10^{-6}**
GCI: UNEMP	-5.086×10^{-4}	7.626×10^{-3}	1	-0.067	0.9477
GCI: ATPRI	-1.600×10^{-2}	9.039×10^{-3}	1	-1.771	0.0957
GCI: ATSEC	4.249×10^{-23}	4.854×10^{-3}	1	8.752	**1.70×10^{-7}**
GCI: ATTER	-9.860×10^{-8}	2.484×10^{-7}	1	-0.397	0.6966
Residuals	-	0.1596765	16	-	-

Aim 2 (Results): The effect of tertiary education on South Africa's economic growth and global competitiveness

The following section will be subdivided into two section. The first will address the impact of the throughput rates of all higher education institutions in South Africa on South Africa's economic growth and global competitiveness. The second section will address the impact of the throughput rates in the various higher education institutions grouped according to their cluster classifications on South Africa's economic growth and global competitiveness.

Descriptive statistics

The mean throughput rate number of graduates and percentages were calculated for the South African universities included in this study for the period between 2005 and 2017. Overall, the data showed an increase in these two parameters over time, as shown by the trendline equations and R^2 values (*Fig. 4.1* and *Fig. 4.2*). Furthermore, the mean throughput rate percentage levels out between 2013 and 2017, remaining between 23.1 in 2013 and 23.6 in 2017 (*Fig. 4.2*).

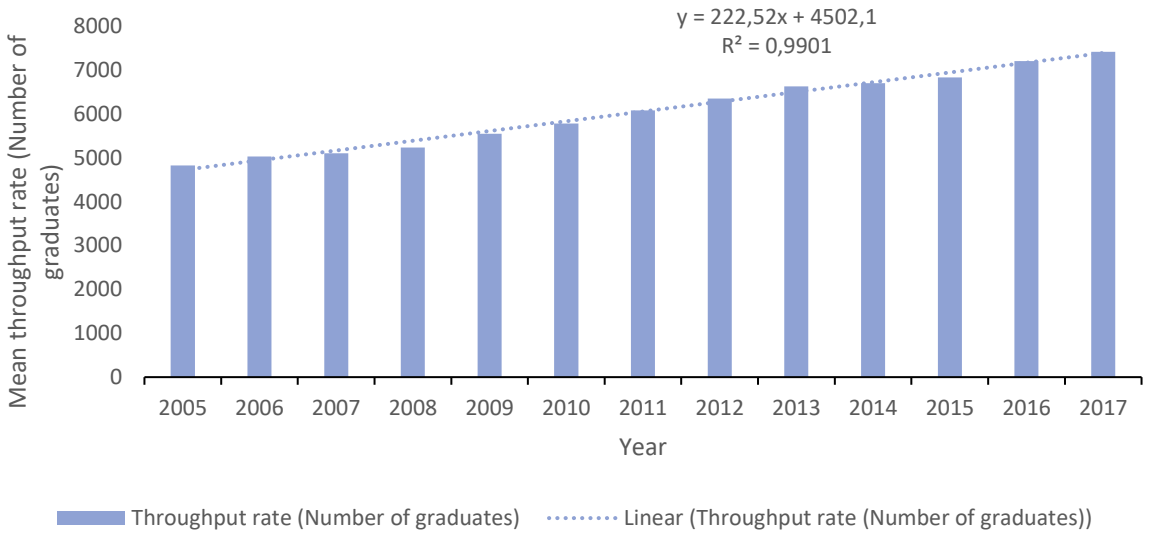

Fig. 4.1. The mean throughput rate (number of graduates) for South African universities between 2005 and 2017.

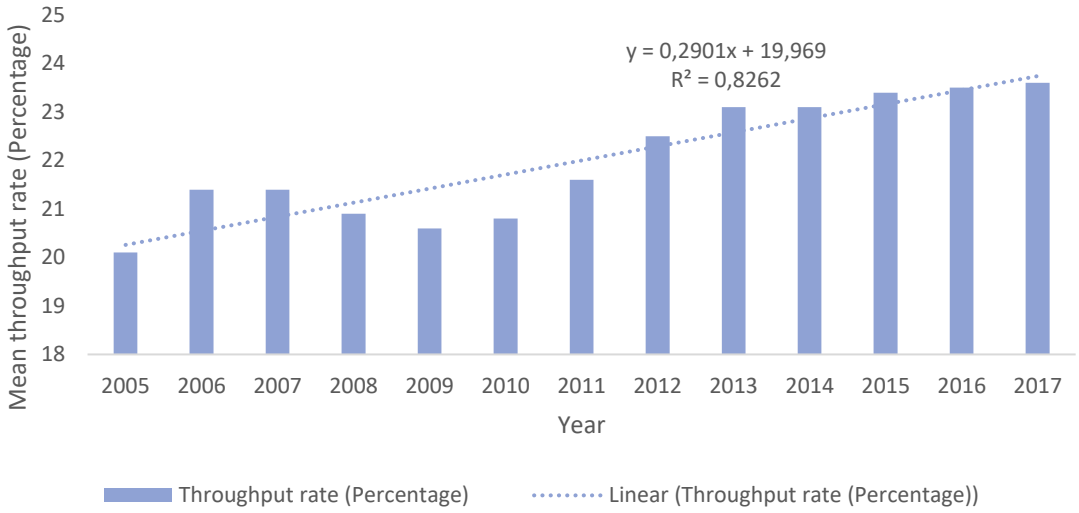

Fig. 4.2. The mean throughput rate (percentage) for South African universities between 2005 and 2017.

The overall effect of South African higher education institution throughput rates (percentages) on South Africa's economic growth and global competitiveness.

The models for testing the effects of throughput rate percentages of all higher education institutions on economic growth and global competitiveness were all significant ($p<0.05$) (*Table 4.5 and 4.6*). The results show that the throughput percentage of all higher education institutions was not a significant factor on South Africa's economic growth ($p>0.05$), or global competitiveness ($p>0.05$) (*Table 4.5 and*

4.6). The model for economic growth showed a direct relationship between population size, population growth and economic growth in South Africa (*Table 4.5*), whereas the global competitiveness model showed that there was an inverse relationship between South Africa's global competitiveness and its population size, and a direct relationship between South Africa's global competitiveness and its population growth (*Table 4.6*).

Table 4.5. GLM results for the effects of the overall higher education institution throughput rates (TPPERC) (percentages), population size (POPSI), and population growth (POPGRO) on South Africa's economic growth (GDPPC) for the period between 2005 - 2017. Bolded values indicate significance ($p<0.05$).

	Estimate	**Std. Error**	**df**	**t-value**	**Pr(>|t|)**
Intercept	2.009×10^{4}	1.106×10^{3}	-	18.163	**$<2 \times 10^{-16}$**
GDPPC: TPPERC	6.999	1.639×10^{1}	1	0.427	0.67
GDPPC: POPSI	4.996×10^{-4}	2.543×10^{-5}	1	19.649	**$<2 \times 10^{-16}$**
GDPPC: POPGRO	5.125×10^{3}	6.139×10^{2}	1	8.394	**2.31×10^{-15}**
Residuals	-	1012.514	282	-	-

Table 4.6. GLM results for the effects of the overall higher education institution throughput rates (TPPERC) (percentages), population size (POPSI) and population growth (POPGRO) on South Africa's Global competitiveness index (GCI) for the period between 2005 – 2017. Bolded values indicate significance ($p<0.05$).

	Estimate	**Std. Error**	**df**	**t-value**	**Pr(>|t|)**
Intercept	4.752	7.341×10^{-2}	-	64.730	**$<2 \times 10^{-16}$**
GCI: TPPERC	9.096×10^{-4}	1.024×10^{-3}	1	0.888	0.3752
GCI: POPSI	-9.883×10^{-9}	1.558×10^{-9}	1	-6.344	**9.89×10^{-10}**
GCI: POPGRO	9.095×10^{-2}	3.659×10^{-2}	1	2.486	**0.0136**
Residuals	-	0.0593	260	-	-

The overall effect of South African higher education institution throughput rates (number of graduates) on South Africa's economic growth and global competitiveness.

The models for testing the effects of throughput rate (number of graduates), of all higher education institutions on economic growth and global competitiveness were all significant ($p<0.05$) (*Table 4.7 and 4.8*). The results showed that the number of graduates of all higher education institutions was not a significant factor of South Africa's economic growth ($p>0.05$), or global competitiveness ($p>0.05$) (*Table 4.7 and 4.8*). The model for economic growth showed a direct relationship between population size, population growth and economic growth in South Africa (*Table 4.7*), whereas the global competitiveness model showed that there was an inverse relationship between South Africa's global competitiveness and its population size, and a direct relationship between South Africa's global competitiveness and its population growth (*Table 4.8*).

Table 4.7. GLM results for the effects of the overall higher education institution throughput rates (TPNUMB) (number of graduates), population size (POPSI), and population growth (POPGRO) on South Africa's economic growth (GDPPC) for the period between 2005 - 2017. Bolded values indicate significance ($p<0.05$).

	Estimate	**Std. Error**	**df**	**t-value**	**Pr(>|t|)**
Intercept	2.012×10^{4}	1.114×10^{3}	-	18.062	**$<2 \times 10^{-16}$**
GDPPC: TPNUMB	-6.559×10^{-4}	1.687×10^{-2}	1	-0.039	0.969
GDPPC: POPSI	5.021×10^{-4}	2.533×10^{-5}	1	19.827	**$<2 \times 10^{-16}$**
GDPPC: POPGRO	5.151×10^{3}	6.141×10^{2}	1	8.389	**2.38×10^{-15}**
Residuals	-	1012.839	282	-	-

Table 4.8. GLM results for the effects of the overall higher education institution throughput rates (TPNUMB) (number of graduates), population size (POPSI) and population growth (POPGRO) on South Africa's Global competitiveness index (GCI) for the period between 2005 – 2017. Bolded values indicate significance ($p<0.05$).

	Estimate	**Std. Error**	**df**	**t-value**	**Pr(>|t|)**
Intercept	4.757	7.389×10^{-2}	-	64.384	**$<2 \times 10^{-16}$**
GCI: TPNUMB	-2.604×10^{-8}	1.012×10^{6}	1	-0.026	0.980

GCI: POPSI	-9.583×10^{-9}	1.553×10^{-9}	1	-6.170	**2.6×10^{-9}**
GCI: POPGRO	9.069×10^{-2}	3.665×10^{-2}	1	2.475	**0.014**
Residuals	-	0.0594	260	-	-

The effect of throughput rates (percentages) of blue cluster institutions on South Africa's economic growth and global competitiveness.

The models for testing the effects of throughput rate (percentages), of blue cluster higher education institutions on economic growth and global competitiveness were all significant ($p<0.05$) (*Table 4.9 and 4.10*). The results showed that the percentage of graduates of all blue cluster higher education institutions was not a significant factor of South Africa's economic growth ($p>0.05$), or global competitiveness ($p>0.05$) (*Table 4.9 and 4.10*). The model for economic growth showed a direct relationship between population size, population growth and economic growth in South Africa (*Table 4.9*), whereas the global competitiveness model showed that there was an inverse relationship between South Africa's global competitiveness and its population size (*Table 4.10*).

Table 4.9. GLM results for the effects of blue cluster higher education institutions throughput rates (TPPERC) (percentage), population size (POPSI), and population growth (POPGRO) on South Africa's economic growth (GDPPC) for the period between 2005 - 2017. Bolded values indicate significance ($p<0.05$).

	Estimate	**Std. Error**	**df**	**t-value**	**Pr(>|t|)**
Intercept	2.045×10^{4}	1.873×10^{3}	-	10.918	**$<2 \times 10^{-16}$**
GDPPC: TPPERC	3.227	3.312	1	0.974	0.332
GDPPC: POPSI	4.85×10^{-4}	4.472×10^{-5}	1	10.863	**$<2 \times 10^{-16}$**
GDPPC: POPGRO	5.064×10^{3}	1.030×10^{3}	1	4.916	**3.46×10^{-6}**
Residuals	-	1020.819	100	-	-

Table 4.10. GLM results for the effects of blue cluster higher education institutions throughput rates (TPPERC) (percentage), population size (POPSI), and population growth (POPGRO) on South Africa's Global competitiveness index (GCI) for the period between 2005 - 2017. Bolded values indicate significance (p<0.05).

	Estimate	**Std. Error**	**df**	**t-value**	**Pr(>|t|)**
Intercept	4.763	1.238×10^{-1}	-	38.466	**$<2 \times 10^{-16}$**
GCI: TPPERC	8.211×10^{-4}	2.033×10^{-3}	1	0.404	0.6872
GCI: POPSI	-9.966×10^{-9}	2.725×10^{-9}	1	-3.657	**0.0004**
GCI: POPGRO	8.901×10^{-2}	6.169×10^{-2}	1	1.443	0.1524
Residuals	-	0.0601	92	-	-

The effect of throughput rates (number of graduates) of blue cluster institutions on South Africa's economic growth and global competitiveness

The models testing the effects of the number of graduates from blue cluster institutions on South Africa's economic growth and global competitiveness were both significant (p<0.05)(*Table 4.11 and 4.12*). Population size was significant in both models (p<0.05), however population growth was only significant to economic growth (p<0.05) (*Table 4.11*). The results showed that the throughput rates in terms of number of graduates was not a significant factor of South Africa's economic growth (p>0.05) and global competitiveness (p>0.05) (*Table 4.11 and 4.12)*.

Table 4.11. GLM results for the effects of blue cluster higher education institutions throughput rates (TPNUMB) (number of graduates), population size (POPSI), and population growth (POPGRO) on South Africa's economic growth (GDPPC) for the period between 2005 - 2017. Bolded values indicate significance (p<0.05).

	Estimate	**Std. Error**	**df**	**t-value**	**Pr(>|t|)**
Intercept	2.015×10^{4}	1.877×10^{3}	-	10.733	**$<2 \times 10^{-16}$**
GDPPC: TPNUMB	1.699×10^{-3}	3.397×10^{-2}	1	0.050	0.96
GDPPC: POPSI	5.015×10^{-4}	4.279×10^{-5}	1	11.718	**$<2 \times 10^{-16}$**
GDPPC: POPGRO	5.152×10^{3}	1.031 x103	1	4.996	**2.46×10^{-6}**
Residuals	-	1025.638	100	-	-

Table 4.12. GLM results for the effects of blue cluster higher education institutions throughput rates (TPNUMB) (number of graduates), population size (POPSI), and population growth (POPGRO) on South Africa's Global competitiveness index (GCI) for the period between 2005 - 2017. Bolded values indicate significance (p<0.05).

	Estimate	**Std. Error**	**df**	**t-value**	**Pr(>|t|)**
Intercept	4.759	1.244×10^{-1}	-	38.252	**$<2 \times 10^{-16}$**
GCI: TPNUMB	1.482×10^{-7}	2.054×10^{-6}	1	0.072	0.9426
GCI: POPSI	-9.631×10^{-9}	2.624×10^{-9}	1	-3.670	**0.0004**
GCI: POPGRO	9.078×10^{-2}	6.162×10^{-2}	1	1.473	0.1441
Residuals	-	0.0602	92	-	-

The effect of throughput rates (percentages) of green cluster institutions on South Africa's economic growth and global competitiveness.

The models for testing the effects of throughput rates (percentages) of green cluster institutions on South Africa's economic growth and global competitiveness were both significant (p<0.05) (*Table 4.13 and 4.14)*. Population size was significant in both models (p<0.05) and had a direct relationship with economic growth and an inverse relationship with global competitiveness (*Table 4.13 and 4.14*). Population growth was significant (p<0.05) and had a direct relationship with economic growth (*Table 4.13*), however it was not significant to global competitiveness (*Table 4.13*). The throughput rate at green cluster institutions was a significant factor of South Africa's global competitiveness (p<0.05), but not significant to its economic growth (p>0.05) (*Table 4.13 and 4.14*)

Table 4.13. GLM results for the effects of green cluster higher education institutions throughput rates (TPPERC) (percentage), population size (POPSI), and population growth (POPGRO) on South Africa's economic growth (GDPPC) for the period between 2005 - 2017. Bolded values indicate significance (p<0.05).

	Estimate	**Std. Error**	**df**	**t-value**	**Pr(>|t|)**
Intercept	2.026×10^{4}	1.760×10^{3}	-	11.512	**$<2 \times 10^{-16}$**
GDPPC: TTPERC	-2.012×10^{1}	4.055×10^{1}	1	-0.496	0.621
GDPPC: POPSI	5.079×10^{-4}	4.105×10^{-5}	1	12.374	**$<2 \times 10^{-16}$**

GDPPC: POPGRO	5.153×10^{3}	9.690×10^{2}	1	5.317	**5.37×10^{-7}**
Residuals	-	1022.269	113	-	-

Table 4.14. GLM results for the effects of green cluster higher education institutions throughput rates (TPPERC) (percentage), population size (POPSI), and population growth (POPGRO) on South Africa's Global competitiveness index (GCI) for the period between 2005 - 2017. Bolded values indicate significance ($p<0.05$).

	Estimate	**Std. Error**	**df**	**t-value**	**Pr(>|t|)**
Intercept	4.721	1.135×10^{-1}	-	41.585	**$<2 \times 10^{-16}$**
GCI: TPPERC	5.842×10^{-3}	2.347×10^{-3}	1	2.489	**0.014**
GCI: POPSI	-1.134×10^{-8}	2.445×10^{-9}	1	-4.636	**1.04×10^{-5}**
GCI: POPGRO	9.035×10^{-2}	5.629×10^{-2}	1	1.605	0.1115
Residuals	-	0.058	104	-	-

The effect of throughput rates (number of graduates) of green cluster institutions on South Africa's economic growth and global competitiveness.

The models for testing the effects of throughput rates (number of graduates) from green cluster institutions on South Africa's economic growth and global competitiveness were significant ($p<0.05$) (*Table 4.15 and 4.16*). Population size was a significant factor of both economic growth and South Africa's global competitiveness ($p<0.05$). Furthermore, population size had a direct relationship with economic growth (*Table 4.15*) and an inverse relationship with South Africa's global competitiveness (*Table 4.16*). The throughput rates (number of graduates) from green cluster institutions was not significant to South Africa's economic growth or global competitiveness ($p>0.05$) (*Table 4.15 and 4.16*).

Table 4.15. GLM results for the effects of green cluster higher education institutions throughput rates (TPNUMB) (number of graduates), population size (POPSI), and population growth (POPGRO) on South Africa's economic growth (GDPPC) for the period between 2005 - 2017. Bolded values indicate significance ($p<0.05$).

	Estimate	**Std. Error**	**df**	**t-value**	**Pr(>|t|)**
Intercept	2.012×10^{4}	1.763×10^{3}	-	11.411	**$<2 \times 10^{-16}$**

GDPPC: TPNUMB	-1.129 x10^{-3}	2.494 x10^{-2}	1	-0.045	0.9640
GDPPC: POPSI	5.023 x10^{-4}	4.004 x10^{-5}	1	12.546	**<2 x10^{-16}**
GDPPC: POPGRO	5.152 x10^{3}	9.701 x10^{2}	1	5.311	**5.54 x10^{-7}**
Residuals	-	1023.37	113	-	-

Table 4.16. GLM results for the effects of green cluster higher education institutions throughput rates (TPNUMB) (number of graduates), population size (POPSI), and population growth (POPGRO) on South Africa's Global competitiveness index (GCI) for the period between 2005 - 2017. Bolded values indicate significance ($p<0.05$).

	Estimate	**Std. Error**	**df**	**t-value**	**Pr(>|t|)**
Intercept	4.758	1.170 x10^{-1}	-	40.671	**<2 x10^{-16}**
GCI: TPNUMB	9.739 x10^{-8}	1.495 x10^{-6}	1	0.065	0.9482
GCI: POPSI	-9.622 x10^{-9}	2.457 x10^{-9}	1	-3.916	**0.0002**
GCI: POPGRO	9.063 x10^{-2}	5.795 x10^{-2}	1	1.564	0.1209
Residuals	-	0.060	104	-	-

The effect of throughput rates (percentages) of red cluster institutions on South Africa's economic growth and global competitiveness.

The models used to determine the effects of throughput rates (percentages) of red cluster institutions on South Africa's economic growth and global competitiveness were both significant ($p<0.05$) (*Table 4.17 and 4.18*). Population size was a significant factor in both models ($p<0.05$), and it had a direct relationship with South Africa's economic growth and an inverse relationship with its global competitiveness (*Table 4.17 and 4.18*). Population growth was a significant factor of South Africa's economic growth ($p<0.05$) and these two parameters had a direct relationship with one another (*Table 4.17*). The results show that throughput rates (percentages) of red cluster institutions are not significant factors of South Africa's economic growth and global competitiveness ($p>0.05$) (*Table 4.17 and 4.18*).

Table 4.17. GLM results for the effects of red cluster higher education institutions throughput rates (TPPERC) (percentage), population size (POPSI), and population growth (POPGRO) on South Africa's economic growth (GDPPC) for the period between 2005 - 2017. Bolded values indicate significance ($p<0.05$).

	Estimate	**Std. Error**	**df**	**t-value**	**Pr(>|t|)**
Intercept	1.988×10^{4}	2.536×10^{3}	-	7.842	**8.24×10^{-11}**
GDPPC: TPPERC	9.157	3.339×10^{1}	1	0.274	0.7848
GDPPC: POPSI	5.009×10^{-4}	5.354×10^{-5}	1	9.356	**2.14×10^{-13}**
GDPPC: POPGRO	5.199×10^{3}	1.331×10^{3}	1	3.907	**0.0002**
Residuals	-	1037.546	61	-	-

Table 4.18. GLM results for the effects of red cluster higher education institutions throughput rates (TPPERC) (percentage), population size (POPSI), and population growth (POPGRO) on South Africa's Global competitiveness index (GCI) for the period between 2005 - 2017. Bolded values indicate significance ($p<0.05$).

	Estimate	**Std. Error**	**df**	**t-value**	**Pr(>|t|)**
Intercept	4.792	1.649×10^{-1}	-	29.067	**$<2 \times 10^{-16}$**
GCI: TPPERC	-1.444×10^{-3}	2.041×10^{-3}	1	-0.707	0.4822
GCI: POPSI	-9.380×10^{-9}	3.285×10^{-9}	1	-2.855	**0.0060**
GCI: POPGRO	8.399×10^{-2}	7.918×10^{-2}	1	1.061	0.2934
Residuals	-	0.0607	56	-	-

The effect of throughput rates (number of graduates) of red cluster institutions on South Africa's economic growth and global competitiveness.

The models used to determine the impacts of throughput rate (number of graduates) from red cluster institutions on South Africa's economic growth and global competitiveness were both significant ($p<0.0005$) (*Table 4.19 and 4.20*). Population size was a significant factor in both models ($p<0.05$) and demonstrated a direct relationship with economic growth and an inverse relationship with global competitiveness (*Table 4.19 and 4.20*). Population growth was a significant factor ($p<0.05$) and had a

direct relationship with South Africa's economic growth (*Table 4.19*). The results show that the throughput rates (number of graduates) from red cluster institutions do not have a significant impact on South Africa's economic growth or global competitiveness (p>0.05) (*Table 4.19 and 4.20*).

Table 4.19. GLM results for the effects of red cluster higher education institutions throughput rates (TPNUMB) (number of graduates), population size (POPSI), and population growth (POPGRO) on South Africa's economic growth (GDPPC) for the period between 2005 - 2017. Bolded values indicate significance (p<0.05).

	Estimate	**Std. Error**	**df**	**t-value**	**Pr(>|t|)**
Intercept	2.011×10^{4}	2.387×10^{3}	-	8.425	**8.18×10^{-12}**
GDPPC: TPNUMB	-2.602×10^{-3}	3.735×10^{-2}	1	-0.070	0.9447
GDPPC: POPSI	5.026×10^{-4}	5.430×10^{-5}	1	9.257	**3.14×10^{-13}**
GDPPC: POPGRO	5.153×10^{3}	1.320×10^{3}	1	3.902	**0.0002**
Residuals	-	1038.144	61	-	-

Table 4.20. GLM results for the effects of red cluster higher education institutions throughput rates (TPNUMB) (number of graduates), population size (POPSI), and population growth (POPGRO) on South Africa's Global competitiveness index (GCI) for the period between 2005 - 2017. Bolded values indicate significance (p<0.05).

	Estimate	**Std. Error**	**df**	**t-value**	**Pr(>|t|)**
Intercept	4.753	1.588×10^{-1}	-	29.932	**$<2 \times 10^{-16}$**
GCI: TPNUMB	-5.152×10^{-7}	2.265×10^{-6}	1	-0.227	0.8209
GCI: POPSI	-9.454×10^{-9}	3.339×10^{-9}	1	-2.831	**0.0064**
GCI: POPGRO	9.100×10^{-2}	7.894×10^{-2}	1	1.153	0.2539
Residual	-	0.0609	56	-	-

Chapter 5: Discussion

This section addressed both aims 1 and 2 as separate discussions. The first part of the section is dedicated to discussing the findings for aim 1: the effects of education enrolment and attainment on economic growth and global competitiveness. The second part of the section is dedicated to discussing the findings for aim 2: the effects of South Africa's current overall and cluster higher education throughput rates on its economic growth and global competitiveness. It is worth noting that for aim 2, no international comparisons were made, and only South African data was examined and is thus discussed. Additionally, this section will make comparisons between the results from this thesis and the existing literature.

Aim 1 (Discussion): The effects of enrolment and attainment on economic growth

The factors that affected economic growth directly included tertiary education enrolment, secondary school attainment and primary government expenditure (*Table 5.1*). Avalos (1996) has stated that education has been singled out as an important area of focus within a country, because the belief is that the more educated a country's population is, the higher its productivity and the higher its ability to compete in international markets. This increased economic growth and financial prosperity will supposedly aid the country to improve the living conditions of its most impoverished members of the population (Avalos, 1996). Subsequently, the segments of education that have an impact on economic growth should have the higher levels of investment from the government. It was interesting to note that although tertiary level enrolment had an impact on economic growth, it was secondary school attainment that had an impact on economic growth. This could be explained by the fact that members of the population that are in possession of a secondary school education are fed into base of the workforce. In terms of tertiary level enrolment, due to the fees that are being paid to enrol and study at universities, there is a cash injection into the economy at the initial stage of tertiary education. The amount of money obtained per year from students tends to drop off contemporaneously as students deregister and get excluded throughout the duration of the degrees for which they register. The high levels of students that register in first year require a substantial amount of staffing from academic institutions, in order to cope with all the administrative requirements. Increased tertiary level enrolment can lead to job creation, which would indirectly contribute to economic growth.

The factors that affected economic growth inversely included unemployment rate and population growth (*Table 5.1*). In terms of population dynamics, the old (individuals post retirement/economically productive age) and young (children under the age of 18) portions of the population tend to consume more than they generate as they are most likely to be unemployed (Bloom, Canning and Malaney,

2000). This effect is further exacerbated by the unemployed segment of the middle-aged working population (Bloom, Canning and Malaney, 2000). Due to the imbalance in resource production and consumption, higher levels of unemployment would result in lower levels of economic growth. Furthermore, if the portion of the population which is growing is either the young (occurring through an increased birth rate) or the old population, this would mean that an increasing population growth rate would also affect economic growth negatively (Crenshaw, Ameen and Christenson, 1997).

The effects of enrolment and attainment on the Global Competitiveness Index ranking

The factors that affected global competitiveness directly included secondary school level government expenditure and secondary school education level attainment (*Table 5.1*). Considering that the larger portion of a country's workforce is comprised of people who have completed their secondary school education, it would stand to reason that investment in this level of education by the government would have an influence on global competitiveness.

The factors that affected global competitiveness inversely included primary school education level government expenditure (*Table 5.1*). If the growth of the population occurs within the least productive portions of the economy (the youngest and oldest individuals of the population), this could stagnate or reduce the level of economic growth, and thus, global competitiveness of a country (Grosse, Krueger and Mvundura, 2009). In the case where there is an increased birth rate (increasing the population growth), the government would have to increase its expenditure on entry level education to cater for the increased number of children in the system. Furthermore, once these children complete primary school, their attainment of this education level would mean that further expenditure would need to take place in order to cater for their secondary school needs. This could explain the inverse relationship between primary school education level government expenditure and a country's global competitiveness.

Table 5.1. The effects of various factors on GDPPC (which has been used as a proxy for economic growth) and the Global Competitiveness Index scores, as per the data collected and analysed between 2006 and 2016. "=" denotes a direct relationship and "α" denotes an inverse relationship.

Factors	**Effects**	**Parameter**
Tertiary level education enrolment Secondary school education level attainment Primary school education government expenditure	=	GDPPC (Economic growth)
Unemployment rates Population growth	α	GDPPC (Economic growth)
Secondary school education expenditure Secondary school education level attainment	=	Global competitiveness Index
Primary school education government expenditure	α	Global competitiveness Index

Implications and recommendations for governments on a Global scale

The segment of the population that seems to have the highest impact on both economic growth and global competitiveness is secondary school education attainment. This could be because in most economy's, these individuals tend to make up that largest base of the work force which keeps the economy functional (Grosse, Krueger and Mvundura, 2009). Although tertiary level education enrolment was seen to have a direct effect on economic growth, tertiary level education attainment did not influence either economic growth or global competitiveness. This could possibly be attributed to the fact that the data used only accounted for Bachelor's level graduates. There is evidence to suggest that the graduates responsible for the higher levels for innovation tend to be holders of post graduate degrees (Yufeng, Jing and Zidian, 2013). Bearing this in mind, the portion of graduates with bachelor's degrees would most likely add to the work force as opposed to increase innovation, which is one of the main drivers of economic growth and global competitiveness.

Taking all these aspects into consideration, perhaps governments around the world can improve their country's economic growth and global competitiveness by taking the following steps:

1. Maintaining a stable population size: Populations tend to grow through increased birth rates. Raising awareness and improving delivery mechanisms of contraceptive methods could help to decrease the birth rates, thus maintaining relatively stable population sizes.

2. Education enrolment and attainment rates: It is important for countries to evaluate the ratios of enrolment and attainment at the different levels of education, and to base their funding on the levels of education which will contribute most to the country's economy. Furthermore, efforts should be made to determine potential areas which require innovation within the country's economy. Once this has been established, governments should invest in grooming individuals to fill those gaps and potentially produce levels of innovation which could make the country more competitive on an international level.

Shortcomings of the models (Aim 1)

The solutions listed above are all based on the results obtained from the models designed in this study. It is important to note that the model had the following shortcomings which could possibly be improved upon in future studies:

1. Unavailable data: Due to various constraints, not all the data was available for all the categories used in the study, particularly for the bottom 10 globally competitive countries. The hope is that if this study is repeated, this data can become available, thus refining the results that have been obtained.
2. Time constraints: Due to the time allocated to the project, the amount of data that could be collected was limited. Future studies could potentially take the same model and use it to test the data available for all of the countries in the world and determine whether the results from the sample used in this study align with those obtained from using the entire world populations' data.

Aim 2 (Discussion): The effects of South Africa's current throughput rates in higher education institutions on its economic growth and global competitiveness.

Although the theory suggests that educated human capital improves economic growth, it is important to consider context. In South Africa, the trend has been that students from historically disadvantaged backgrounds tend to struggle through their university degrees due to inadequate schooling (Smit, 2012). In addition to this, it is important to consider that although students may complete their higher education, there remains high levels of unemployment amongst the educated youth (Badat, 2010)

The results in this chapter demonstrate that the current throughput rates in South African universities have no significant impact on South Africa's economic growth and global competitiveness. This could be attributed to several factors. Firstly, the throughput rates are low (less than 40% as mentioned in the literature review), ranging from an average of 20.1% in 2005 to 23.6% in 2017. This suggests that

perhaps the focus in higher education should be to devise ways in which to improve the throughput rate and increase the probability of students completing their degrees.

The solution above does present a problem in itself, considering the current high levels of unemployment present amongst graduates (Badat, 2010). In order to effect constructive change, amendments need to be made at all levels. Therefore, prior to creating an influx of graduates, government needs to ensure that this influx is catered for in the job market. Failure to do so will result in the increase of the unproductive proportion of the economy, which will only exacerbate the current lack of economic growth.

In terms of global competitiveness, it is important to consider which proportions of graduates are responsible for innovation. The data used for this study was based solely on graduates who have obtained their bachelor's degrees. It would be interesting to observe whether Honours, Masters and PhD graduates have the same impact on the economy, considering that their levels of education encourage innovation much more than bachelor's degrees (Yufeng, Jing and Zidian, 2013).

The results also show interesting relationships between South Africa's population dynamics and its economic growth and global competitiveness. The general trend in this data shows that there is a direct relationship between South Africa's population size and growth and its economic growth, and an inverse relationship between its population size and global competitiveness. This seems to contradict most literature which suggests that increased population size and growth rate decreases economic growth (Crenshaw, Ameen and Christenson, 1997; Bloom, Canning and Malaney, 2000). Perhaps the other factor at play within the South African context is the ages of the productive and non-productive populations. Disadvantaged South Africans are heavily reliant on the social grants provided by government (Neves et al., 2009). Although this system has increased purchasing power amongst the South African population, it has also made them heavily reliant on it, sometimes disincentivising individuals from working (Neves et al., 2009). If unemployment does not decrease and increasing numbers of the population become reliant on these grants, this could prove to be detrimental to the economy. Therefore, it is important that government places heavy emphasis on the importance of the absorption of human capital in the South African economy and creates mechanisms which allow for graduates to become productive and innovative members of the economy.

From the managerial perspective, it is understood that the willingness of an employee and the creation of opportunity is what determines the amount of knowledge that they contribute to the firm (Conner and Prahalad, 1996). Perhaps the government and business should consider making

provisions to promote the establishment of a knowledge-based economy in South Africa. This would allow for increased technological capabilities and absorption rates (Cooke and Leydesdorff, 2006), which could result in increased economic growth and global competitiveness.

Chapter 6: Conclusion

Previous literature has indicated that on a global scale, education enrolment had a positive impact on economic growth and global competitiveness (Barro, 1991; Psacharopoulos, 1994). Additionally, the benefits of education not only accrue to the individual, but to the country as well (Schultz, 1993; Crook et al., 2011). However, for the development of effective fiscal policy, it is important to understand the current global situation in terms of which levels of education (primary, secondary and tertiary education) enrolment and attainment have an impact on economic growth and global competitiveness. Through understanding this relationship, policies can be developed which are specifically focused on funding the levels of education which could potentially yield increased economic growth and global competitiveness.

In light of South Africa's diverse but often unequal past, understanding the current socio-economic status of the country and whether or not further policies need to be implemented in order to correct the errors of the past. Furthermore, South Africa currently has the highest rate of inequality in the world, with a Gini coefficient of 63.0 (Leibbrandt et al., 2010; World Bank, 2018c). It is therefore of utmost importance to understand whether higher education (specifically the throughput rates in higher education) is currently having an impact on the country's economic growth and global competitiveness and whether new policies need to be developed to increase the throughput rates. The rationale being that previous studies have shown that educated populations result in a country's increased ability to absorb or create new technologies which subsequently result in increased economic growth (Simonen, Svento and Juutinen, 2015).

This thesis comprised of two studies which had the following aims:

Aim 1: To determine the effects of education on economic growth and global competitiveness, based on the top and bottom 10 globally competitive countries (20 countries in total).

Methodology: This was done by gathering data from the top and bottom 10 globally competitive countries between 2006 and 2016, and determining the relationship between population size, population growth, unemployment rates, education enrolment and attainment rates (for primary, secondary and tertiary education), and percentage of government expenditure on education, and economic growth and global competitiveness.

Aim 2: To determine the relationships between the current overall and cluster (red, blue and green clusters) throughput rate of South African Higher Education Institutions and South Africa's economic growth and global competitiveness

Methodology: This was done by gathering data for the throughput rates of all South African Higher Education Institutions, South Africa's population size and growth determining the relationship between these factors and South Africa's economic growth and global competitiveness. The data used for this study ranged between 2005 and 2017.

The results for the first aim showed that on a global scale, unemployment and population growth have an inverse relationship with economic growth and tertiary level education enrolment, secondary school education attainment and government expenditure on primary school education has a direct relationship with economic growth. Government expenditure on primary school education has an inverse relationship with global competitiveness, whereas government expenditure on secondary school education and secondary school education attainment has a direct relationship with global competitiveness.

The results for the second aim showed that the throughput rate has increased during the period between 2005 and 2017 and the throughput rate in 2017 was 23.6. Unfortunately, the models demonstrated that the overall and cluster throughput rates in South African higher education institutions did not have an impact on South Africa's economic growth during the period between 2005 and 2017. However, the throughput percentage in green cluster universities did have a direct relationship with South Africa's global competitiveness.

The data from this thesis shows some relationships between education and economic growth and global competitiveness. It is important for policy makers to critically evaluate the enrolment and attainment numbers associated with the different levels of education in their countries, and plan their expenditure according to the necessity, as well as the overall impacts that each level will cause to the economy. Considering the cyclical impacts that improved education has on an economy, it is important to increase the accessibility of education to every socio-economic group of the economy. The abovementioned recommendations will hopefully not only improve the quality of life of individuals within countries, but also the economic growth and Global competitiveness. However, prior to implementation, it is important for each country to critically assess its needs in terms of education and then adjust according to the outlined specifications.

For graduates to become participants in the economy, opportunities need to be made available. In recent times, there has been an influx of graduates leaving South Africa and seeking opportunities in other countries. It is important to create opportunity prior to increasing the throughput rate, as an increase in throughput rate with no opportunity creation can result in increased unemployment rates. It is important for government and higher education institutions to work in an integrated manner to

develop solutions for the absorption of graduates and thereafter, the increase of the current throughput rate in South African Higher Education Institutions.

Prior to doing so, it is of pivotal importance to run scenario models to fully understand whether the increase in throughput rates would actually achieve the desired outcomes. It is also of utmost importance to understand the needs of the present and future markets in order to produce graduates that have a higher likelihood of being absorbed into those markets. South Africa is currently suffering from a well-known phenomenon, aptly named “the brain drain” (Kaplan and Höppli, 2017). The “brain drain” describes the movement of highly educated workers mostly from developing countries to developed countries in search of better opportunities and higher income (Carrington and Detragiache, 1999). The risk that this present to an economy is that even though the investment in education may be high, the benefits would not accrue to that country and will instead accrue to the country to which the highly educated worker has migrated to, thus reducing the potential return on investment, and subsequently not resulting in the desired economic growth (Carrington and Detragiache, 1999). As such, it is of utmost importance to not only produce the members of society with the required levels of education, but to also ensure that the market have vacancies available to absorb the newly produced intellectual capital.

In conclusion, both on a global and South African scale, the solution to the improvement of economic growth and global competitiveness must be multi-faceted, and structured to include stakeholders at all levels of society. Furthermore, foresight is of utmost importance, considering that the world is currently moving towards the fourth industrial revolution and possibly beyond. Therefore, policymakers need to do adequate research and consult the various stakeholders in order to create policies which are holistic in their results and potential lead to the desired outcomes of positive economic growth and global competitiveness.

Chapter 7: Institutional and managerial recommendations

Globally, economic growth optimisation is a well-researched field. It is important to consider that South Africa as a country, presents a unique context. Due to its tumultuous political past, there are various socio-economic issues that are at play, making its economic situation quite unique. The following chapter seeks to provide recommendations to government and business institutions based on the data presented in the preceding chapters.

The literature has stated various factors as drivers of economic growth. These factors include specialisation and diversification (Simonen, Svento and Juutinen, 2015), policy and governance (Rodrik, 2014), population dynamics (Mankiw, Romer and Weil, 1992) and economic freedom (Easton and Walker, 1997) amongst others. Perhaps the initial step for the South African government should be to critically assess the current state of these various parameters and to develop mitigation strategies for the issues at hand. In addition to this, it is important for South Africa to consider the pivotal role that its human capital plays in the success and sustainability of any mitigation strategies put in place (Crook et al., 2011).

Based on the international data results, secondary school education attainment impacts economic growth and global competitiveness more than all the other parameters tested in that study. Holders of secondary school education tend to make up the largest base of the workforce which keeps the economy functional. However, considering the unemployment rates in South Africa, the possible problem could be that there are insufficient vacancies available for secondary school education holders to occupy.

The literature suggests that education plays a significant role in economic growth. Theory suggests that an increase in education amongst a country's population increases its labour force, which results in a higher number of individuals contributing towards the country's gross domestic product (Hanushek and Woessmann, 2010). Furthermore, education can encourage innovation, which can result in the production of newer technologies, subsequently promoting overall growth in the country (Hanushek and Woessmann, 2010). Spreading knowledge through education can also result in the understanding and processing of information to become more efficient within the country, thus promoting economic growth (Hanushek and Woessmann, 2010). Within the South African context, the question then becomes which level of education contributes the most towards its economy and thereafter, it is important to invest in the correct education level, whilst simultaneously creating opportunities for the absorption of this knowledge capital.

Additional results showed that the current throughput rate at South African Higher Education Institutions does not currently have a significant impact on the South African economy. Potential reasons for this could be that the current throughput rates are low, or that the subsequent absorption of the newly created knowledge capital is insufficient. Further research needs to be conducted to determine ways in which opportunities can be created for graduates within the South African context. Furthermore, it is important to determine which education level contributes most to the South African economy. Thereafter, government should evaluate its current investment policies and determine whether the education level that contributes the most is sufficiently funded. In addition to this, government and business should co-operate and determine ways in which the knowledge capital being produced is adequately absorbed in order to optimise economic growth.

There are various factors within the South African context which must be considered when attempting to develop strategies to improve its economic growth. However, these strategies must be devised and implemented with the co-operation of the various stakeholder involved. Stakeholder theory states that it is important for firms to understand their purpose and for managers to understand their responsibility to the various stakeholder involved (Freeman, Wicks and Parmar, 2004). Thereafter, it is important for the firm to assess the power and interest of the vested stakeholders and to make decisions that will satisfy the needs of these stakeholders without purposefully causing any negative impacts (Freeman, Wicks and Parmar, 2004). The South African government needs to effectively engage the various stakeholder involved in order to remedy and improve the state of its economy. Through adequate stakeholder engagement, mitigation strategies can be devised and implemented and in turn, the lives of South Africans can be improved in a sustainable manner.

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