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TRADE COMPETITION MEASUREMENT AND THE CHOICE OF MEASUREMENT INDEXES

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Abstract. The aim of this paper is to bring a methodological and empirical contribution to the measurement of trade competition. Globalization and the emergence of new poles in the world economy brought changes to the global landscape and consequent increase in international trade. There is a debate in the literature with regard the indexes that are better fit to be applied in empirical examples for the acquirement of relevant results for measurement of trade competition. This measurement will be achieved by observing the levels of structural similarity in distinct areas and at different moments in time. A higher degree of similarity between the export structures implies a stronger competition in destination markets. The values obtained for this measurement are highly relevant for the trade competition topic. Through this study we further explore the measurement of trade competition and comparatively discuss several indexes used in this area of research.

JEL classification: B17, B27;

Keywords: trade competition; structural similarity; export structures; trade competition indexes; competition measurement; Krugman index

1. Introduction

The concept of measuring the levels of structural similarity in distinct areas and at different moments in time to observe a higher degree of similarity between the export structures has already been studied. A high similarity implies a stronger competition in destination markets in correlation with the trade competition topic.

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What we propose to do in this study is to further explore the measurement of trade competition and present several indexes that have already been used in this area of research. Alongside the measurement of trade competition through sector shares we explore structural similarity as an intra-sector dimension in order to measure the quality in product specialization. Moreover we measure inter-sector similarity to reflect the degree of similarity between sectors. All of these approaches are based on trade competition being measured through the exports of two countries (a,b) for a given destination market (m). The indexes used to measure the above types of competition are variations of the Krugman index as in Lopes et al. (2014) all starting from the traditional Krugman index as in Krugman (1991). For our study in the empirical section the estimation of the specialization levels will be done focusing on the evolution of export structures over time.

Furthermore, this paper explores other types of perspectives of analysis: the competition in a block of countries, the competition between two countries in all the markets, competition that a country faces in a specific destination market, competition that a country faces in all markets, competition in a given market among all the countries, and finally competition between all countries in all markets.

2. Literature review

International trade and the measurement of trade competition have been intensely researched and debated in the recent years (Palan and Schmiedeberg, 2010, Crespo and Simoes, 2012). The aim of this paper is to bring a methodological and empirical contribution to trade competition measurement. As stated “Globalization is neither inevitable nor irreversible” (World Trade Economy, 2013, p. 5), alongside with the emergence of new poles in the world economy consequently making the global landscape modify. Globalization is a driver in the geographical reconfiguration facilitating the shift in economic power for numerous nations (Head and Mayer, 2013; Riad et al., 2012). All these factors have contributed to the high-powered increase of international trade (Berthelon and Freund, 2008). With all the changes in the worldwide trade the concept of trade competition should be granted a higher attentiveness. Furthermore the conclusions of this paper will show what is left to be researched in this area in order to have a complete review on measuring trade competition.

Based on the research that has been done so far there is a debate among the indexes more applicable in empirical examples for the acquirement of relevant results. According to Palan (2010, p. 3) “Due to the increasing interest on the effects of economic integration on the specialization of countries, the necessity to measure heterogeneity across countries as well as its effects on the competitiveness of individual countries has risen Yet there seems to have been no agreement on which index is best to capture specialization, although the empirical results depend heavily on the statistical methods and measures employed.”

Even more, analysing trade structural similarity is an important subject to be researched in international economics (Wacziarg, 2004). Several empirical analyses have measured the levels of structural similarity in distinct areas and years to observe that if the export structures have a higher degree of similarity that implies a stronger competition in destination markets (Midelfart-Knarvik et al., 2003; Crespo and Fontoura, 2007; Palan and Schmiedeberg, 2010).

There are multiple ways to evaluate the phenomenon but most studies on this subject have focused on the structural similarity to weight trade competition (Crespo and Simoes, 2012). In this study we further explore the measurement of trade competition. Several indexes that have already been used in this area of research will also be presented.

There are a lot of researchers that have studied the topic of trade competition measurement while further emphasising the perspective of competition of two countries in a given market m (Crespo and Simoes, 2012). The following phase of research was based on exploring the existence of various typologies of competition between countries (Moreira et al., 2017, Lopes et al., 2014). Jenkins' paper (2008) is focused on one specific type of competition; the one faced by all exporters by one market *m*. Also Krugman's study (1991) became the foundation for this research and is the most used index for this field.

The remainder of the paper focuses on the choice of Krugman index and the description of its modified version in order to measure trade competition between two countries to one destination market. This section also elaborates different approaches to measure this kind of competition, such as inter-sector and intra-sector similarity. The empirical part of this article analyses trade competition in a block of countries and presents other useful perspectives of analysis that can be involved. Lastly, some final remarks are being presented.

3. Methodology

The first perspective of approach for trade competition is the situation where two countries *a* and *b* compete in market *m*. The modified Krugman index is the baseline index which only considers sectoral shares.

Crespo and Simoes (2012) propose the consideration of an average of the Krugman Index calculated at different levels of sectoral disaggregation in order to evaluate not only the level of actual competition (traditionally evaluated through the Krugman Index) but also the potential one.

In order to calculate sectoral shares similarity Crespo and Simoes (2012) propose a modified Krugman index that can be expressed as:

$$E_{abm} = 1-\beta\sum_{i=1}^{I} | v_{iam} - v_{ihm} |$$

The authors have chosen to use β as it is commonly used in studies as β=1/2; with values between 0 and 1. When E_{abm} =1 it means that there is a maximum similarity with the weights of each sector being equal in the exports of countries *a* and *b* to market *m*.

To further explore the perspective of competition between countries *a* and *b* that face competition in market *m* and to obtain a broader view the inclusion of inter-sectoral similarity and intra-sectoral similarity is fundamental Moreira et al. (2017). After having the base for index for the sectoral share competition measurement, the inter-sectoral similarity approach is introduced to consider the degree of dissimilarity between sectors and the intra-sectoral approach in order to introduce the quality factor.

Index E_{abm} could be enlarged to reflect the degree of dissimilarity between sectors for a better analysis of the difference in specialization thus obtaining a stronger measure of trade competition. Moreover we could take a hypothetical example of three countries R(Romania), H(Hungary) and B(Bulgaria) that are totally specialized in one sector. If R would be specialized in curtains, H in bed covers and B in pharmaceuticals; after testing E_{abm} we would obtain the value 0 which would indicate a maximum level of structural dissimilarity between all country pairs as the sectors in discussion are different. On the other hand we can say that the sectors of curtains and bed covers are very similar from the point of view production materials and obtaining processes as opposed to the pharmaceutical sector. Therefore it would be useful to have an index that could measure the similarity between R and H and lower structural similarity between R, H and B. In order to measure this difference a criteria to distinguish how distinct the sectors are from each other must be set. Furthermore to empirically measure this inter-sectoral similarity the index must develop even more. It can be obtained calculating the average of the structural similarity indices obtained at each level of sectoral disaggregation considered in the empirical analysis (g = 1, 2, . . . , G; where G is the most disaggregated level). The best suggestion is to use a predefined sectoral nomenclature that has different levels of disaggregation. The nomenclature used in the methodological and empirical study of Moreira et al. (2017) was the Standard International Trade Classification (SITC). The SITC is a classification of goods used to classify the exports and imports of a country to enable comparing different countries and years. The classification system is maintained by the United Nations. The data is used for analytical purposes applied in economy and are given by trading partners, with products classified according to each level of the Combined Nomenclature (CN8, HS6, HS4 and HS2). I will be used in this study to use the predefined sectors and subsectors of export.

$$F_{abm}=\frac{\sum_{g=1}^{G} E_{abm}^{g}}{G}$$

We can calculate E_{abm}^{g} as for sectoral shares for each level *g*.

While Crespo and Simoes (2012) consider equal weights for all levels of sectoral disaggregation and calculate the index through a simple average in the

study of Moreira et al. (2017) the development is that they generalise that measure by allowing the weights to be defined according to the objectives of each specific research.

The new index being:

$$S_{abm} = \sum_{g=1}^{G} \alpha^{g} E_{abm}^{g}$$

Where $\sum_{g=1}^{G} \alpha^{g}$=1, and E_{abm}^{g} is calculated as E_{abm} (from sectoral shares) for each level of *g*. Depending on the purpose of each study the weights for each level of disaggregation may vary depending on the importance of structural similarity in the discussed research. This index was designed to be applied in studies based mainly on the level of potential competition instead of present competition.

In order to get a complete view on structural similarity an intra-sectoral dimension should be included to measure the quality in product specialization. However measuring quality empirically can be challenging so considering using unit export values as a quality proxy (Stiglitz, 1987) may modify the index into the following form:

T_{abm}=$Z_{abm}E_{abm}$ that can be obtained through the formulas

$$Z_{abm} = \sum_{i=1}^{I} U_{iabm}\, \varepsilon_{iabm}$$

Where $U_{iabm} = \frac{Min[UV(x_{iam}), UV(x_{ibm})]}{Max[UV(x_{iam}), UV(x_{ibm})]}$

And $\varepsilon_{iabm} = \frac{v_{iam} + v_{ibm}}{2}$

Z_{abm} is used to reduce the level of structural similarity between countries *a* and *b* and be a function of the average degree of intra-sectoral dissimilarity. This can be calculated through a weighted average of the differences in terms of quality levels in each sector; ε_{iabm} are the average share of *i* in the exports of *a* and *b* to *m*. The value U_{iabm}=1 can be obtained when the unit export values of *a* and *b* to *m* ($UV(x_{iam})$, $UV(x_{ibm})$) are the same. Furthermore if the values are the same for all products Z_{abm}=1 and in conclusion T_{abm}=E_{abm}. If the difference in the unit export values is grater it implicitly means bigger penalization on E_{abm} that would suggest a lower degree of trade structural similarity between the two countries.

4. Measurement Indexes

In the study of Jenkins (2008) several types of index are reviewed that can be used to measure trade competition based on export values. One of them is called the Export Similarity Index and it is one of the most well-known index since it was presented by Finger and Kreinin (1979) in a research where they were measuring the similarity of the exports of two countries to a third market. So mainly it was an index to measure the similarity of exports of country *a* and *b* to market *m*.

$$ESI = 100 * \sum_{i} (x_{ia}, x_{ib})$$

What we use to calculate the index is the share of each product in each country's total exports and is the sum of the smaller value for each product. In the formula above *x* is a share of a certain commodity in exports, *I* is the product, and *a* and *b* are the two countries for which the index is being calculated. The value of the index ranges between 0 and 100 (meaning no overlap between the product that the two countries export when it equals 0 to an identical export habit when it equals 100).

Another index that has been used to measure competition was Coefficient of Conformity (CC) by Blazquez-Lidoy et al. (2006). The CC index is based yet again on two countries but this time on the product of the market shares of these countries:

$$CC = \frac{100 * (\sum_i x_{ia} x_{ib})}{\sqrt{(\sum_i x_{ia}^2 \sum_i x_{ib}^2)}}$$

There are also other indexes used to measure market concentration, such as the Hirschman-Herfindahl Index, even though it was mainly used in industrial economics to determine if there is a presence of monopoly. The index works through attributing higher weight to larger firms (by giving α different values). If the value of α is higher more weight is given to the largest industries and the emphasis on small industries is lower. The may be calculated in the following way:

$$HHI = \sum_{i=1}^{I} b_i^{\alpha}$$

As said above the value of α is arbitrary and the industries/countries are noted with i=1,… I. The b_i^{α} represents the share of industry *i* in the total industries of country *n*. We could use the HHI index in our study to try to measure the intra-sectoral similarity and to see how strongly a country is specialized.

Other indexes can only be used to measure specialization in particular situations, such as the Shannon Entropy Index (SEI) in the way it was adjusted by several authors

(Attaran and Zwic, 1987, Smith and Gibson, 1988, Aiginger and Davies, 2004 or Aiginger and Pfaffermayr, 2004). The SEI can be defined as the negative sum of the shares of country *a* multiplied by the natural logarithm of shares of each single country *i*.

$$SEI = -\sum_{i=1}^{I} b_i \ln(b_i)$$

If we compare the SEI with the HHI we might notice that the logarithm form brings some differences: the relative weights of big countries are reduced compared to the HHI, also the SEI is an inverse measure of specialization. For the values obtained for the SEI that are closer to 0 we can say they indicate absolute specialization and for higher values of the ln*I* it indicates complete diversification.

However the issue with SEI is that it is not possible to calculate the value of the index for any country with sectoral shares that have exports equal to zero. When we talk about small values for exports in the case of some sectors we notice that the SEI does not change significantly, implying that very small sectoral shares only have a negligible effect on the level of specialization.

5. An empirical application

In the previous sectors several methodological options have been presented with the approach of measuring the degree of trade competition between two countries. For a better understanding of the theoretical measurements we propose an empirical example. We analyse the trade competition among eight economies that are predicted to be the ruling world economies in 2050—China (CH), India (IN), United States of America (US), Indonesia (ID), Brazil (BR), Russia (RU), Mexico (MX), Japan (JP) in 2016 (Hawksworth et al., 2017). As destination markets we chose the four most powerful European economies Germany (DE), France (FR), the United Kingdom (GB), Italy (IT) alongside to the eight previous economies (i.e., M = 14).

Trade data (in value and volume) is drawn from Eurostat using the Harmonized Commodity Description and Coding System (HS nomenclature). The largest level of sectoral disaggregation is HS6. Additionally, for incorporating inter-sectoral similarity, exports data (in value) classified in terms of HS2 and HS4 are also considered.

We will be applying the methodological option that has proven to be the most relevant to this study in section 2.1 and producing examples for each of the 6 competition perspectives presented in the subsections of chapter 3. All off the data produced will illustrate the applicability of the indexes proposed for all the possibilities of competition.

Trade competition between two countries for one destination market

Firstly we focus on the perspective where we measure the competition between two countries *a* and *b* in market *m*. The trade competition assumes the exports of these countries in a given destination market. The economies chosen for this example are USA, India and China regarding with the destination market Germany. In the table below we have the values for E-HS6 that is the result of the modified Krugman index applied on the data from Eurostat for the highest level of disaggregation-HS6; S2 is the value for intersectoral similarity; A is the obtained value for intrasectoral similarity and C2 is the total similarity including all factors.

Table 1: USA, India, China exports to Germany

DE	CH-US	CH-IN	IN-US
E - HS6	0.252	**0.270**	0.185
S2	0.286	**0.311**	0.227
A	0.105	0.163	0.077
C2	0.176	**0.231**	0.146

Source: Designed by the authors based on own calculations.
Data sources: European Commission (EUROSTAT) (2016)

The values obtained for the three country pairs produce some interesting conclusions. Analysing the E-HS6 level we may observe that the Chinese and Indian economies result to be most similar, followed at a quite small difference by the Chinese and American similarity. After including the intersectoral similarity and intrasectoral similarity factors the difference becomes clearer with TCI_{CHINDE}=0.231. An interesting factor is that China and India are most similar at intersectoral level.

Trade competition between two countries in all the markets

Through this method we can measure the competition between countries *a* and *b* in all the markets. Applying this index we will compare countries a and b and also all the markets they export to. Considering the fact that this is an example we will take the same three countries as used in the previous example: China, India, United States and the four European markets: Germany, Italy, France and United Kingdom.

Table 2: USA, India, China exports to Germany, France, Italy and UK

IN-US

TCI	DE	FR	IT	UK
E6	0.055977	0.039239	0.021756	**0.07899**
S2	0.068646	0.045672	0.026407	**0.090153**
A	0.023153	0.013683	0.005933	**0.02755**

IN-CH

TCI	DE	FR	IT	UK
E6	0.039797	0.058382	0.054362	**0.113655**
S2	0.045848	0.06814	0.064053	**0.1297**
A	0.02403	0.034363	0.032331	**0.067148**
C	0.034023	0.050125	0.047529	**0.094819**

US-CH

TCI	DE	FR	IT	UK
E6	0.039278	0.043191	0.034521	**0.093739**
S2	0.044615	0.049653	0.055416	**0.107513**
A	0.016376	0.014894	0.009141	**0.038184**
C	0.027439	0.02843	0.036381	**0.065847**
C	0.044028	0.026505	0.014539	**0.051573**

Source: Designed by the authors based on own calculations.
Data sources: European Commission (EUROSTAT) (2016)

Above we have three tables with each country pair: India-United States, China-India and China- United States. It is very interesting to notice that through comparing either of India, China or United States in pars of two, in the same 4 countries as destination markets for their exports it is clear that the highest (marked with bold) competition between India-United States, China-India, China- United States lies in the British market. Comparing the results in the United Kingdom market, between all three country pairs, the highest similarity is between China and India, therefore the highest competition.

Competition faced by a country in a specific destination market

In this situation we measure the degree of competition that a country *a* faces in market *m* from all the other countries exporting to *m*. As explained before in the above example we measure the degree of competition that China faces in the German market from all the remaining countries (India, United States, Indonesia, Brazil, Russia, Mexico and Japan).

Table 3: Competition faced by China in German market

TCI	CH-IN	CH-US	CH-ID	CH-BR	CH-RU	CH-MX	CH-JP
E6	0.021679	**0.139509**	0.007928	0.005016	0.0075606	0.010252	2.5E-05
S2	0.024975	**0.158466**	0.009265	0.006387	0.0092729	0.012715	2.92E-05
A	0.01309	**0.058164**	0.004141	0.002218	0.0017379	0.004226	9.6E-06
C2	0.018534	**0.127855**	0.006424	0.004288	0.0049059	0.008196	1.8E-05

Source: Designed by the authors based on own calculations.
Data sources: European Commission (EUROSTAT) (2016)

Table 3 presents the competition faced by China in the German market, by all the other exporting countries to Germany. The country that China is the most similar with is United States clearly determined with higher values in all situations. The Chinese and American export pattern to the German market is very similar including intersectoral similarity and intrasectoral similarity.

6. Conclusion

In conclusion there is a wide range of indexes that can be used to measure competition but not all result in being as efficient when measuring trade competition. One property that was fundamental when choosing the index to be further used in the measurement of all types of competition was the adaptability to be modified. None of the initially presented indexes provide inter-industry linkages therefore creating the need for a modified version of the most applicable index that is relevant to this study. The Krugman index was modified in order to measure all the types of competition, covering the competition between two countries in a certain market up to global competition and has provided relevant results. The limitation for this type of application is the great amount of data that needs to be extracted for all categories of products for all the countries which proved to be time consuming.

Further development of the topic would be widening the spectrum of competition. In order to obtain a complete study the geographical spectrum should be further researched.

To conclude, with the combined research done until this point a broad perspective on trade competition can be reached. Structural similarity is a very important component in trying to measure competition from any perspective (taking into account the competition between two markets in a certain market m, or any of the above presented types of competition) and through an empirical example it can reveal a relevant assessment. Nevertheless trade competition is formed by structural similarity and geographical similarity.

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COMPETITIVENESS THROUGH THE INTEGRATION OF LOGISTICS ACTIVITIES IN SMEs

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Abstract. Logistics among competing organisations is a strategic management activity that can affect the operational, market and financial performance of an organisation. Small and medium enterprises (SMEs) need to understand the role of logistics activities in achieving competitive performance and creating a high level of customer satisfaction through greater economies of scale in production and reduction in the price of goods. This study aims to determine the nature and extent of SMEs competitiveness through logistics activities. This research used a quantitative method of data collection and analysis. The data were statistically analysed using SPSS (25.0) as well as SMART-PLS (3.0) software for structural equation modelling (SEM) to assess the measurement reliability and the research structural model. The findings show that SMEs nature and extent of competitiveness based on logistics activities differs among the three measurement constructs, namely price/cost competitiveness, quality competitiveness and delivery competitiveness. This study adds value to the knowledge of the perceived benefits and importance of logistics activities among the participating SMEs.

JEL classification: L1

Keywords: Logistics activities, Price/cost competitiveness, Quality competitiveness, delivery competitiveness, SMEs

1. Introduction and background

Švárová and Vrchota (2014) state that the approach of strategy formulation is an improvement over that of traditional long-range planning, which begins with the definition of the company mission. Formulation of strategy also involves growth strategy, logistics strategy, retrenchment strategy, turnaround and divestment liquidation (Aktürk, Kurt, 2016; González-Rodríguez, Jiménez-Caballero, Martín-Samper,

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Köseoglu, Okumus, 2018), which are the focus of small and medium enterprises (SMEs). SMEs transfer their experiences gained by observation into organisational life and as owners or managers, they use their value and norms to define the vision and goals based on habits of thinking, which can involve deep-rooted assumptions that other members of the organisation use as direction for behaviour and for the success of the organisation (Hagen, Zucchella, Cerchiello, De Giovanni, 2012; Bozkurt, Kalkan, 2013; Rahimi, Fallah, 2015). As part of the strategy formulation, logistics activities include everything from the moment a product or service needs to be manufactured, through to incoming raw materials management, production, finished goods storage, delivery to customer and after sales service (Kain, Verma, 2018; Liao, 2018). Logistics is concerned with the profitable movement of information and materials into the organisation (time-based activity), through it and out to customers (Yu, Cadeaux, Song, 2017). Therefore, there is logistics in SMEs because logistics is a strategy that affects other functions in the organisation.

In every operation's management within any organisation, logistics is regarded as the key performance required for the movement, positioning and timing of inventory ordered from supplier and manufactured for customers (Pienaar, Vogt, 2016; Hill, Zhang, Miller, 2018). Logistics merges the gap between supply and demand. For example, logistics of customer service performance is determined by product availability, stockout frequency as well as fill rate performance, while operational logistics service performance is determined by equipment and facilities suitability, accessibility, goods security, transaction time, reliability and consistency of transaction time as well as flexibility performance (Brekalo, Albers, Delfmann, 2013; Feng, Pang, Lodewijks, Li, 2017; Sohn, Woo, Kim, 2017; Kain, Verma, 2018). Logistics increases the wealth and value creation of organisations within a supply chain through the efficient and effective movement of desired goods and services, information and finance to the required "designated place and time, in the required condition and quantity and at an acceptable cost or price" (Pienaar, Vogt, 2016:1). The Council of Supply Chain Management Professionals (CSCMP) define logistics management as "that part of supply chain management that plans, implements and controls the efficient, effective forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption to meet customers' requirements".

Logistics is the capability needed by an organisation for the implementation of business objectives (Kohn, McGinnis, Kara, 2011; Marchesini, Alcântara, 2016). Logistics formulation of strategy in SMEs organisation focuses on customer responsiveness, control strategy, geographic closeness, flexibility strategy and coordination with suppliers for inventory and stock availability (Bai, Sarkis, 2013; McFarlane, Giannikas, Lu, 2016; Gunasekaran, Subramanian, Papadopoulos, 2017). Just as strategy formulation for competitiveness is not optional for larger organisations, it is also not optional for SMEs. At first, SMEs may not have a formal logistics strategy but they still make strategic choices through their actions. Accordingly, SMEs utilise an internal growth strategy, which is divided into three sub-strategies: the market penetration strategy, market development strategy and the product

development strategy together with logistics activities to secure competitive advantage, which provides strategic direction (Bai, Sarkis, 2013). This study, therefore, seeks to determine the extent to which logistics activities influence price/cost competitiveness, product/ service quality competitiveness and delivery competitiveness among SMEs within the Emfuleni Local Municipality. The classification of SMEs according to Falkena (2000:26) was followed in the study. A small enterprise constitutes fewer than 50 employees with an annual turnover of between R2 million and R25 million. A medium enterprise is a business with between 50 and 200 employees with an annual turnover of between R4 million and R50 million.

2. Logistics activities

The logistics activities for this study are limited to transportation, warehousing, forecasting and demand management as well as reverse logistics (Pienaar, Vogt, 2016:13). Transportation is a very important part of SMEs business operation for competitiveness because it is the physical link connecting the organisation's raw materials and finished goods, plants and warehouses to provide a high-quality service to customers (Matijošius, Vasiliauskas, Vasilienė-Vasiliauskienė, Krasodomskis, 2016; Bakara, Jaafar, 2016; Silalahi, Handayani, Munajat, 2017). Outbound transportation has become the centre of focus for all firms over the years, to minimise operating costs (Fancello, Schintu, Serra, 2018). Outbound/physical distribution refers to the set of processes, systems and capabilities that enhance SMEs ability to serve their customers. Transportation, as one of the logistics activities, facilitates (Abushaikha, 2018) the physical flow of goods and service as well as related information from the point of origin to the final consumers. The ultimate goal of transportation is to satisfy customers both upstream and downstream in the logistics chain with greater effectiveness and efficiency than is provided by the competitors (Yu et al., 2017). Transportation usually represents the most important single element in logistics strategy for firms and thus, SMEs need to understand the role transportation plays in creating a high level of customer satisfaction and its contribution to greater competition in the marketplace, greater economies of scale in production and reduction in the price of goods (Abushaikha, 2018). Transportation bridges the gap between buyer and sellers, ensures on-time delivery, adds value to the SMEs by creating a time and place utility, reduces inventory costs, increases profitability and improves productivity for both buying and supplying SMEs (Holl, Mariotti, 2018). Transportation is a very important element in the logistics chain because a firm cannot function without it. For example, even if a product is produced in the right time, with the right quality and at the right price, it will be useless if there is no transportation available to transport the product to the customer at the place and time when it is needed (De Keizer, Akkerman, Grunow, Bloemhof, Van der Vorst, 2017).

2.1 Warehousing

According to Singh, Chaudhary, Saxena (2018), “a warehouse is a large building where raw materials or manufactured goods may be stored prior to their distribution for sale”. With the emergence of strategic alliances, just-in-time and supply chain philosophies, the warehouse has taken on a strategic role in attaining the logistics goals of shorter cycle times, lower inventories, lower costs and better customer service (Abushaikha, Salhieh, Tower, 2018). By astute warehousing, SMEs can avoid the wide fluctuations in output levels due to uncertainties and variations in demand patterns. It allows the consolidation of smaller quantities into a larger shipment or for less-than-truckload (LTL) deliveries with significant transportation savings. Another area that is important to logistics is plant and warehouse site location. A location change could alter time and place relationships between plants and markets or between supply points and plants. Such changes will affect positively transportation rates and service, customer service quality, inventory requirements and possibly other areas (Coyle, Bardi, Langley, 2003:506).

2.2 Forecasting and demand management

Forecasting is a future guess about what is likely to happen, which may cause the risk of product obsolescence if the demand forecast is too high and also may result in unhappy customers if the demand forecast is too low (Hart, Lukoszova, Kubikova, 2013). This may further result in product return by customers, thereby causing delays in sales (Lui, Mantin, Wang, 2014). Demand management on the other hand, focuses on the transformation of demand forecast into a more collaborative business plans that require a collaborative organisational culture, a robust set of processes and effective information technology tools (Tiemessen, Fleischmann, Van Houtum, Van Nunen, Pratsini, 2013). Information is the key to demand forecasting: information from the market place in the form of medium-term forecasts; information from the customer, preferably based on the actual usage and consumption; information on production schedules and inventory status and information on marketing activities such as promotions that may cause demand to fluctuate from the norm (Dietrich, Ettl, Lederman, Petrik, 2012; Hofmann, Rutschmann, 2018).

2.3 Reverse logistics

Another logistics competitive strategy with an organisation is reverse logistics. Reverse logistics is the process of planning, implementing and controlling the efficient, cost-effective flow of raw materials, in processing inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing or creating value or for proper disposal (Kussing, Pienaar, 2016:499). In other words, it is a backward logistics operation. Reverse logistics is a challenge among SMEs, which, over the years, has been avoided. According to Jack, Powers, Skinner (2010), reverse logistics is an important asset to gain competitive advantage and it is a value-added strategy that impacts on

customer relations. To improve customer service and competitiveness, the development of reverse logistics competencies to physically handle returns, such as stock selection, transportation, centralised collection, data collection, refurbishing or remanufacturing and disposition is important (Morgan, Richey Jr, Autry, 2016; Hansen, Larsen, Nielsen, Groth, Gregersen, Ghosh, 2018). Furthermore, SMEs should integrate supply chain management capabilities that integrate manufacturer and retailer data, create invoices, generate store credits, detail accounts receivable, issue management reports and strategically apply the information gathered to streamline internal processes (Mellat-Parast, Spillan, 2014). With this, competitive benefits such as higher return on investment, higher return on assets, lower cost, higher quality of products and/or services, higher level of customer service and effective knowledge management mechanisms may result (Pal, 2017).

3. Price/cost, quality and delivery competitiveness

According to (Matijošius et al., 2016:423), "competition is defined as a struggle where both manufacturers and consumers are involved in striving to satisfy their economic interests. The ability to win the struggle thus ensuring long-lasting domination in the market is referred to as a competitive advantage" competitiveness is the ability of SMEs to maintain competitive position in the marketplace (Mellat-Parast, Spillan, 2014). For this study, competitiveness is the ability of SMEs to maintain competitive position through logistics activities to create superior value customers. Logistics activities create customer value by ensuring customer satisfaction through providing unique quality product/ service, cost reduction as well as JIT reliability strategy (Sigalas, 2015).

The implementation of logistics activities within SMEs is a clear advantage of SMEs competitiveness, because in operational terms, it is one of the most important integration mechanisms. Well integrated logistic activities not only enhance efficient operations but also facilitate effective customer satisfaction (Praiogo, Oke, Olhager, 2016). SMEs tend to neglect the key importance of logistics activities integration and, as such, SMEs business operations may underperform within the emerging competing environment, especially within the Emfuleni Municipality. World-class organisations' success depends on resource capabilities and a well-planned logistics integrated structure (Liao, Marsillac, Johnson, Liao, 2011). Logistics activities integration forces organisations to search for collaborative relationships both within and outside the organisation (Praiogo et al., 2016). Furthermore, logistics activities may help bring an enterprise to realise the full potential of its value-added activities; hence, gaining a significant competitive advantage over competitors. It may also lead to a reduction in operation costs and an improvement in product/ service quality and delivery reliability as well as customer services (Spillan, McGinnis, Kara, Yi, 2013). Enterprises that consider logistics to be a strategic factor, tend to develop long-term performances that are both financial and organisational. Therefore, the following relationships are proposed for this study:

3.1 Logistics activities and price/cost competitiveness

According to Spillan, McGinnis, Kara and Yi (2013), one of the most effective and strategic changes that logistics activities can bring is to reduce operational cost overtime, whilst still maintaining quality customer service without wasting organisation time and resources. With this, Jena and Seth (2016) argue that logistics activities are essential elements in decision-making pertaining to cost competitiveness in an organisation. Hence, logistics activities have become the obvious choice for price/cost competitiveness (Qureshi, Kumar, Kumar, 2007; Gani, 2017; Kain, Verma, 2018). For this reason, this study proposed that:

H1: There is a positive relationship between the use of logistics activities and price/ cost competitiveness among SMEs

3.2 Logistics activities and quality competitiveness

Logistics service quality produces values in the form of products and services in the hands of the ultimate customer (Sohn, Woo, Kim, 2017). Murfield, Boone, Rutner and Thomas (2017), explain that the reason for poor quality products/ services among SMEs is the result of poor and undefined logistics quality service. Logistics is a powerful quality system that enhances value offerings that are valued by customers and ensures stable performance under changing conditions (Ling-yee, Ogunmokun, 2008). Kain and Verma (2018) state that the primary process of logistics is setting customer services. This is because according to the CSCMP, logistics is "that part of supply chain management that plans, implements and controls the efficient, effective forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements" Therefore, logistics activities are quality competitive tools for SMEs whose business strategic focus is based on customer satisfaction and loyalty (Murfield et al., 2017).

H2: There is a positive relationship between the use of logistics activities and quality competitiveness among SMEs

3.3 Logistics activities and delivery reliability competitiveness

One of the key performance indicators of logistics activities is on-time delivery to customers. According to Durugbo, Tiwari and Alcock (2014), delivery reliability is a logistics capability that enhances firm effectiveness and competitive performance. Delivery reliability is the ability of the SMEs to comply timeously with the promised delivery date made to customers at the right time, place, price, quantity and quality (Basic, Skender, 2017). In this case, delivery unreliability may result in dissatisfied customers and thereby losing the customers to a competitor (Marino, Zotteri, Montagna, 2018). In recent times, organisations are forced to redefine

business logistics strategy because of the global increase in customer demand for delivery reliability, accuracy and quality service (Akinc, Meredith, 2015), for example, the use of information and communication technology, just-in-time approach, vendor-managed inventory, outsourcing, lean logistics and logistics flexibility (Park, Lee, Shin, Park, 2010; Yu, Cadeaux, Song, 2017; Pan, Giannikas, Han, Grover-Silva, Qiao, 2017). Therefore,

H3: There is a positive relationship between the use of logistics activities and delivery reliability competitiveness among SMEs

4. Research methodology and measuring instrument

The quantitative method of data collection was used in this research and a self-administered questionnaire was distributed to SMEs within the Emfuleni local Municipality through a convenience sampling approach. Convenience sampling is a type of nonprobability sampling where members of the target population that meet certain practical criteria are included in a study (Ilker, Sulaiman, Musa, Sunusi, 2016). This method is considered appropriate because it allows selection of respondents based on availability and ease of access. Using the historical evidence approach and based on the recommended sample size for SEM (Tabachnick & Fidell, 2007:718), the questionnaire was distributed to 350 SMEs and a total of 331 were returned. The questionnaire was hand delivered and collected after completion by a research assistant. Only the managers and the owners could complete the questionnaire. The instrument that measures competitiveness in terms of price/ costs, quality and delivery were adopted from Lia, Ragu-Nathan, Raob (2006). Items for logistics activities in this study were transportation, warehousing, forecasting/ demand management and reverse logistics (Pienaar, Vogt, 2016). A letter containing the ethical consideration was attached to the questionnaire to seek permission and inform the participating SMEs of the aim and purpose of the study before completion of the questionnaire.

5. Data analysis and result

Table 1: Demographic characteristics of SMEs in the sample

Variables	Categories	Frequency	Percentage
Number of years in operation	2 to 4 years	114	34.4
	5 to 7 years	88	26.6
	8 to 10 years	82	24.8
	11 or more	47	14.2
Annual sales	≤ R1million	168	50.8
	R1million to ≤ R5million	80	24.2
	R5million to ≤ R10million	35	10.6
	R10million to ≤ R20million	30	9.1
	≥ R20million	18	5.4

Variables	Categories	Frequency	Percentage
Physical assets	≤ R4million	206	62.2
	R4million to ≤ R8 million	81	24.5
	R8million to ≤ R12 million	25	7.6
	R12million to ≤ R16million	14	4.2
	≥ R16million	5	1.5
Number of employees	≤ 50 employees	272	82.2
	50 to 99 employees	35	10.6
	≥ 200 employees	24	7.3

The demographic description of the SMEs profiles as presented in Table 1 indicates that 114 (34.5%) of the SMEs have been in business for more than four years. Most of the SMEs have annual sales of <R1 million (n=168; 50.8%). In terms of their physical assets, most of the SMEs had an asset base of <R4 million (n=206; 62.2%). Lastly, a total of (n=272; 82.2%) have fewer than 50 employees, about (n=35; 10.6%) have 50 to 99 employees and only about (n=24; 7.3%) of the SMEs had workforce of 200 and more.

5.1 Psychometric properties of the measurement scale

The SMART-partial least squares (SMART-PLS 3) structural equation modelling procedure was used to analyse the data. Table 2 shows the accuracy of all the measurement scales, which present the research constructs, Cronbach alpha test, composite reliability (CR), average variance extracted (AVE) and item loadings.

Table 2: Measurement accuracy assessment and descriptive statistics

Research constructs	Indicators	Descriptive statistics		Reliability statistics			Validity statistics	
		Mean ($\bar{x}$)	SD	Alpha (α)	CR	AVE	√AVE	Factor loading
Logistics activities	LA1	4.756	1.371	0.820	0.875	0.584	0.764	0.790
	LA2	4.702	1.369					0.827
	LA3	4.733	1.461					0.697
	LA4	4.863	1.312					0.686
	LA5	4.328	1.545					0.809
Competitiveness Price/Cost	CP1	4.550	1.519	0.70	0.761	0.622	0.799	0.919
	CP2	5.359	0.950					0.633
Competitiveness	CQ1	5.282	1.072		0.850	0.586	0.767	0.798

Research constructs	Indicators	Descriptive statistics		Reliability statistics			Validity statistics	
		Mean ($\bar{x}$)	SD	Alpha (α)	CR	AVE	√AVE	Factor loading
Quality	CQ2	5.237	1.111	0.764				0.742
	CQ3	4.969	1.342					0.803
	CQ4	4.794	1.402					0.716
Competitiveness Delivery	CD1	5.099	1.171	0.845	0.906	0.762	0.874	0.867
	CD2	4.733	1.318					0.863
	CD3	5.000	1.447					0.890

Note: Alpha (α)=Cronbach's alpha; *CR=Composite reliability; AVE=Average variance extracted*

Cronbach's alpha test (α) and composite reliability test (CR) were used to test the internal reliability of the measurement model. From Table 1, the alpha values as well as the composite reliability values for all the measurement variables range from 0.70 to 0.84 and 0.76 to 0.90 respectively. According to Johnson and Christensen (2012), a value greater or equal to 0.70 indicates a good internal consistency for the measurement constructs.

The AVE value for this study, ranges from 0.58 to 0.76 with estimated values greater than 0.5, provide an acceptable level of internal reliability and validity of the research construct (Khosrow-Pour, 2006:75; Vinzi, Chin, Henseler, Wang, 2010:437). Convergent validity was determined using the obtained factor loadings, which were expected to be above 0.5. Drawing from Table 1, all factor loadings are greater than 0.5 (ranging from 0.63 to 0.92). This indicates acceptable individual item convergent in the validity of all scale items. Discriminant validity was done by assessing whether inter-correlation matrix among the constructs is less than the square root of the AVE (Garson, 2016). In tables 2 and 3, the inter-correlation values for all paired latent variables are less than √AVE (ranging from 0.76-0.87) and, therefore, reveal the existence of discriminant validity (Khosrow-Pour, 2006).

Table 3: Correlation analysis results and discriminant validity measures

Constructs	Delivery Competitiveness	Price/Cost Competitiveness	Quality Competitiveness	Logistics Activities
Delivery Competitiveness	**1**			
Price/Cost Competitiveness	**0.574**	**1**		
Quality Competitiveness	**0.734**	**0.651**	**1**	
Logistics Activities	**0.473**	**0.447**	**0.445**	**1**

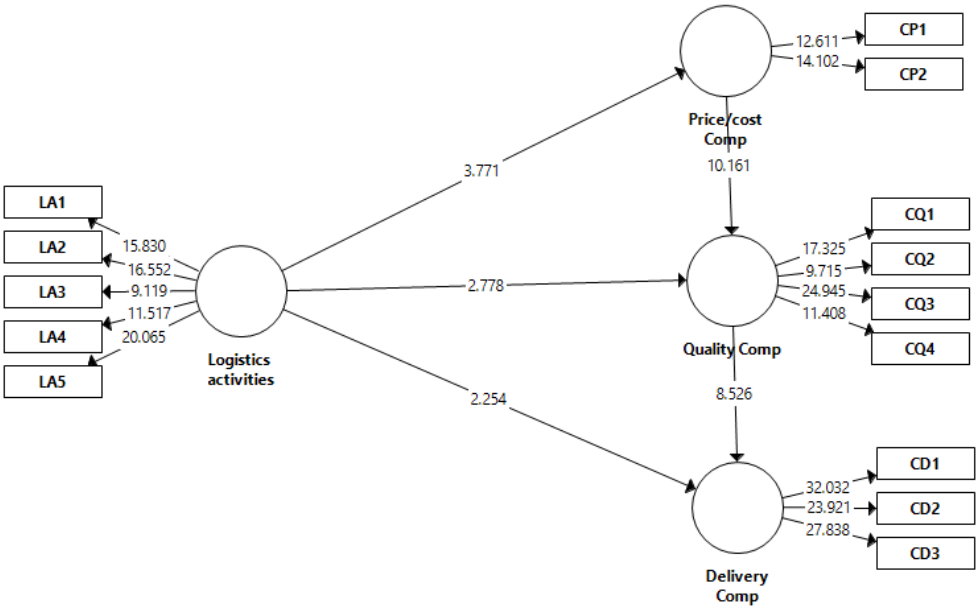

Figure 2: PLS 3.0 Bootstrapping analysis results

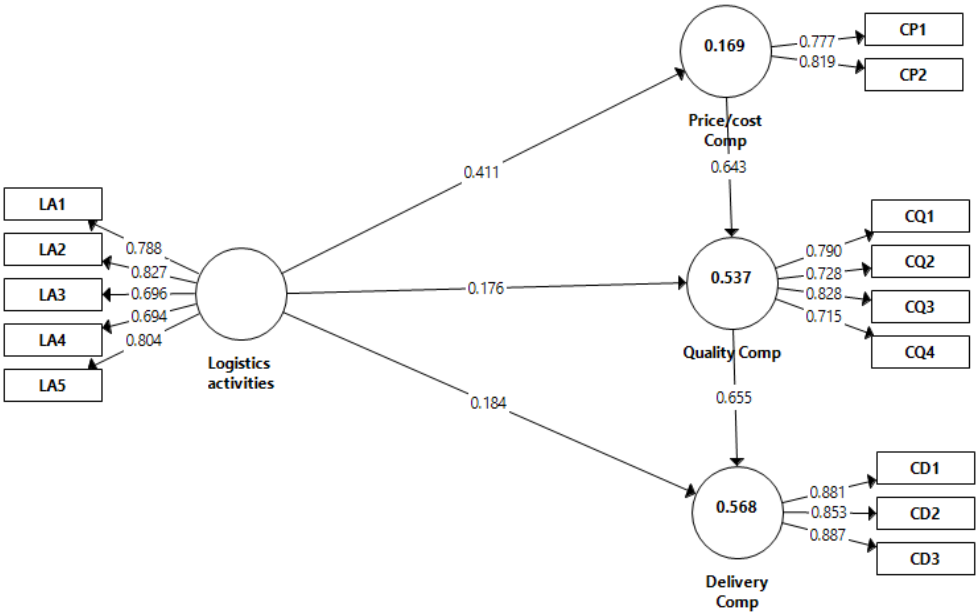

Figure 3: PLS 3.0 the main research model results

5.2 Path model results and factor loadings

Figures 2 and 3 indicate the p-value, path modelling results and the item loadings for the research constructs. In the figures, LA stand for logistics activities, CP stands for price/ cost competitiveness, CQ stands for quality competitiveness and CD is the abbreviation for delivery competitiveness.

Table 4: Results of structural equation model analysis

Proposed path relationship	Hypothesis	Path coefficient	T-value	P-value	Outcome
LA ⟶ CP	H_1	0.411	3.771	0.000	Supported
LA ⟶ CQ	H_2	0.176	2.778	0.006	Supported
LA ⟶ CD	H_3	0.184	2.254	0.025	Supported
CP ⟶ CQ	H4	0.643	10.161	0.000	Supported
CQ ⟶ CD	H5	0.655	8. 256	0.000	Supported

Table 4 and Figure 3 present the five hypothesised relationships, path coefficients, the t-statistics and the decision criteria. The value of the t-statistic indicates whether the relationship is significant or not. A significant relationship is expected to have a t-statistics above 1.96 and a p-value ≤0.05 indicates strong relationship levels (Gravetter, Wallnau, 2016:669). Table 4 also shows that all five hypothesised relationships are statistically significant.

6. Discussion of findings

From Table 4 and Figure 3, the relationship, which states that logistics activities have a positive influence on SMEs price/cost competitiveness, is supported at the t-statistics value of 3.771. Furthermore, the path result of the structural equation model also shows a predictive relationship (path estimate=0.411; p=0.00<0.05) and explained about 17 percent (R^2=0.169). This means that the integration of logistics activities among SMEs within the Emfuleni municipal district is to compete based on price/ cost. According to Jena and Seth (2016), logistics activities are vital business strategies that offer a competing price lower than competitor price. However, this may require SMEs to position themselves strategically with the logistics networks to enable them get access to hands-on information and also to be flexible

with effective responses to customers and competitors. This finding is consistent with that of Hart, Lukoszova and Kubikova (2013), stating that the growth and survival of companies depend on their ability to reduce costs.

In the case of logistics activities and quality competitiveness, the statistics significant value is 2.778 and the path result of the structural equation model also shows a predictive relationship (path estimate=0.176; p=0.00<0.05) and explained about 54 percent (R^2=0.537). The explanatory power in terms of quality competitiveness through the integration of logistics activities is higher than that of price/cost competitiveness. This shows that offering competing prices lower than that of the competitors among SMEs does not negate the importance of product/ service quality among the participating SMEs. This evidence is clear when looking at the standardised path regression weight of 0.643 with t-value of 10.161 between logistics activities, price/cost competitiveness and quality competitiveness. The above relationships have the highest level of significance. This is because within the modern competing environment, customers repurchase decision is no longer based on brand loyalty only, but mainly on those organisations that can offer high quality products even at a competing price (Stapleton, Pati, Beach, Julmanichoti, 2004). According to Fernarndes, Moori and Filho (2018:388), "a way that companies have found to respond to the challenges of customer satisfaction is the development of logistics service quality". Meaning that to compete based on quality, SMEs should invest in their logistics capabilities. For example, investment in an on-time delivery, implementation of logistics information technology, meeting deadlines, being proactive in finding solutions to logistical problems and developing innovative logistics solutions during emergency situations. SMEs ability to provide customers with quality logistics service may determine their competitiveness over competitors (Zailani, Jafarzadeh, Iranmanesh, Nikbin, Selim, 2018).

From Table 4 and Figure 2, the relationship, which states that logistic activities have a significant positive influence on SMEs delivery competitiveness, is supported at a t-statistics value of 2.254. However, the path result of the structural equation model shows a predictive relationship (path estimate=0.184; p=0.025<0.05) and a high explanatory power of about 57 percent (R^2=0.568). The R^2 indicates that the majority of SMEs competitive priority is based on delivery reliability, delivery flexibility and on-time delivery. To compete effectively within the global competitive environment, SMEs must respond to customers' changing demand with a flexible strategy, of which delivery reliability plays a critical role. Delivery reliability is the ability of the SMEs to comply timeously with the promised delivery date made to customers, which may further enhance firms' reputation. The path model also shows a positive relationship (path estimate=0.655; p=0.00<0.05) with a high significant level of (t-statistics=8.526) between quality and delivery competitiveness. The result reveals the importance of quality in delivery performance. This finding is consistent with Bushuev (2018) stating that logistics performance is characterised by product/ service delivery to the final consumer at the right time, place and in good condition (quality). In this case, transportation plays an important role in delivery performance through improving logistics efficiency and effectiveness in terms of place and time utility.

7. Conclusion and managerial implication

The purpose of this study was to determine the extent to which logistics activities influence price/ cost competitiveness, product/service quality competitiveness and delivery competitiveness among SMEs within the Emfuleni Local Municipality. Three research relationships between the research variables were proposed and statistically tested. All three proposed relationships were statistically significant. The findings did not only reveal the importance of logistics activities in achieving high levels of competitive advantage, but also revealed how the positioning of SMEs logistics activities is centered around quality − doing things right; speed − doing things fast; delivery dependability − doing things on time; and flexibility − changing what you do and the cost of doing things cheaply (Wong, Soh, Chong, Karia, 2015; Taschner, 2016; Aharonovitz, Vieira, Suyama, 2018; Omoruyi, 2018). To survive the fast-changing business environment, logistics activities are critical business tools to obtaining a competitive advantage. Due to the SMEs business strategic focus, logistics strategy and competitive focus differs among the participating SMEs.

Importantly, SMEs should re-define their business strategy to include logistics objectives that seek to continuously enhance and develop future logistics strategy on how to further satisfy customers' needs and offer good product/ service design at lower price/ cost. This can be possible through benchmarking, that is, by comparing products/ services and practices against those of larger organisations and external competitors. SMEs should consider forming strategic alliances and outsource third-party logistics services to form part of the production process to realise and improve on organisations' competitive performance. With this, SMEs are also able to handle other surprising challenges, such as greater demands from order givers, competition in domestic markets, increased global competition, organisational transformation, higher customer expectations of services and products, and increased environmental concerns.

The importance of logistics activities has been researched as essential toward organisations' competitive performances. However, despite its importance, this study is not without any limitations. This study only focused on the competitiveness through the integration of logistics activities in the Emfuleni Local Municipality, specifically around Vanderbijlpark and Vereeniging, therefore, it does not fully represent all the SMEs in South Africa. Consequently, the study findings cannot be generalized to all SMEs since the method used was convenience sampling. Both qualitative and quantitative methods of data collection are recommended for any further research on logistics activities and competitive performance in SMEs. However, this study has relevance in that it adds value to the knowledge of the perceived benefits and importance of logistics activities within the SMEs business objectives in the Emfuleni district. The research methodology and analysis made it possible to identify the extent of competitiveness through the implementation of logistics activities in SMEs. A further value of this study rests on the fact that it shows that quality competitiveness mediates price/cost competitiveness and delivery reliability competitiveness. This shows that SMEs logistics objective positioning, based on price/cost competitiveness, should consider quality. Likewise, the SMEs logistics objective positioning based on delivery reliability should also consider quality to outperform competitors.

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THE FDI-GROWTH NEXUS IN SOUTH AFRICA: A RE-EXAMINATION USING QUANTILE REGRESSION APPROACH

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Abstract. This study sought to contribute to the growing empirical literature by investigating the effects of FDI on per capita GDP growth for South Africa using time series data collected between 1970 and 2016. Compared to the majority of previous studies, we use quantile regressions which investigates the effects of FDI on economic growth at different distributional quantiles. Puzzling enough, the empirical results show that FDI has a negative influence on welfare at extremely low quantiles whereas at other levels this effect turns insignificant. Contrary, the effects of domestic investment on welfare is positive and significant at all levels. Collectively, these results have important implications for policymakers in South Africa.

JEL Classification: C21, C31, E22, F43, O40.

Keywords: FDI, Economic growth, Quantile regression, Global financial crisis, South Africa.

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1. Introduction

Since the financial liberalization era of the 1980's and 1990's, when economies worldwide began to be increasingly integrated into the global economy, the relationship between foreign direct investment (FDI) and output growth became subjected to intense research. FDI is perceived as a major factor in enhancing economic growth, especially in developing countries where the savings rates are relatively low. In particular, FDI contributes to the integration of developing countries into the world economy as it provides not only capital but also technology and management know-how necessary for restructuring firms in the host countries (Keho, 2015). Nevertheless, the empirical evidence regarding the empirical links amongst FDI and economic growth remains mixed due to different methodologies employed, different data usage and different country specifics.

Following the global financial crisis of 2007-2008, many economies worldwide are still recovering from the aftereffects of the global recessionary period of 2009-2010 and the Euro debt crisis of 2010 which ensued afterwards. Many economies across the globe witnessed major declines in output, employment and trade. GDP growth worldwide declined drastically in 2009, dropping from slightly over 4 percent to 0.9 percent between 2007 and 2009. Moreover, approximately 34 million jobs worldwide were lost during the 2009 recession while world trade volumes plummeted by more than 40 percent in 2008, collapsing at rate that outpaced the fall of aggregate output (Alfaro and Chen, 2011). According to the World Economic Forum, in order for the world to recover from its decline in growth, the global economy needs an injection of new FDI to reach US$ 3 trillion annually (approximately 4% of current world gross domestic product, GDP). Hence there has been a recent rejuvenation of empirical interest concerning the effects of FDI on economic growth.

Nevertheless, we notice two major shortcomings associated with a majority of previous empirical studies addressing the subject matter. Firstly, most studies do not take into consideration the possible effect of the financial crisis on the FDI-growth relationship. Secondly, studies suffer from the methodological shortcoming of relying on OLS and other linear estimating techniques hence assuming that the effects of FDI on economic growth are uniform across all levels of FDI. In reality, this assumption does not hold true. In our study we take into consideration these identified flaws by making a case study for the South African economy over the period of 1970 to 2016. South Africa is often regarded to be the gateway to the Sub-Saharan Africa (SSA) region, as well as being one of the prominent FDI recipients in terms of national resources, traditional oil as well as minerals. However, prior to the first democratic elections in 1994, when international sanctions were imposed on the state between the 1980's and the early 1990's, South Africa's FDI had been close to zero as the country become increasing isolated from the global economy during that period. Nevertheless, following the termination of the apartheid regime in the early 1990's, the new democratic South Africa government changed the focus of it's economic development and growth strategy towards deeper global integration, developing stabilizing macroeconomic policies as well as attracting increasingly higher numbers of foreign investors.

Over the past two decades, South Africa has become an important global economic player. In 2012, the country was considered one of the largest recipients of FDI in Africa with over US$3 billion. According to the United Nations Conference on Trade and Development (UNCTAB, 2013), South Africa has been receiving a bulk majority of it's FDI (i.e. approximately 89%) from the European Union, while other major contributing countries include the UK with 75.8% and other minor contributors include Germany with 6% and other developing countries an overall of 4% of FDI to South Africa, of which 2.5% is generated by Asian economies alone.

In our study we rely on the quantile regression methodology of Koenker and Bassett (1978). The primary advantage of quantile regression over least-squares regression is its flexibility for modelling data with heterogeneous conditional distributions. Therefore, in comparison to other linear estimation techniques commonly used in the literature, quantile regression provides a more complete covariate picture of the covariate effect when a set of percentiles is modelled, and makes no distributional assumption about the error term in the model (Koenker and Hallock (2001). Our contribution to the ilterature is as follows. Firstly, to the best of our knowledge, we become the first study in the literature to employ the quantile regression in investigating the FDI-growth nexus and as by-product the first to examinine possible nonlineraities for the case of South Africa. Secondly, we go beyond the exising literature and examine the effects of the global financial crisis on the FDI-growth relationship for South Africa.

Against this background, we structure of the remainder of the paper as follows. The next section of the paper will review the literature concerned with the effects of FDI on economic growth. The third section will present the econometric model and this will be followed by the data and empirical analysis which are presented in section four. Section five will conclude the study and provide recommendations based on the research findings.

2. Literature review

Theories of FDI

Theories of FDI began to more prominently emerge in the post- World War II era. Even though theories of FDI are wide spread, for convenience sake, we restrict the reviewed mainstream theories of FDI to those classified under imperfect markets which can further be categorized into four main theories. Firstly, there is the industrial organization approach of Hymer (1968 and 1970) and extended upon by Kindelberger (1969) which is consider one of the earliest explanations of investment flows in an oligopolistic market situations. According to this theory, when a multinational corporations (MNC's) establish a subsidiary in a foreign country it faces several disadvantages in competing with local firms such as culture, language, legal system and consumers preferences. As initially argued in Kindelberger (1969), these disadvantages can be offset by some form of market power such as the possession of proprietary resources and unique capabilities such as differentiated products, proprietary technology, managerial skills, better access to capital and government

imposed market distortions confer MNCs with competitive advantage over indigenous firms in the host country and help them offset the disadvantages of operating in a foreign country (Nayyar,2014).

Under the second approach, the transaction cost approach or internalization theory, as popularized in the works of Buckley and Casson (1976) and Williamson (1979) and yet having its roots embedded in the seminal works of Coase (1937), FDI is viewed as an organizational response to market imperfections faced by MNC's. In particular, the internalization theory hinges on three postulates i) firms maximize profits in a market that is perfect ii) When markets in intermediate products are imperfect, there is an incentive to bypass them by creating internal markets iii) internalization of markets across the worlds leads to MNC's (Nayak and Choudhury, 2014). Since intangible assets, such as technology, marketing ability and consumer goodwill, based largely on proprietary information, they cannot be exchanged at across borders for a variety of reasons rising from the economics of information as well as from the economics of public goods (Morck and Young, 1992). The firm thus overcomes these market imperfections by creating an internal market and this internalization of markets is an on-going process which continues until the marginal benefits and marginal costs are equal.

The last theory of FDI we discuss the eclectic paradigm of international production as pioneered by Dunning (1973). In essence, the theory integrates both the internalization and oligopolistic theories and adds a third dimension in the form of location theory to explain why firm opens a foreign subsidiary (Nayak and Choudhury, 2014). The theory asserts that, at any given moment of time, the extent and pattern of international production will be determined by the configuration of three sets of forces; namely, i) the net competitive *ownership* MNc's possess vis-à-vis foreign firms ii) the extent to which firms perceive it to be in their best interests to *internalize* the markets for the generation and/or the use of these assets; and by so doing add value to them; and iii) the extent to which firms choose to *locate* these value-adding activities outside their national boundaries (Nayyar,2014). Combining these three factors, namely, ownership (O), internalization (I) and location (L) provides MNC's a three-tier framework to use when deciding to invest in a foreign country.

Theories of economic growth

Dynamic models of economic growth were formally introduced in the seminal work of Harrod (1939) and Domar (1946) and later refined as the neo-classical model by Solow (1965). A major contribution by the neo-classical growth economists is the distinction of different growth factors; namely, capital accumulation or gross fixed capital formulation, growth in the labour force and technological progress. Within the neo-classical model, which typically operates via a Cobb-Douglas production technology, the savings rate is a key determinant of the level of capital intensity and thus the start of any dynamic movement within the economy. The role of FDI can be envisioned as a channel through which technology exerts spillover effects such that MNC's contribute to sectoral production (Rudy, 2012).

Following the neo-classical era, came the construction of a class of growth models in which the keys determinants of growth were endogenous to the model (Romer (1986) and Lucas (1988)). Endogenous growth theories describe economic growth as a process generated by factors within the production process, for example; economies of scale, increasing returns or induced technological change; as opposed to outside (exogenous) factors such as increase in population, and growth in neo-classical models depends on the rate of return on capital (Solow, 1994). The role of FDI in influencing economic growth is more pronounced because unlike the neo-classical model, technological advances are treated as the heart of economic growth (Seyoum et al., 2014). Nevertheless, there are two major contentions on the role of FDI in these growth models. Firstly, whilst dynamic growth models tend to indicate that FDI has numerous advantages for economic growth, it can also have a negative impact mainly through the crowding out of domestic investment i.e. displacement effect. Secondly, these models, by design, are particularly suited for advanced economies which tend to put FDI flows to more productive use in comparison to FDI flows to developing or emerging economies. Nevertheless, FDI has been successfully incorporated in dynamic endogenous growth theories in developing eonomies as is evidence in the works of Bende-Nabende and Ford (1998), Vu (2008) and Cleeve et al. (2015).

3. Empirical review

Industrialized economies

There has been a considerable debate on the role of FDI on economic growth in industrialized economics. A majority of the available empirical literature for industrialized economies is primarily focused on the EU region (Moudatsou (2003), Tang (2015)), the US (Alfaro (2003), Roy and van der Berg (2006)), Australia (Pandyal and Sisombat (2017), Portugal (Leitao and Rasekhi (2013)) and Central and East Europe countries (Popescu, 2014). Notably a vast majority of these empirical studies advocate for a positive relationship between FDI and economic growth (Moudatsou (2003), Alfaro (2003), Roy and van der Berg (2006), Leitao and Rasekhi (2013), Leitao and Rasekhi (2013) and Pandyal and Sisombat (2017)) with a sole exceptions provided in the works of Tang (2015) which fails to finds any evidence of a significant relationship between the variables for EU countries.

Developing and emerging economies

The empirical efforts dedicated towards examining the FDI-growth relationship in developing and emerging economies appears to be more extensive in comparison to other world regions. For convenience sake, the literature concerning developing and emerging economies and be further disseminated into those concentrating on Latin American countries (Bengoa and Sanchez-Robles (2003) for Latin American countries, Naguibi (2002) for Argentina, Dias et al. (2014) for Brazil), Asian countries

(Chakraborty and Basu (2002) for India, Khaliq and Noy (2007) and Velnampy et al. (2013) for Sri Lanka, Naz et al. (2015) for Pakistan, Rahman (2015) for Bangladesh, Najaf and Najaf (2016) for Pakistan and Afghanistan, Zhang (2001, 2006) and Hong (2014) for China) as well as for African countries (Seetanah and Khadaroo (2007) for 39 SSA countries, Esso (2010) for 10 SSA countries, Sakyi and Egyir (2012) for 45 African countries, Seyoum et al. (2015) for 23 African countries and Jugurnath et al. (2016) for 32 SSA countries).

In summarizing the results of these studies, we note that Zhang (2001, 2006), Bengoa and Sanchez-Robles (2003), Seetanah and Khadaroo (2007), Sakyi and Egyir (2012), Velnampy et al. (2013), Dias et al. (2014), Hong (2014), Naz et al. (2015), Seyoum et al. (2015), Jugurnath et al. (2016) and Najaf and Najaf (2016) all find a positive FDI-growth relationship, whilst Rahman (2015) finds a negative relationship and Naguibi (2002), Chakraborty and Basu (2002), Khaliq and Noy (2007) as well as Esso (2010) establish no significant relationship between the time series.

Mixed economies

There also appears to be a handful of empirical studies which have investigate the FDI-growth relationship for mixed economies. For instance, in a much earlier empirical study Borensztein et al. (1998) investigated the FDI-growth relationship for 69 developing countries and discovered a positive relationship of FDI on productivity growth only when the host country has a minimum threshold stock of human capital level such that sufficient absorptive capacity of the advanced technologies exists in the host country.

De Mello (1999) investigates the FDI-growth relationship for 15 OECD countries and 17 non-OECD countries and establishes a positive link between FDI and growth for both sets of data. On the other hand, Nair-Reichert and Weinhold (2001) also find a positive relationship between FDI and growth for 24 developed and developing countries even though the authors caution on the relationship being highly heterogeneous across countries. Choe (2003) investigates the FDi-growth relationship for 81 countries and despite finding a positive association between the time series, the author cautions that this finding does not necessarily indicate that FDI promotes economic growth.

Using a sample of 31 developing economies, Hansen and Rand (2006) found that FDI has a significant positive effect on economic growth via knowledge transfers and adoption of new technology. Similarly, Li and Liu (2005) investigated the impact of FDI on growth for a mixture of 84 developed and developing countries an identified a significant positive endogenous relationship existing from the mid-1980's. For a mixture of 71 developed and developing countries comprising of 20 OECD and 51 non-OECD countries, Alfaro et al. (2004) establish that the impact of FDI on economic growth is more pronounced the more developed the financial markets of the host country. On the other hand, in purely focusing on a cluster of 28 developing countries comprised mainly of African, Latin American and Asian countries, Herzer et al. (2008) found no clear association between FDI, per capita GDP growth and other growth determinants. In undertaking a comparative analysis for EU and ASEAN

countries, Moudatsou and Kyrkilis (2011) find that FDI has a positive influence on growth for both regional blocs even though this effect is more pronounced in ASEAN countries.

Previous South African studies

We also present a review of studies for South Africa and we consider this important as these studies are more closely related to our current study. To the best of our knowledge, the works of Fedderke and Romm (2006), Sridharam et al. (2009), Masipa (2014), Mazenda (2014), Agrawal (2015), Sakyi and Egyir (2017) and Sunde (2017) suffice as an exhaustive list of previous empirical studies conducted on the South African economy using econometric techniques.

Beginning with the study by Fedderke and Romm (2006) who use vector error correction models (VECM's) to investigate the FDI-growth relationship between 1960 and 2002. The authors establish a positive correlation between the FDI and growth even though the authors find evidence of FDI crowding our domestic investment in the short-run. Similarly, Sridharam et al. (2009) examined the FDI-growth relationship for South Africa as member of the BRICS countries using VECM technique between 1996 and 2007 and find a positive long-run relationship between FDi and growth for all BRICS countries under the period of investigation. Along the same lines, Masipa (2014) employs Johansen's (1991) cointegration procedure to also concluded that FDI is a conducive factor towards improving and sustaining long-run employment and economic growth.

Applying Johansen (1991) cointegration procedure and estimating an associated VECM model to South African time series collected between 1980 and 2010, Mazenda (2014) finds a significant and negative influence of FDI on economic growth whereas domestic investments exerts a significantly positive effects on economic growth. These results thus offer evidence in support of a crowding out effect of FDI on domestic investment. Conversely, Agrawal (2015) adopt panel cointegration techniques to instigate the FDI-growth relationship for BRICS countries and uncovers a positive relationship between FDI and economic in which increases in FDI lead to increases in economic growth. In a more recent study, Sunde (2017) applies the more robust autoregressive distributive lag (ARDL) model to model the tri-variate relationship between FDI, economic growth and exports in South Africa between 1990 and 2014. The empirical results support conventional theory by depicting a positive relationship between FDI and growth for the data.

4. Econometric model

Empirical studies assessing the impact of foreign direct investment (FDI) on economic growth typically assumes the following econometric framework:

$$Y_t = \alpha fdi/gdp_t + \beta X_t + e_t \quad (1)$$

Where Y_t is the per capita GDP growth rate, fdi/gdp_t is the share of FDI in economic growth, X_t represents a vector of conditioning variables and et is a well-behaved error term. In deviating from the traditional OLS methodology and other linear estimation techniques used in previous South African case studies (Fedderke and Romm (2006), Sridharam et al. (2009), Masipa (2014), Mazenda (2014), Agrawal (2015), Sakyi and Egyir (2017) and Sunde (2017)), we examine the impact of FDI on the conditional distribution of economic growth. In particular, our empirical quantile regression (QR) can be specified as:

$$Y_t = \alpha(q) fdi/gdp_t + \beta(q) X_t + e(q)_t \quad (2)$$

Where α(q) and β(q) represent unknown parameters associated with the q^{th} quantile, $q \in (0, 1)$. As q increases monotonously from 0 to 1, we can investigate the influence of FDI on the whole conditional distribution of economic growth. In particular, the q^{th} conditional quantile function of Y_t can be formulated as:

$$Q(q/F_{t-1}) = \alpha(q) fdi/gdp_t + \beta(q) X_t + e(q)_t \quad (3)$$

In further creating a vector $x_t = (1, Y_{t-1},\ldots,Y_{t-p})$ and denoting β_τ as the regression quantiles, equation (3) can be re-specified as:

$$Q(\tau/F_{t-1}) + e_t = x_t{}'\beta_\tau + e_t \quad (4)$$

And β_τ are estimated as:

$$\beta_\tau^* = \arg_{\beta \in R^{P+1}} \min_{\square} \sum_{t=1}^{T} \rho_\tau(Y_t - x'_t\beta) \quad (5)$$

Where ρ_τ (.) is the quantile loss function which is a tilted absolute value function yielding the q^{th} sample quantile as its solution i.e. $\rho_\tau(u) = u[q - I.(u < 0)]$. Equation (5) can be solved straightforward using linear programming methods.

5. Data and empirical results

Empirical data

All data used in our empirical analysis has been collected between from the World Bank database on an annual basis for a span of 47 years, dating from 1970 to 2016. The dataset consists of the per capita gdp growth rate ($gdp.capita_t$), the share of FDI in GDP (fdi/gdp_t), the share of gross fixed capital accumulation in GDP (inv_t/gdp), CPI inflation rate (π_t), population growth ($population_t$) and terms of trade (tot_t). The descriptive statistics of these variables are reported in Table 1, the correlation matrix amongst the time series are reported in Table 2 whereas the plot of the time series are presented in Figure 1.

Table 1: Summary statistics of the time series variables

	mean	s.d.	skewness	kurtosis
$gdp.capita_t$	0.53	2.23	-0.42	-0.64
fdi/gdp_t	0.80	1.21	2.04	5.66
inv/gdp_t	21.79	4.91	0.47	-1.02
π_t	9.37	4.19	0.25	-0.99
pop_t	1.99	4.19	-0.23	-1.52
tot_t	-0.29	4.19	0.23	-0.20

Note: Authors own computation

Table 2: Correlation matrix of the time series variables

	$gdp.capita_t$	fdi/gdp_t	inv/gdp_t	π_t	pop_t	tot_t
$gdp.capita_t$	1.00	0.26	-0.11	0.43	-0.28	0.04
fdi/gdp_t		1.00	-0.31	-0.43	-0.58	-0.09
inv/gdp_t			1.00	0.44	0.70	-0.37
π_t				1.00	0.63	-0.18
pop_t					1.00	-0.36
tot_t						1.00

Note: Authors own computation

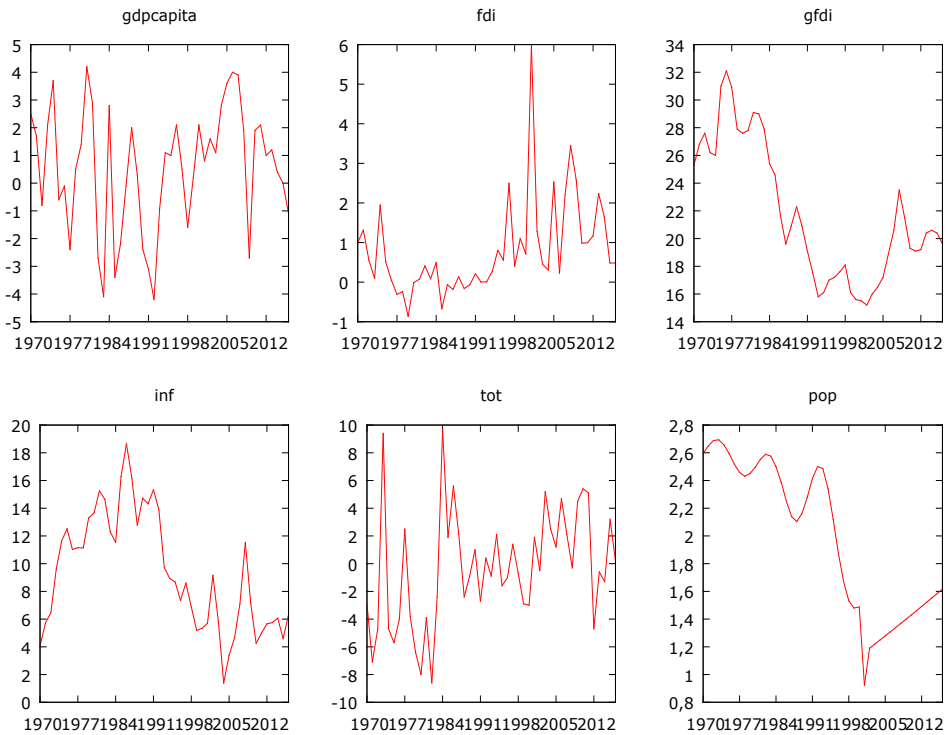

Figure 1: Time series plot of the variables

As can be observed from the summary of descriptive statistics reported in Table 1, the skewness and kurtosis statistics particularly hint that the time series may not be normally distributed. This observation provides a genuine case for the use of quantile regression over traditional OLS estimates. Also note some of the linear dependences between the variables as depicted by the correlation matrices presented in Table 2, are in contradiction to what is dictated by conventional growth theory, for instance, the negative relationship between FDI and per capita GDP growth as well as the positive correlation between inflation and per capital GDP growth. This further provides a plausible reason for further econometric analysis that would paint a broader picture than that presented by linear estimates. In this sense, quantile regression present a suitable alternative methodology.

Unit root tests

Before we can estimate our empirical QR model, we first perform unit root and cointegration tests in order to avoid the possibility of spurious regressions in our empirical estimates. The concept of a unit root within a time series can be demonstrated by specifying the following autoregressive (AR) model of a time series, y_t, i.e.

$$y_t = \alpha y_{t-1} + e_t \tag{6}$$

Where $e_t \sim$ iid. From regression (6)., the series y_t is said to be stationary if $|\alpha| < 1$ and the series contains a unit root process if $\alpha = 1$. Dickey and Fuller (1979) extend equation (5) to accommodate ARMA structure through the following test regression:

$$y_t = \beta' D_t + \phi y_{t-1} + \sum_{i=1}^{p} \delta_j \Delta y_{t-i} + e_t \tag{7}$$

Where the vector D_t is a vector of deterministic trends. The hypotheses tested are formally given as:

H_0: $\phi = 1$, $y_t \sim I(1)$ (8)
H_1: $\phi = 1$, $y_t \sim I(0)$ (9)

And the test statistic used to test the above hypothesis is computed as:

$$ADF_{\phi=1} = \frac{\dot{\phi}*-1}{SE(\dot{\phi}*)} \tag{10}$$

Where ϕ^* and $SE(\phi^*)$ are the least squares estimate of ϕ and the standard error estimate, respectively. The critical values of the ADF tests statistics are reported in MacKinnon (1996). We perform the unit root tests on the levels as well as on the first differences of our time series variables and report the results in Table 3

below. Note that the unit root tests are performed with i) no constant, ii) a constant and ii) a trend, with the maximum lag used in the ADF test based on the modified AIC (MAIC).

Table 3: ADF unit root tests results

time series	levels		first differences	
	drift	trend	drift	trend
$gdp.capita_t$	0.14	-3.51*	-5.83***	-5.83***
fdi/gdp_t	-0.46	-4.47***	-3.15**	-3.15
inv/gdp_t	-2.45	-5.43***	-2.93*	-2.93
π_t	-2.52	-4.11**	-2.84*	-2.84
pop_t	-1.22	-1.52	-5.40***	-5.37***
tot_t	-0.61	-0.31	-1.73*	-1.73

Notes: "***", "**","*" denote the 1%, 5% and 10% significance levels, respectively.

Based on the reported results, all observed time series fail to reject the unit root null in the levels of the variables when the tests are performed with a drift. However, when a trend is included the unit root null is rejected for the per capita gdp (10% statistical significance), FDI (significant at all critical levels), domestic investment (significant at all critical levels) and inflation (5% statistical significance) variables. In their first differences, all the time series reject the unit root null at significance levels of at least 10 percent when the test is conducted with a drift. When performed with a trend, only the gdp.capita and population variables reject the unit root null hence rendering the results of the unit root tests performed with a trend as being ambiguous. We therefore consider the results of the test run with only a drift and declare that all series are first difference I(1) variables, a condition which is indicative of cointegration amongst the time series. We thus formally test for cointegration relations within the series in the next section of the paper.

Cointegration tests

The concept of cointegration originated in the seminar work of Engle and Granger (1987). According to these authors, a pair of time series variables can be said to be cointegrated if the variables are mutually first difference variables and collectively produce a stationary error term. Their theorem particularly notes that such a condition will ensure that there exists a singular cointegration vector between the time series over the long-run. Johansen (1991) extend upon Engle and Granger

(1987) by allowing for multiple cointegration vectors or relations for a vector of time series. In particular, Johansen (1991) devised two likelihood ratio tests for cointegration. The first, the lambda-maximum test, is based on the log-likelihood ratio Ln[Lmax(r)/Lmax(r+1) and is conducted sequentially for r = 0, 1, …, k-1. The second test, the trace test, is based on the log-likelihood ratio Ln[Lmax(r)/Lmax(k) and is conducted sequentially for r = k-1, …, 1, 0. Seeing that we have previously found our time series to be difference stationary variables, we are enabled to test for multivariate cointegration vectors amongst the time series. The results of Johansen's (1991) cointegration tests as performed on our time series are found in Table 3 and based on the obtained test statistics for both Eigen and trace cointegration tests, we are compelled to render that there are two cointegration vectors amongst the observed variables.

Table 4: Johansen's test for cointegration

Rank	Eigen statistic	p-value	Trace statistic	p-value
0	175.04	0.00***	75.40	0.00***
1	99.64	0.00***	38.74	0.00***
2	60.90	0.00***	38.15	0.00***
3	22.75	0.27	11.87	0.57
4	10.89	0.22	8.79	0.31
5	2.09	0.15	2.09	0.15

Notes: "***", "**","*" denote the 1%, 5% and 10% significance levels, respectively.

QAR regression estimation results

The quantile regression estimates of our empirical model are reported in Tables 5, and has been executed for nine quantiles (i.e. 10^{th} quantile, 20^{th} quantile, 30^{th} quantile, 40^{th} quantile, 50^{th} quantile, 60^{th} quantile, 70^{th} quantile, 80^{th} quantile and 90^{th} quantile). The plots of coefficients from the quantile functions for each of the time series regressors are provided in Figure 2. Also note that for comparative sake, the OLS estimates of the long-run regression are also reported in Table 1. As can be observed, the OLS estimates indicate a surprisingly negative and significant coefficient on FDI and yet a produces a positive and significant coefficient on domestic investment. Note that these results concur with that obtained from the study of Mazenda (2014) for South Africa and Rahman (2015) for Bangladesh, albeit using different econometric techniques. Other results reported in Table 1 include a correct negative yet insignificant coefficient on inflation, a negative and insignificant coefficient on population and a negative and significant coefficient on terms of trade.

However, the estimates from our quantile regression indicate that the OLS esteems may be depicting an incomplete picture of the actual relationship. For instance, for the FDI variable, we find a negative and significant estimates at the 10th and 40th quantile whereas at the remaining quantiles, the coefficients are negative and insignificant. The insignificant effect of FDI on economic growth has been previously found in the studies of Tang (2015) for EU countries, Naguibi (2002) for Argentina, Chakraborty and Basu (2002) for India, Khaliq and Noy (2007), Herzer et al. (2008) for developing countries as well as Esso (2010) for SSA countries. Concerning the domestic investment, we note positive and significant impact of domestic investment on economic growth at all quantiles with the effect being more pronounced as one moves up the quantiles. In turning to the inflation variable, we note a negative and highly significant coefficients at the lower quantiles (i.e. 10th, 20th, 30th and 40th) as well as at the 90th quantile whilst at other quantiles the coefficients turn insignificant. The coefficients on the population variable remain insignificant throughout the quantiles albeit being positive up to the 30th quantile and turn negative thereafter. Finally, the quantile coefficient estimates on the terms of trade variable are more puzzling, being negative and significant at the 10th and 40th quantiles, positive at the 20th quantile and turning positive and insignificant at all other quantiles.

Table 5: QAR regression estimates on original time series

q	fdi/gdp_t		inv/gdp_t		π_t		pop_t		tot_t	
	estimate	p-value	estimate	p-value	estimate	p-value	estimate	p-value	estimate	p-value
ols	-0.43	0.03**	0.36	0.00***	-0.06	0.74	-0.24	0.15	-1.57	0.15
0.1	-0.41	0.00***	0.19	0.00***	-0.23	0.00***	0.21	0.42	-0.12	0.00***
0.2	-0.03	0.26	0.17	0.00***	-0.36	0.00***	0.01	0.79	0.40	0.00***
0.3	-0.08	0.60	0.17	0.02**	-0.29	0.04**	0.48	0.53	-0.10	0.32
0.4	-0.18	0.02**	0.22	0.00***	-0.20	0.00***	-0.14	0.64	-0.15	0.00***
0.5	-0.52	0.27	0.39	0.05**	0.10	0.77	-2.24	0.32	-0.31	0.29
0.6	-0.52	0.26	0.39	0.04**	0.10	0.76	-2.24	0.31	-0.31	0.28
0.7	-0.50	0.15	0.41	0.00***	-0.10	0.67	-1.73	0.28	-0.19	0.36
0.8	-0.24	0.33	0.38	0.00***	-0.24	0.20	-1.09	0.34	-0.13	0.39
0.9	-0.24	0.18	0.38	0.00***	-0.24	0.08*	-1.09	0.20	-0.13	0.24

Notes: “***”, “***”, “*” represent the 1%, 5% and 10% significance level, respectively.

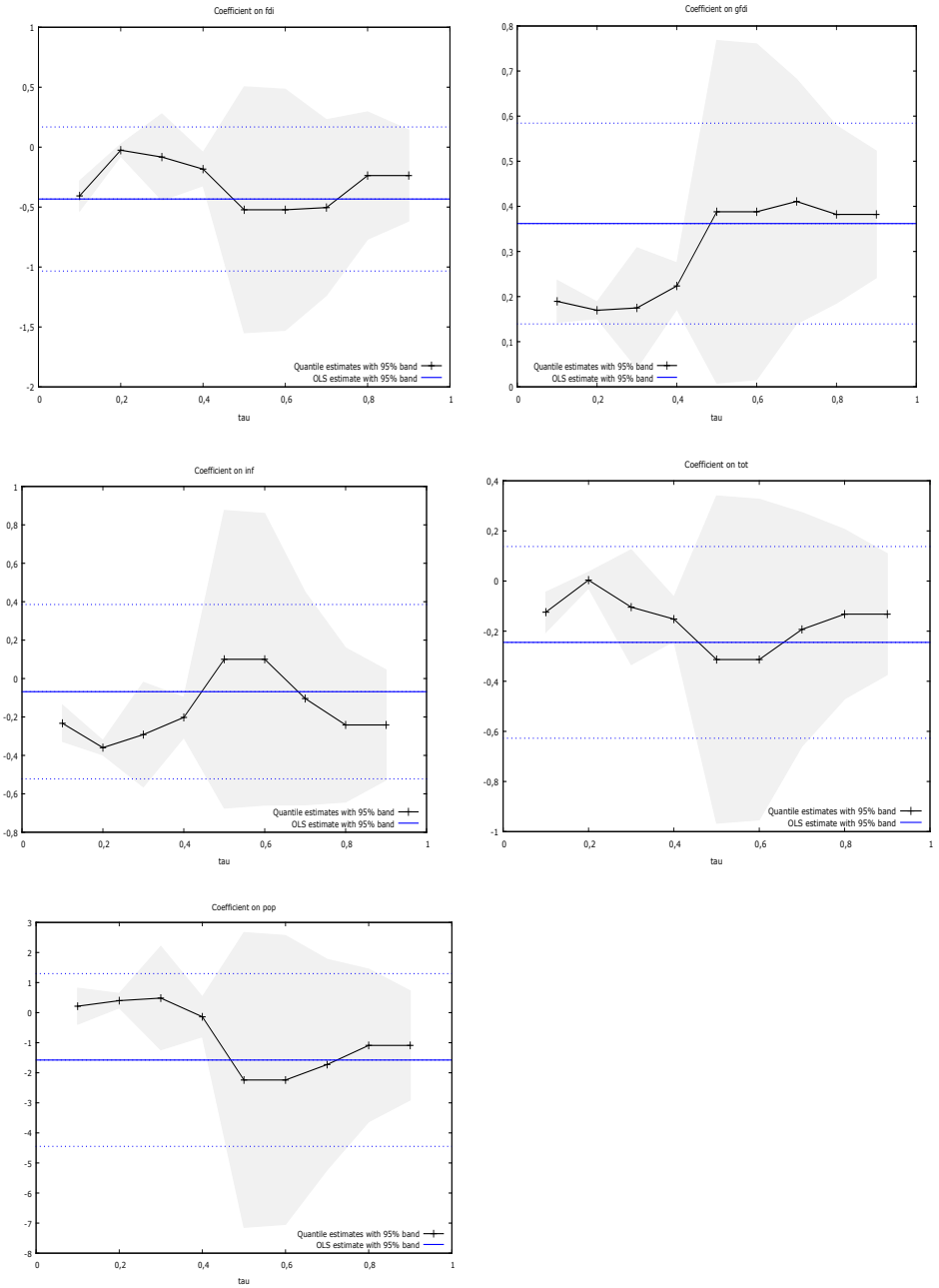

Figure 2: Plots of coefficients from different quantiles

Sensitivity analysis

Notwithstanding, the encouraging results obtained from our initial quantile estimates, we feel it is important to perform sensitivity analysis on our estimated regressions. A significant yet often overlooked factor that would distort the FDI-growth relationship overt time would be the structural break caused by the 2007 global financial crisis. Thus, we conduct our sensitivity analysis as means of ensuring that our estimates are not biased, we segregate our data into two sub-periods corresponding to the pre-crisis (1970-2006) and post-crisis (2007-2016) periods and performed our empirical quantile estimates on the theses sub-samples. In being aware of the danger posed by the low number of observations particular associated with post-crisis period, we interpolate our data from annual to quarterly frequencies as a means of increasing the observations numbers available for empirical use. The results of this empirical exercise are reported in Table 6 with the associated plots of coefficients from the quantile functions for the pre-crisis and post-crisis periods are plotted in Figures 3 and 4, respectively.

In quickly browsing through the OLS estimates, we note that all obtained coefficients are insignificant in both sub-sample periods with the exception of the inflation coefficient in the pre-crisis which produces the correct negative and significant regression estimate. We also summarize the findings of our quantile estimates as follows. For the FDI variable, we note that coefficient estimate is negative and significant at the 60^{th} and 80^{th} quantile and in the 10^{th}, 20^{th} and 90^{th} quantiles in the post-crisis. We also find significant positive coefficient estimate on the domestic investment variable at the 10^{th} and 90^{th} quantile for both pre-and-post crisis periods, the 40^{th}, 60^{th}, 70^{th} and 80^{th} quantile in the pre-crisis periods and the 20^{th} quantile in the post-crisis period. Inflation is also found to have a negative and significant in both sub-sample periods at the 90^{th} quantile whereas the coefficient estimates are negative and significant at all other quantiles for the pre-crisis periods whereas they turn negative and insignificant in the post-crisis data. On the other hand, population is negative and significant at the 60^{th} and 80^{th} quantiles for the pre-crisis period and at the 10^{th}, 20^{th} and 90^{th} quantiles in the post-crisis whereas the remaining coefficient estimates as negative and insignificant. Lastly, terms of trade coefficients are negative and significant at the 60^{th} and 80^{th} quantiles in the pre-crisis and at the 10^{th}, 20^{th} and 90^{th} quantile for the post-crisis period. All-in-all, we observe a change in regression results when account for the global financial crisis, note only for the quantile regressions but also for the OLS estimates.

Table 6: QAR regression estimates on logs of variables

q		fdi/gdpt		inv/gdpt		πt		popt		tott	
		estimate	p-value	estimate	p-value	estimate	p-value	estimate	p-value	estimate	p-value
ols	Pre-crisis	0.33	0.21	0.13	0.22	-0.24	0.00***	-0.15	0.89	0.05	0.60
	Post-crisis	-1.06	0.67	1.19	0.48	-0.53	0.61	-12.30	0.49	-0.20	0.60
0.1	Pre-crisis	-0.03	0.71	0.17	0.00***	-0.36	0.00***	0.40	0.30	0.01	0.94
	Post-crisis	-4.95	0.00***	2.49	0.00***	0.07	0.84	-29.54	0.00***	-0.57	0.00***
0.2	Pre-crisis	-0.03	0.90	0.17	0.12	-0.36	0.09*	0.40	0.73	0.01	0.98
	Post-crisis	-4.95	0.00***	2.49	0.02**	0.07	0.88	-29.54	0.00***	-0.57	0.02**
0.3	Pre-crisis	-0.03	0.90	0.17	0.11	-0.36	0.08*	0.40	0.72	0.01	0.98
	Post-crisis	-0.61	0.62	1.02	0.24	-0.40	0.44	-11.23	0.23	-0.25	0.22
0.4	Pre-crisis	-0.08	0.48	0.17	0.02**	-0.29	0.02**	0.48	0.43	-0.10	0.21
	Post-crisis	0.37	0.73	0.68	0.36	-0.50	0.29	-7.10	0.37	-0.18	0.30
0.5	Pre-crisis	-0.08	0.74	0.17	0.15	-0.29	0.19	0.48	0.71	-0.10	0.53
	Post-crisis	-0.33	0.85	1.31	0.28	-0.85	0.26	-13.11	0.30	-0.13	0.63
0.6	Pre-crisis	-0.76	0.00***	0.50	0.00***	0.32	0.00***	-3.74	0.00***	-0.40	0.00***
	Post-crisis	-1.35	0.54	2.22	0.17	-1.37	0.17	-21.88	0.20	-0.05	0.89
0.7	Pre-crisis	-0.19	0.35	0.30	0.02**	-0.61	0.01**	0.70	0.50	0.05	0.68
	Post-crisis	-1.35	0.54	2.22	0.17	-1.37	0.17	-21.88	0.20	-0.05	0.89
0.8	Pre-crisis	-0.19	0.01**	0.30	0.00***	-0.61	0.00***	0.70	0.03**	0.05	0.14
	Post-crisis	-1.38	0.48	2.25	0.12	-1.32	0.13	-22.36	0.14	-0.05	0.87
0.9	Pre-crisis	-0.19	0.36	0.30	0.02**	-0.6	0.01**	0.70	0.50	0.05	0.69
	Post-crisis	-1.38	0.00***	2.25	0.00***	-1.32	0.00***	-22.36	0.00***	-0.05	0.08*

Notes: “***”, “***”, “*” represent the 1%, 5% and 10% significance level, respectively.

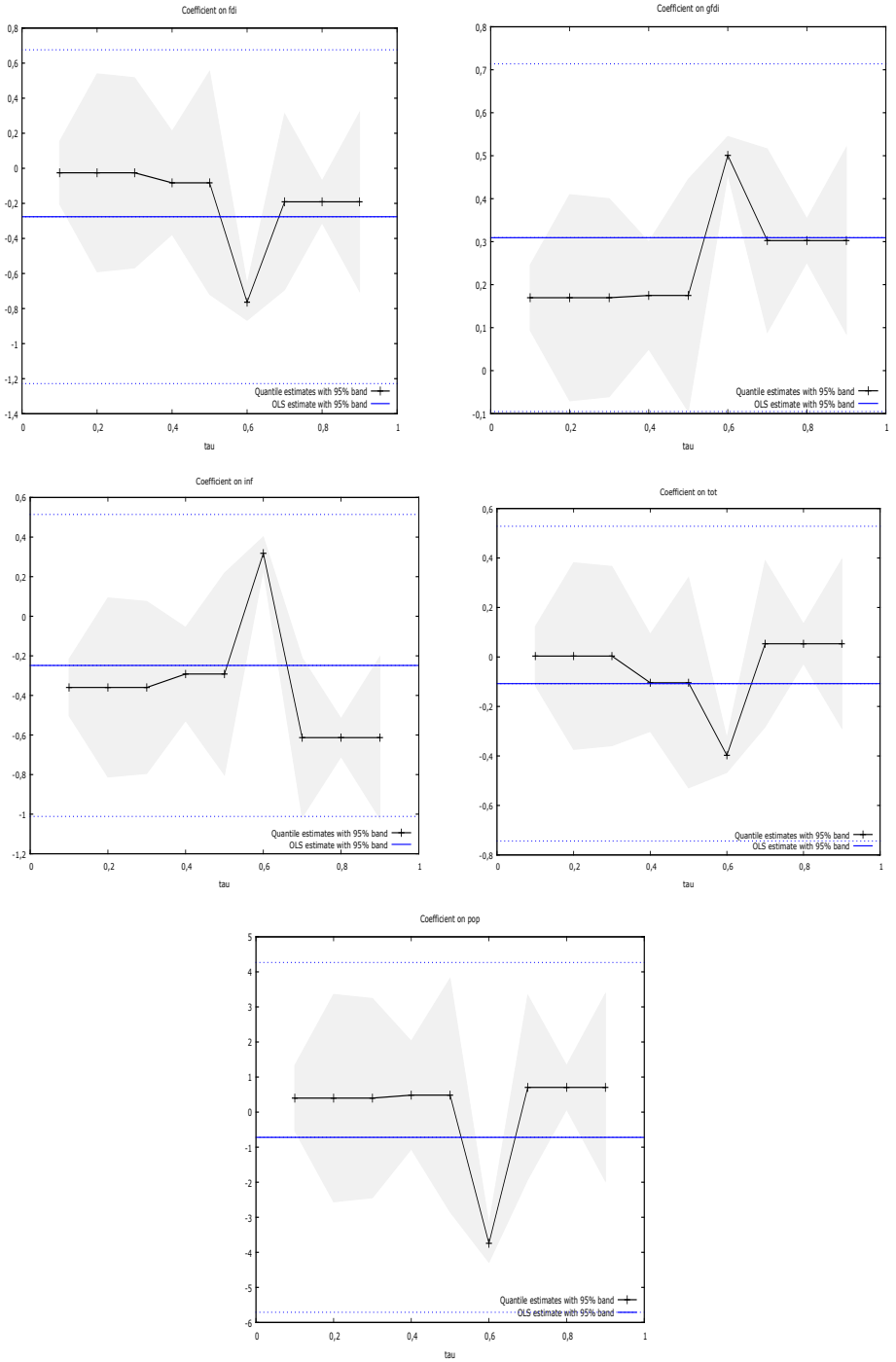

Figure 3: Plots of coefficients from different quantiles (pre-crisis)

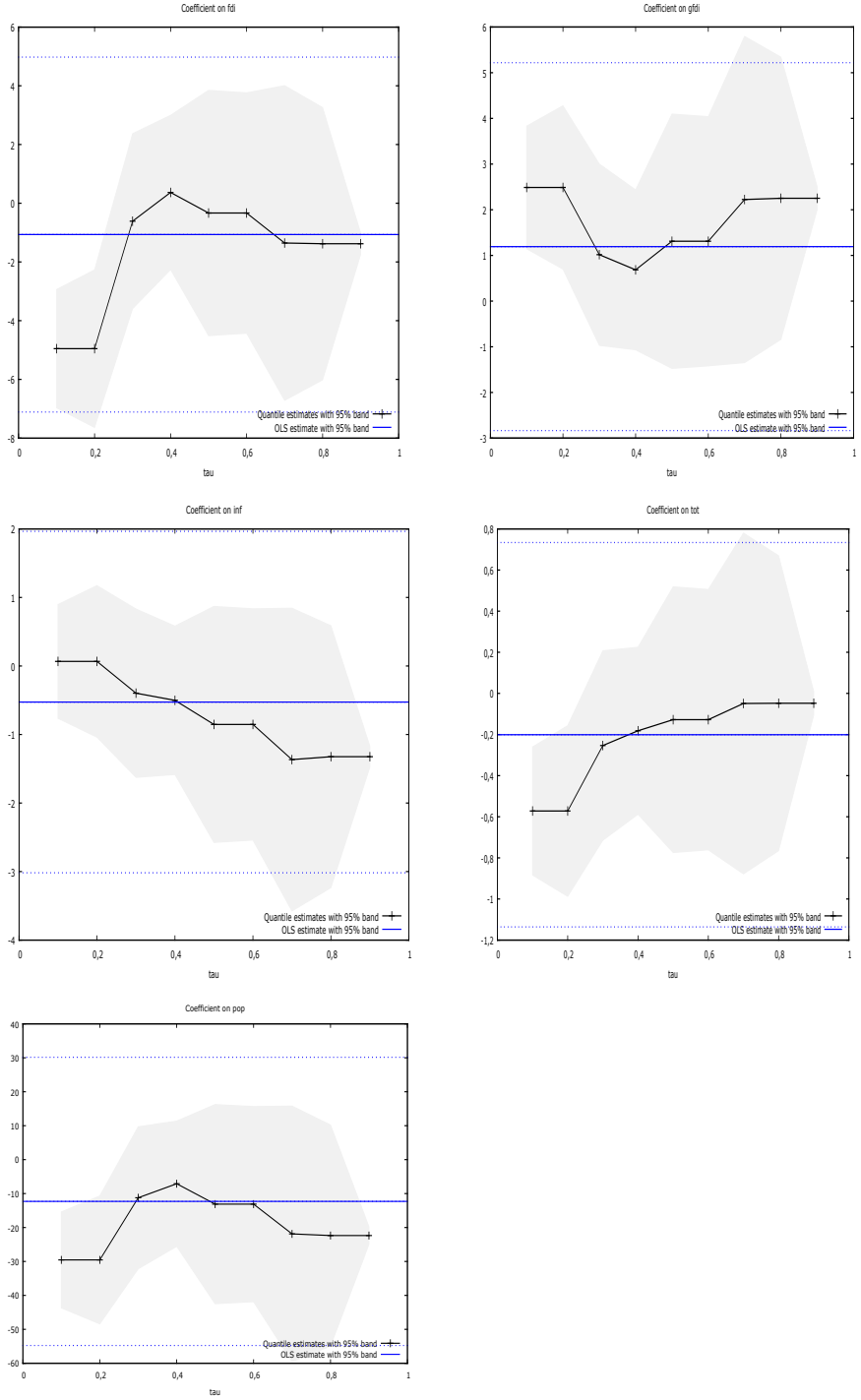

Figure 4: Plots of coefficients from different quantiles (post-crisis)

6. Conclusion

Much debate has been cast on the relationship between FDI and growth more prominently so during the post 2008-recession era. It is widely believed that FDI is an important component in assisting the world economy recovering from the recessionary period, more specifically so for developing regions. We contribute to the on-going literature by presenting an empirical analysis of the effects of FDI on growth in South Africa, one of the largest recipients of FDI in the Sub-Saharan Africa (SSA) region. In differing from previous South African case studies we use quantile regression approach as opposed to restrictive OLS technique and carry out our analysis using data collected from 1970 to 2016. As part of our sensitivity analysis, we accounted for the global financial crisis as a break period and perform a comparative analysis thereafter.

Concerning the FDI-growth relationship, our results indicate that FDI negatively affects economic growth welfare at lower extreme quantiles more prominently so during the post-crisis period. At other levels, FDI insignificantly influences welfare. Conversely, we find that domestic investment positively affects per capita GDP growth in a majority of quantiles regardless of the observed sample period. Collectively, a plausible policy implication which can be drawn from our analysis is that FDI may be crowding out domestic investment in the aftermath of the global financial crisis via a displacement effect. Our results thus caution policymakers to not only dedicate efforts towards attracting more levels of FDI but should more importantly focus on developing strategies and channels through which FDI can be directed at improving economic welfare in South Africa. Identifying the channels through which FDI can possible influence economic welfare without crowding out domestic investment would thus pose as the main challenge to policymakers. Considering the limited scope of this current study, we are unable to provide answers concerning the channels through which FDI can affect growth and can only speculate on channels such as instituional quality and urbanization. Investigating the possible 'transmission' channels can be empirically reserved for future research analysis.

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GENDER DIFFERENCES AND OTHER FINDINGS ON THE COGNITIVE REFLECTION TEST

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Abstract. Intelligence is the traditional element of interest when measuring the human cognitive abilities. However, intelligence is complex and researchers are constantly finding new angles of looking at it. One such angle is reflective reasoning. Sometimes individuals choose to override the intuitive answer and by engaging in further reflection they reach the correct answer. The cognitive reflection test (CRT) measures a person's ability to suppress their incorrect intuitive answer in favor of reflection that should then lead to the correct response. The test contains three short mathematically based problems, which measure, among others, cognitive ability, mathematical abilities and cognitive reflection. Using a sample of 195 students from a state university, one of the largest universities in Romania, we explore the extent to which a variety of phenomena and trends identified by previous findings on CRT show similar results on our sample.

JEL Classification: J16, D89, D91;

Keywords: cognitive reflection test, decision making, reflection.

1. Introduction

The Cognitive Reflection Test is a three question test that has been developed by Shane Frederick (2005). It is a mean to differentiate people with a higher cognitive ability from those with a lower one, the former ones differentiating from the later one's through their "ability to inhibit intuitive responses in favor of reflective and deliberative reasoning" (Travers et al., 2016). According to Juanchich et al., 2016, the CRT "is a powerful predictor of normative decision-making", but the existing literature is yet not sure about what the test actually measures. Traditionally this differentiation has been made with the help of tests like the IQ test, but such a

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test is usually rather lengthy and taking it can be quite time-consuming. The CRT is useful exactly for that reason: doing it takes a couple of minutes (unlike other tests that measure cognitive abilities that can take up to 3,5 hours) and its correlation to a person's IQ is very high (Frederick, 2005).

The purpose of the current study was to examine (a) the gender differences with regard the CRT in a representative adult sample, (b) the correlation between the results at the Romanian final high school exams *baccalaureate exam* and the CRT, (c) a few other previous findings from the literature.

What is such a differentiation between individuals with a higher cognitive ability and individuals with a lower cognitive ability useful for? It can be useful for many things, for example it gives researchers the possibility to separate individuals in different groups in accordance to their cognitive abilities (and without using a time-consuming test in the process). This can help them then see, for example, how people with a higher cognitive ability take decisions differently from people with a lower cognitive ability. According to research (Eysenck, 1979; Herrnstein and Murray, 1994; Jensen, 1980; Simonton, 1996; etc.), general intelligence assessed during childhood has consistently predicted behaviors that are maladaptive as well as adaptive. To this behaviors we can count, among others, "delinquent behavior, rate of learning, high-risk health behaviors", a better general health (Auld and Sidhu, 2005). A current issue when dealing with social problems has been that social sciences have neglected the influence of general intelligence when developing public policy and creating (effective) interventions, because they have concentrated mostly on specific groups instead of specific behaviors (Lubinski and Humphreys, 1997). Therefore, one of the uses of the CRT would be to easily help differentiate between people with higher and lower cognitive abilities as a means for creating better policies.

More recent studies on the CRT focused on, among others, expanding the CRT (see Toplak et al. 2014), explaining gender differences on the test (see Zhang et al. 2016), the prediction power of cognitive reflection in real-life decision situations while testing for personality and decision-making styles (see Juanchich et al. 2016), testing the dual process theory of reasoning of participants solving the CRT with the help of their mouse cursor movements (see Travers et al. 2016), intuitiveness – not something measured by the CRT (see Pennycook et el. 2015).

The three problems of the CRT are presented in Figure 1. When trying to answer the 3rd problem, if one was to respond intuitively, without deliberately reflecting on the answer, then they would likely answer 24 days. This choice of an answer can be explained by the dual-process theories, that have been mentioned in the literature quite often (Baron et al., 2015; Evans and Curtis-Holmes, 2005; Evans and Frankisch, 2009; Kahneman, 2011; Kahneman and Frederick, 2002; Sherman et al., 2014; Sloman, 1996). Different names have been used to differentiate between these two types processes; however, for simplicity, I will use Stanovich and West's terminology: "System 1" and "System 2" (Stanovich and West, 2000), even though in the latest literature many researchers, including Stanovich, prefer the terminology "type 1 processing" and "type 2 processing" (Sherman et al., 2014). The dual-process theory can be explained the following way: there are two types of cognitive operations, some are quick, associative, intuitive, heuristic, automatic,

unreflective, driven by affect, they are undemanding on our limited cognitive resources, and others that are slow, rule-based, reflective, and they require effortful thinking. Results at the CRT are explained in the following way: when the correct answer is given, then the System 2, the reflective one, manages to override the functioning of System 1, the intuitive one. However, when the wrong answer is given (to a problem that is not particularly difficult), then it is because System 2 didn't (most likely) *help* System 1 in the decision-making process (Baron et al., 2015; Campitelli and Gerrans, 2014; Kahneman and Frederick, 2002).

(1) A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost? _____ cents

(2) If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets? _____ minutes

(3) In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake? _____ days

Fig. 1: The Cognitive Reflection Test
Source: Frederick (2005)

Among Shane's most interesting results regarding the CRT was that the predictions of the prospect theory (Kahneman and Tversky, 1979) that "people will be more willing to take risks to avoid losses than to achieve gains; that respondents will switch from risk aversion to risk seeking when the valence of the gamble changes from positive to negative" worked very well when it came to the low CRT groups, but it was wrong when it came to the high CRT groups (Frederick, 2005).

2. Methodology

2.1. Participants and procedure

As far as we are aware, the CRT hasn't been applied to students at this faculty in a scholar environment and for scientific purposes. We developed a questionnaire that included a few additional questions next to the CRT and more groups of students filled in the questionnaire.

Our sample consisted of a total of 195 participants (140 females and 54 males), all students at one of the biggest universities in Romania. Since our population could clearly be divided into groups based on the characteristic study year, we used the stratified random sampling method based on the year of study of the students. Our sample was made of undergraduate students in the 1st year (44

students), 2nd year (64 students), 3rd year (77 students) and graduate students in the 2nd year (10 students). The participants were not paid for their participation. The students needed around 10 minutes to fill in the questions.

2.2. Results and Interpretation

The questions we tried to answer in this study, as well as our results can be found in the next sections.

Cognitive ability measured with the CRT

Firstly, we compared the results at the CRT of the students from our faculty to the ones of students from other universities and groups in which the test was applied, more precisely, the results mentioned in the original article by Frederick (Frederick, 2005). It can be seen in the table that almost all the other samples came from the US.

Table 1: Scores at the CRT, by Location

		Percentage scoring 0, 1, 2 or 3				
		"Low"			*"High"*	
Locations at which data were collected	*Mean CRT score*	*0*	*1*	*2*	*3*	*N=*
MIT	2.18	7%	16%	30%	48%	61
Princeton University	1.63	18%	27%	28%	26%	121
Boston fireworks display	1.53	24%	24%	26%	26%	195
Carnegie Mellon University	1.51	25%	25%	25%	25%	746
Harvard University	1.43	20%	37%	24%	20%	51
Univ. of Michigan: Ann Arbor	1.18	31%	33%	23%	14%	1267
Web-based studies	1.10	39%	25%	22%	13%	525
Bowling Green University	0.87	50%	25%	13%	12%	52
Univ. of Michigan: Dearborn	0.83	51%	22%	21%	6%	154
Michigan State University	0.79	49%	29%	16%	6%	118
Sample from one university in Romania	**0.77**	**51%**	**29%**	**12%**	**8%**	**195**
University of Toledo	0.57	64%	21%	10%	5%	138
Overall	1.2	**36%**	**24%**	**21%**	**17%**	**3623**

Source: compare to Frederick (2005)

As it can be seen in Table 1, the students from our sample who filled in the questionnaire had a mean CRT score of less than 1, which means that on average a person responded correctly to less than 1/3 of the questions. This result is very similar to the one of the sample from the Michigan State University (which had a mean CRT score of 0,78 vs. 0,79) (Frederick, 2005). However, the mean of our sample was lower than the overall mean of all the samples included in Table 1 and a lot lower than the sample with the highest results, a sample of students from MIT.

Consistency with Kahneman's Linda-question

As seen in Appendix A, we added the reasonably famous Linda-question (Kahneman, 2011) - see Figure 2 - as a continuation to the CRT. The Linda-question is one of a series of similar questions developed by Tversky and Kahneman during their long collaboration which led to the later one receiving the Nobel prize in 2002.

Linda is 31 years old, single, outspoken and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations. Rank the following statements according to their probability: using 1 for the most probable and 2 for the least probable:

(a) Linda is a bank teller.

(b) Linda is a bank teller and is active in the feminist movement.

Fig. 2: Kahneman and Tverky's Linda-question
Source: Tversky and Kahneman (1983)

The particular phenomenon that Tversky and Kahneman discovered in 1983 regarding the previously mentioned question is the following: “people tend to believe that a conjunction of events (e.g., Linda is a bank teller *and* is active in the feminist movement) is more likely to occur than one of the conjuncts (e.g., Linda is a bank teller)”. Researchers have been trying to come up with reasons to explain this particular phenomena and the literature mentions usually two reasons: the *misunderstanding* of the problem or the presence of a *reasoning bias* (Moro, 2009). However, those particular things don't concern us right now. The reason why we tested whether there is a correlation between the two is related to the following: if achieving a good result at the CRT implies having mathematical abilities, and properly solving questions like the Linda-question implies following the conjunction rule of the probability theory, which has something to do with mathematical abilities again, then common sense would dictate a correlation between the two.

Table 2. Correlations between the different questions of the CRT and the Linda question

		CRT question 1	*CRT question 2*	*CRT question 3*	*Linda question*
CRT question 1	*Pearson Correlation*	1.00	.43	.38	-.02
	Sig. (2 tailed)		.00	.00	.81
	N	152	152	152	145
CRT question 2	*Pearson Correlation*	.43	1.00	.21	.01
	Sig. (2 tailed)	.00		.01	.88
	N	152	152	152	145
CRT question 3	*Pearson Correlation*	.38	.21	1.00	-.08
	Sig. (2 tailed)	.00	.01		.35
	N	152	152	152	145
Linda question	*Pearson Correlation*	-.02	.01	-.08	1.00
	Sig. (2 tailed)	.81	.88	.35	
	N	145	145	145	145

Source: Designed by the authors based on own calculations

Looking at Table 2, which presents the correlations between the different questions of the CRT and the Linda-question, we can see the following: there is no significant correlation between the Linda-question and any of the three CRT questions. Even though none of the three CRT questions points out to the conjunction fallacy like the Linda-question, result were a little bit surprising and they differed from the usual findings of the literature (see, e.g., Brañas-Garza et al., 2015).

Gender trend

More researches concluded that on average men have a better result at the CRT in comparison to women (Campitelli and Gerrans, 2014; Frederick, 2005; Pennycook et al., 2015; Primi et al., 2016) and we wanted to test next whether this applies to our participants as well. However, it's worth mentioning that this trend can be seen not only in relation to the CRT; when it comes to math tests, in general, men get better results than women (Benbow and Stanley, 1980; Halpern, 2004; Hedges and Nowell, 1995; Hyde, Fennema and Lamon, 1990). Frederick noticed that in the case of the CRT the types of mistakes that women made were different from the type of mistakes than men made: while men made a larger variety of mistakes, women often made the intuitive type of mistakes, e.g., at the 2nd question of the CRT they answered 100 (Frederick, 2005).

Table 3. Gender differences at the CRT given to students from our sample consisting of students from one of the biggest universities in Romania

	Mean CRT score	*0*	*1*	*2*	*3*	*N=*	*Significance of group difference*
Female	0.65	54%	32%	9%	5%	140	P<0.001
Male	1.06	44%	22%	17%	17%	54	

Source: Designed by the authors based on own calculations

We compared the mean CRT score of males (=1.06) to the mean CRT of females (=0.65) – see Table 3 – to test to test whether in a bigger population males tend to have a better score at this test than women or if the difference in our sample was caused by chance. The results showed a significant difference between the male and female populations, which confirmed the results of previous studies that male perform better than women at this test. However, this test doesn't tell us why such a difference exists. According to Frederick (2005) the reason why men have better results at this test is their mathematical ability or interest. The author of the original article further explains that men are known to be better at solving math tests than women in general and the CRT is another test that can be included in this category.

Results at BAC and CRT – same strong correlation as between SATs and CRT?

Frederick wanted to see in his study how strong was the correlation between the CRT results of the participants in the study and their results at different cognitive measurement tests, among others: the WPT, NFC, ACT, SATs and SATs in the field of mathematics. There was a positive and significant correlation between these measurements (Frederick, 2005). Additionally, research has shown that people who perform well at the CRT tend to have good results at some other types of tests, namely numeracy tests, other general ability tests (Cokely and Kelley, 2009; Frederick, 2005; Liberali et al., 2011; Oechssler et al., 2009; Toplak et al., 2011). Additionally, the CRT also shows substantial correlation with, e.g., common biases in judgment and decisions (Campitelli and Labollita, 2010; Toplak and Stanovich, 2002), utilitarian moral judgments (Baron et al., 2015; Paxton et al, 2012), disbelief in God and the supernatural (Gervais and Norenzayan, 2012; Pennycook et al., 2012; Shenhav et al., 2011). We tested to find out whether there is a correlation between the Romanian version of the SATs, *examenul de Bacalaureat*, and the results at the CRT.

Table 4. Correlation between Cognitive Measures: Comparison between Frederick's CRT+SAT (compare to Frederick, 2005) and CRT+SATm and my sample's CRT+BAC and CRT+BACm

	CRT	*SAT*	*SATm*			*CRT*	*BAC*	*BACm*
CRT		.44	.46		*CRT*		.25 (p<0.05)	.16 (p>0.05)
SAT	.44		.77		*BAC*	.25 (p<0.05)		.67 (p<0.05)
SATm	.46	.77			*BACm*	.16 (p>0.05)	.67 (p<0.05)	

Source: Designed by the authors based on own calculations

The first part of Table 4 shows the correlations from the original article of Frederick (2005) between the CRT and the overall SATs results (=.44) and to the SATs in Mathematics (=.46), respectively. In both cases a moderate positive relationship was found between the two. The second part of the table shows the correlations between the results at the CRT and the overall results at the Romanian final high school exams (*examenul de bacalaureat*), respectively the results at mathematics. A weak positive relationship has been found between the CRT and the overall BAC (=.25). For the CRT and the BACm the correlation we found wasn't statistically significant. We can conclude that while there is a moderate positive relationship between the results of American students at their SATs and their cognitive abilities (which is what the CRT measures), the situation is different when it comes to Romanian students. There is less respectively no significant correlation between the results of the students at the CRT and their BAC results. This can lead further to the question of what does ultimately the *examenul de bacalaureat* intend to measure and what does it actually measure. We weren't able to find many studies about the Romanian baccalaureate. The ones that we found had interesting results, but their research questions were different from ours. For example, a study of Popa & Bochiş (2016) concluded after testing a sample (N=125) of Romanian students that their baccalaureate averages and their GPA tend to be consistent with their overall results during their studies. Marincas & David (2013) spoke about the reasons for the high rates of failure at the baccalaureate. What they mention and is of interest for the current study is the major changes that have been proposed and have taken place during the last years regarding the BAC. We consider that these constant yearly changes and unclear long-term plans of the education boards when it comes to the purpose and use of this exam in Romania are a reason for the lack of correlation that we found.

If you had a bad results at the CRT are you more likely to think it was easy?

Another interesting phenomena described by Frederick (2005) is the following: the persons who took the test and had a worse result were more likely to say that they found the test easy, compared to people who had better results at it, who claimed the test as harder. In order to test this hypotheses, our sample of students was asked to rate the difficulty of the test on a scale from 1 (very easy) to 5 (very difficult). The results of my sample were different than the one's of Frederick: the correlation that we found wasn't statistically significant, so people who did better in the test didn't necessarily find it harder and the other way around. This results were unexpected. A potential explanation for this difference is the different methodologies used. While Frederick (2005) asked the participants in the study how many percent of people they thought answered each of the questions correctly, I used the previously described question. What the author of the original article also noted was that leaving aside whether the participants of the study answered the question correctly or not, they all overestimated by a lot how many other people would give the correct answer to the questions.

3. Conclusions

Some of the results we found confirmed what previous studies concluded, while some of the results were different. The results at the CRT of our sample of students from a university in Romania were similar to the ones of other samples of students from other universities. Men did indeed have better results than women in our sample, which was what previous testing found as well. We did get to wonder and tried to come up with reasons, e.g., why the BAC results showed a much lower correlation compared to the SATs, but this was outside the scope of this study. Testing a bigger and more varied sample of Romanian pupils, adults, and students would be interested in order to see, e.g., how non-university students answer, and to then further study differences between populations, as well as compare the results to results of similar tests from Western Europe.

One of the limits of the paper is the small sample. In a further study we would like to include a bigger sample from Romanian universities and include a few additional questions in order to test whether they could be a possible replacement to the three original ones, which are starting to be known. Additionally, the sampling methodology could be improved in the sense that in the future we could include students from all years of study and in a higher number.

In the context of the discussions about the *baccalaureate exam* in Romania, not finding any significant correlation between the CRT results and the results at the *baccalaureate exam* was surprising. However, even though it was outside of the scope of the current article, an expansive analysis of what the exam actually measures is a possible further direction of study.

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AN ANALYSIS OF THE EFFECTIVENESS OF INTEREST RATES TO FACILITATE PRICE STABILITY AND ECONOMIC GROWTH IN SOUTH AFRICA

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Abstract. Price stability supports accelerated economic growth (GDP), thus the main objective of most central banks is to ensure price stability. The South African economy is experiencing a unique monetary policy dilemma, where a high inflation rate is accompanied by high interest rates and low GDP. This is an unconventional monetary policy scenario and may hold strenuous repercussions for the South African economy. This dilemma was held as the rationale behind this study. The study investigated the effectiveness of the use of the repo rate as an instrument to facilitate price stability and GDP in South Africa. Long-run, short-run and casual relationships between interest rates, inflation and GDP were therefore analyzed. The methodology is based on an econometric process which included a Johansen co-integration test, with a Vector Error Correction model (VECM). Casual relationships were also tested using Granger causality tests. Results of the Johansen Co-integration test indicated the presence of co-integrating long-run relationships between the variables and a significant and negative long-run relationship between the repo rate and inflation rate was revealed, whereas GDP and inflation rate exhibited a significant and positive long-run relationship. The study also found short-run relationships between inflation and GDP, but not for inflation and the repo rate. Further areas of potential research may fixate towards the assessment of other significant alternative policy tools which may be utilized by various countries' monetary policy authorities to influence supply specific inflationary pressures led by the cost-push phenomena, especially in the short-run.

JEL classification: E65, O11, O55;

Keywords: Monetary policy, interest rates, price stability, economic growth, VAR model.

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1. Introduction

Over the years, central banks in developing countries have been seeking to implement a viable monetary policy approach to guide their economies in achieving price stability and sustainable economic growth (Montes, 2010:2). Price stability provides an enabling environment for sustainable growth, where economic decisions taken by economic agents are independent of price changes (Bagsic and Glindro, 2006:4). According to Kaseeram (2012:1), price stability is a prerequisite for achieving faster sustainable growth, as it facilitates long-term financing for private-sector and government debt. In addition, long-term price stability ensures efficient allocation of resources and eradicates potential drags on sustainable growth, whilst instilling the economy with the confidence that the value of money will be stable in the long-run (Kaseeram, 2012:42). This situation encourages people to save and invest, since their respective disposable incomes will be less sensitive to price changes (Elmendorf, 1996).

Similar to most developing countries, the central objective of the South African Reserve Bank (SARB) is to ensure price stability in the economy (van der Merwe, Mollentze, et al., 2014:222). Although this objective is considered to be broad, it is usually interpreted to mean a low and stable rate of price inflation maintained over a long period of time (Poole and Wheelock, 2008). In achieving the objective, the SARB follows a conventional monetary policy approach known as the Inflation Targeting Framework (ITF). The ITF was first adopted by New Zealand in the 1990, and in the case of developing countries, Chile was the first to adopt an ITF (Mishkin, 2000). Since then, the ITF has been practiced by many central banks globally. The ITF enunciates that the short-term interest rate (or repo rate) is the main monetary policy instrument that can be used to achieve price stability (Arestis and Sawyer, 2003).

According to Sarwat (2012), the central banks implement the ITF by estimating and producing a targeted range for inflation and then attempts to steer actual inflation towards that target using the repo rate. Under the ITF, monetary policy sets the repo rate with respect to recommendations within the Taylor rule in response to changes in price level (Arestis *et al*., 2009:2). The repo rate should thereby be increased (or reduced) amidst expected inflationary pressures above (or below) the set and agreed upon target range (Begg et al., 2003:340). This implies raising the repo rate when inflation is high and above the inflation target, and reducing the repo rate when inflation is low and below the inflation target (Williamson, 2016). According to Stiglitz (1999), whenever price growth exceeds a target level, the repo rate should be raised.

In South Africa, the SARB have set the inflation target at a range of 3 - 6 percent, implying that price inflation exists when the average prices rise above 6 percent and price deflation exists when the average price is below 3 percent (SARB, 2016). South Africa's inflation rate was 4.7 percent in January 2018, well below the target range of 3 – 6 percent (Stats SA, 2017). However, the inflation rate changed from 6.6 percent to 4.6 percent during 2017, mostly below the target range as set, compared to a repo rate of 6.75 percent and a prime rate of 10.5 percent during

2017. This situation leaves the South African monetary policy with virtually no room to facilitate economic growth. South Africa's GDP grew by only 1.3 percent in 2017. South Africa is experiencing high inflation, accompanied by high interest rates and low GDP growth. This constitutes a monetary policy dilemma, since South Africa's monetary status quo is contrary to the SARB conventional monetary policy of the ITF, which enunciates that high interest reduces inflation and GDP growth.

The review of empirical literature indicated conflicting results regarding the relationships between inflation, the repo rate and economic growth. This situation indicates a gap in the literature, especially in emerging economies. As such, this study investigates the effectiveness of the current monetary policy approach of the ITF that uses the repo rate as an instrument to manage, control and stabilize inflation, and create an environment where sustainable economic growth can be achieved. In doing so, a substantive analysis with empirical evidence is provided by the study. This analysis includes detail on the cause, effect and relationship between the interest rate, inflation and GDP, with a primary aim to establish if the use of the repo rate is effective in controlling and managing inflation in South Africa.

2. Literature review

2.1 Monetary policy approaches in South Africa post – 1994

According to Kifa (2013:13) South Africa's monetary policy is distinguished by two main monetary regimes. Firstly, pre-targeting that was announced prior to 1994 and uses money supply as its monetary regulatory tool, and secondly, post-inflation targeting that was announced post 1994 and uses short-term interest rates as a monetary regulatory tool. Post 1994, South African monetary policy authorities had to introduce new monetary policies that would serve to address economic growth inhibiting factors at the time, in order to create more conducive economic conditions for growth and employment as well as to fulfill the central bank's mandate (Aron and Muellbauer, 2006). As such, two substantial monetary policies were introduced including a broad-based approach, introduced in 1998 and lasted until 1999, and the ITF, introduced in 2000 and still implemented (Casteleijn, 2001:5). These monetary policy approaches are discussed:

- ***Broad-based approach (1998-1999)***

According to Kifa (2013:16), the objective of the broad-based approach monetary policy was to limit the amount of liquidity in the banking system as efficiently as possible. During this period the South African monetary policy authorities highlighted the broad-based approach's agenda through the amount accessible in the daily sale in order to purchase the transactions again (Casteleijn, 2001:5). However, Shelile (2006:40) stated that the policy drawback was the fact that the contradictory signals were set for inflation and money supply and this caused a significantly biased relationship between output, prices and money supply growth. This weakened the

effectiveness of the money supply targets, and thus made money supply an insignificant tool to be used to predict future trends in macroeconomic variables (Nell, 1999).

- ***Inflation Targeting Framework (ITF) (2000-current)***

Inflation targeting is a framework that comprises a feature of a greater degree of transparency (SARB, 2016). It is all about keeping South Africans updated with the monetary climate of the country. Under this regime the SARB announces the targeted inflation rate and introduces policies to achieve the target (Kamal, 2010). Succinctly, Figure 1 depicts the steps taken when implementing the ITF.

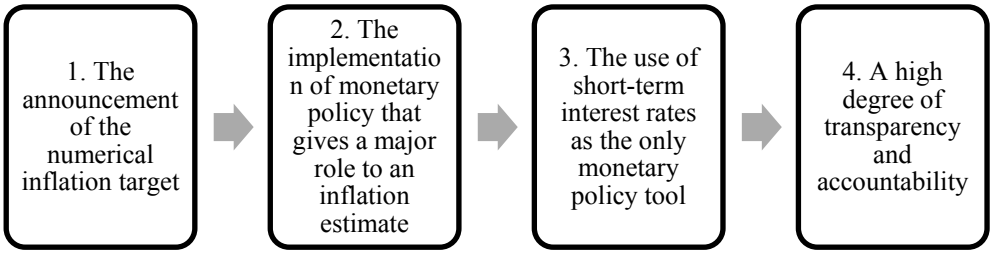

Fig 1: The Inflation Targeting Framework (ITF)
Sources: Author's construction; Svensson (2007)

With regards to the effectiveness of the ITF, previous empirical research has been established by various studies (e.g. Aziakpono and Wilson (2010); Shelile (2006); Kaseeram (2012); Bernard *et al*. (2015); Svennson (1990)). Aziakpono and Wilson (2010:3) provided an assessment of the different periods of monetary policy in South Africa, and revealed that the ITF appeared to be more sufficient in addressing macroeconomic issues and maintaining a steady macroeconomic climate when compared to the previously implemented monetary policy frameworks. In addition, the ITF shares a common target with other economic policies, which is, coordination between monetary policy and other policies (Shelile, 2006:41).

According to Kaseeram (2012:15) the ITF enables monetary policy to focus on domestic considerations and to respond to shocks to the domestic economy. The central bank's commitment to retain inflation within the specified target range, enables monetary policy to balance expectation and predictability (Bernard, *et al*., 2015:20). This prevents people from having high inflation expectation, preventing domestic firms from raising prices and demands for higher compensation by workers (Svennson, 1990:12). The setting of a specific target range, also provides a safety net for the economy, preventing shocks resulting from economic boom and bust cycles (SARB, 2016). However, Pettinger (2011:6) posits that cost-push inflation may cause a temporary blip in inflation. This may result in high inflation compelling the central bank to raise the repo rate. A higher repo

rate will inhibit GDP growth and it is expected to reduce inflation in a normal situation (Schwartz, 2008:16). Although this may be true, alternative empirical evidence on the subject encountered by supporters of ITF is yet to be assessed in the context of various economies (Epstein and Yeldan, 2007). The South African economy is no exception, since the country's inflation is fairly high irrespective of a high repo rate, whilst economic growth is low (Stats SA, 2017). Under these circumstances, the current status quo of the South African economy is a cause for concern, does South Africa's ITF achieve the goals of monetary policy or not.

2.2 Monetary policy approaches in South Africa post – 1994

Monetary policy is said to be effective through the so called "transmission mechanisms". Smal and de Jager (2001:6-9) ascribe that the various monetary transmission mechanisms include the interest rate channel, asset price channels, exchange rate channel, and the credit channel. These channels present mediums by which monetary policy influences aggregate demand, and ultimately, a country's level of inflation (Smal and de Jager (2001:6). The interest rate channel encompasses the change in the monetary policy's official rate which affects loans and other interest rates of building societies, banks and the various financial institutions. Gilt-edges, houses, and shares, are resultingly affected by the latter, which ultimately affects aggregate demand and inflationary levels through underlining transitioning (Muric, 2010). The exchange rate channel, primarily in open economies, are consequent to additional real effects of changes in policy induced short-term interest rates. In the case of a rise in local nominal interest rate at a faster tempo than international counterparts, this leads to a gradual depreciation in the domestic currency at a rate which equates the various debt instruments' risk adjusted returns as required for establishing equilibrium in the foreign exchange market (Ireland, 2005:4). An initial domestic currency appreciation is required by the anticipated future currency depreciation, so that in the scenario where there is a slow adjustment of prices, locally produced goods become more expensive relative to internationally produced goods. Thus, local employment and output fall in the face of a decrease in net exports (Ireland, 2005:4).

As pertains to the credit channel, or the loan market, a monetary policy tightening induces reduced volume of total new loans and an increase in lending rates by commercial banks. This affects aggregate demand, particularly the demand by businesses, mostly small businesses in need of financing (Dovciak, 1999:4). The asset price channel posits that the increase in the short-term nominal interest rates, induced by monetary policy, makes equities less attractive than debt instruments in the investors' eyes. Therefore, a contraction in monetary policy, implies that securities market equilibrium needs to be reestablished, partly through a decrease in prices of equity (Ireland, 2005:4).

Amongst the theories on the maintenance of macroeconomic stability, the classical school of thought propagates market liberalization under perfect competitive markets in which state intervention is minimal (Mohr and Fourie,

2015:35). Under the principle of the "invisible hand", full employment relies on the equilibrium adjustment of market forces inclusive of prices, wages and interest rates (van der Merwe and Mollentze; 2010:154). Henceforth, optimal market activities or transactions only take place when equilibrium market-clearing prices are set and equilibrium interest rates between savings and investment is achieved to ensure demand absorbs supply (Tobin, 1993:53). In the case of interest rate disequilibrium, a mismatch between savings and investments, where interest rates set below equilibrium, leaves firms demanding more funds for investments than savers are willing to provide through savings (van der Merwe and Mollentze, 2010:151).

The classical economic theory asserts that money serves as a determinant of absolute price level or the level of inflation. The quantity theory of money and the Cambridge cash-balance approach insists that an overflow of money stock or money supply instigates an increase in price levels or inflation levels (Ahiakpor, 2009:147; Humphrey, 2004:2). The classical transmission mechanism of the classical theory therefore proposes that under demand-pull inflation, an increase in money supply increases general price levels, implying chasing after the same quantity of output or "too few goods" (Congdon, 2005:131). Changes in equilibrium money supply induces proportional and sustained changes in price levels (Lewis and Mizen, 2000:62). Contrary to this, the Neo-Fisherism theory argues that a lower nominal interest rate target, promotes a decrease in inflation or price level as opposed to the conventional notion of lower interest rates for higher inflation, and vice versa (Williamson, 2016:7).

The "quantity theory of money" under the monetarist approach propagates that increased money supply at a rate greater than economic and income growth may promote increased nominal demand and inflation as a result of the inability to produce additional goods or services (Aubrey, 2015:15). In turn, the monetarist approach identifies inflation as an "ever-present monetary phenomenon" and strongly emphasizes the importance of money under the notion "money matters" (Nelson, 2002:2). Money influences the business cycle's upswings and downswings within the short-run including real economic activity and prices, while causing inflation in the long-run. Rather than applying discretionary measures, the state should thus observe monetary targeting (van der Merwe and Mollentze, 2010:162).

Contrary to the classical and monetarist theory, the Keynesian theory insists that the classical school of thought is only applicable in special economic scenarios of full economic activity (Piedra, 2004:105). The Keynesian theory argues that the moment of cause and effect by market forces inclusive of prices, wages and interest for the adjustment of full-employment and output takes longer than expected as perpetuated by the classical and monetarist theories (Clarke, 1987:398). The period awaiting the proposed classical effect within the long-run implies prolonged economic costs of unemployment and low output levels within the short-run (Davidson, 1998:825). Inflation is thereby cost-push autonomous to pressures of demand until full-employment is reached (Chicheke, 2009:46). As such, Keynes asserts that state intervention by means of fiscal policy through public spending and taxation is actively required in directing economic activity in support of monetary policy.

In efforts to establish the extent to which monetary policy's inflation targeting activities affect the real economy, various studies have investigated the relationship between interest rates or the repo rate and inflation (e.g. Kandel *et al*. (1996);

Asghapur *et al*. (2014); Tobin (1965); Huizinga and Mishkin (1984); Nelson and Schewert (1977); Barsky (1987); Ghazali (2003); Lardic and Mignon (2003); Berument *et al* (1999); Booth and Ciner (2001)). The reason for this is the fact that interest rates play an integral role as a monetary policy tool towards the counterbalancing of inflation (Asghapur, *et al*., 2014). Therefore, a study by Kandel *et al*. (1996) on real interest rates and inflation found a negative correlation between interest rates and inflation. Similarly, Asghapur *et al*. (2014) also found a negative relationship between interest rates and inflation in developing countries.

On the contrary, studies by Tobin (1965), Nelson and Schewert (1977), encountered similar findings that underpins a positive relationship between interest rates and inflation. Equally so, Berument *et al*. (1999) addressed the role of interest rates in the absence of explicit inflation prospects, and discovered that increased inflation uncertainty, induces an increase in nominal interest rates. While, Huizinga and Mishkin (1984) concluded that there is no relationship between interest rate and inflation. However, Huizinga and Mishkin's (1984) findings were disputed by further empirical results produced by Umoru and Oseme (2013), who found an existing long-run negative relationship between interest rates and inflation in Nigeria.

Empirical findings on the relationship between inflation and economic growth present results varying from positive, negative and no relationship. A study established by Mokgola (2015) on the long-run and short-run dynamics using co-integration and error correction techniques revealed that South Africa's inflation targeting regime holds a non-significant negative relationship with the country's economic growth. The study thereby deemed the notion of a relatively low inflation being achieved at the cost of low economic growth as a "misconception". Similarly, Munyeka (2014) established that South Africa's economy has a negative, but significant relationship between economic growth and inflation, findings also suggested that economic growth has a minimal impact on either the decrease or increase in inflation rate. Various authors, Ahmed and Mortaza (2005), Enu *et al*. (2013), Kiliç and Arica (2014), Salian and Gopakumar (2008) also reiterate the significantly negative relationship between the variables under concern in the case of Bangladesh, Ghana, 23 upper-middle income countries and India, respectively.

Contrary to the previous findings, empirical results by Makuria (2014), Mallik and Chowdhury (2001), respectively revealed a positive relationship between inflation and economic growth in Ethiopia, and selected South Asian countries (Bangladesh, India, Pakistan and Sri Lanka). Results by Mallik and Chowdhury (2001) in the case of Bangladesh where further reiterated by Majumder (2016) who also established a significant positive relationship between inflation and economic growth in the long-run as pertains to the period 1975-2013. On the one hand, findings by Anidiobu *et al*. (2018) established a positive but non-significant relationship between the considered variables in the context of the Nigerian economy along the period 1986-2015, based on the Ordinary Least Squares (OLS) method. General findings by Miller *et al*. (2012) on the effects of inflation targeting economic growth amongst developing and developed countries notably suggested that inflation targeting has no effect on developed countries' economic performance, whereas, it exerts a positive effect on developing countries' economic performance. Similar studies by Ball and Sheridan

(2005), Lin and Ye (2007), and Walsh (2009) demonstrate that evidence based on grouped developed countries did not support the notion that inflation targeting affects economic growth and its variability. Nonetheless, a study conducted by Vega and Winkelried (2005) established that inflation targeting affects both developed and developing countries for both grouped and sub-sample estimates, although the effect is greater for developing countries. Gonçalves and Salles (2008) and Lin and Ye (2009) reiterate that the inflation rate and its variability can significantly be lowered for developed countries.

Consequently, Neumann and von Hagen (2002) assesses the performance of interest rates and inflation in inflation targeting and non-inflation targeting countries, the results reveal that inflation targeting is an essential mechanism in curbing and lowering the level and volatility of inflation. Additionally, credibility in inflation targeting by central banks was significantly higher than non-inflation targeting central banks. Similarly, Apergis (2005) asserts that forward looking rules within inflation targeting is attributed to macroeconomic stability and monetary policy credibility. Sound inflation target contributes to less volatility in output. In essence, the results revealed in the aforementioned studies provide a mixed set of findings. Most studies have attributed inflation targeting to an essential mechanism for managing the level and volatility of inflation, as well as promoting macroeconomic stability and monetary policy credibility. While other studies have found insignificant effects of inflation targeting on economic growth, others have found negative effects pertaining to its pro-cyclical and asymmetric effects on aggregate demand.

Contrary to the preceding results, Wray and Forstater (2006) state that ITF is not the best approach to achieve stable prices and economic growth. The reason is that, the ITF is inflexible in nature, it's a solution limited to solving one economic drag (inflation). It has a single focus to meet the central bank's objectives, as it excludes other objectives such as financial stability and growth (Mokgola, 2015:27). Stiglitz (2008) suggested that in trying to contain inflation through the ITF, the "cure would be worse than the disease". On the other hand, findings established by Mwakanemela and Kasidi (2013) showed no long-run relationship between inflation and economic growth in Tanzania, and this was the case for Behera (2014) who revealed that amongst six South Asian economies, only Malaysia exhibited a long-run relationship, countries such as Bangladesh, Bhutan, India, Maldives and Sri Lanka showed no long-run relationship.

According to Mishkin (2000), the ITF is not the solution and may not be effective in most developing countries, but it can be a useful monetary policy approach in a number of these countries. In spite of this, Roger and Stone (2005) argued that the ITF goes hand in hand with improved economic performance. In support, Aron and Muellbauer (2007) applauded the implementation of ITF in South Africa, claiming that it led to stable inflation and improved macroeconomic performance. Similarly, Svensson (2010) argued that the ITF has improved macroeconomic performance among developing economies. Thus, the study attempts to investigate the effectiveness of the ITF in achieving price stability and economic growth in a developing country such as South Africa with high levels of inflation, high interest rates and low GDP growth.

3. Methodology

The research methodology follows a quantitative approach and it adopts a functionalist perspective, as it provides a body of methods and principles for a study concerned with maintaining social stability (Teddlie and Tashakkori, 2009). The study is assessed within the approximations of the Taylor rule and the monetarist approach following the analysis of the concordance among South Africa's inflation levels and the changes in the interest rate. This pertains to the raising and decreasing of interest rates by monetary authorities in line with inflationary changes. Also, the inflation and economic growth nexus is assessed in conjunction with the undersigned principles of the Philips curve.

3.1 Data description

The study uses time series data to examine the relationship between the repo rates, economic growth and inflation in South Africa for the period of 2000 to 2016, using 64 quarterly observations i.e. from the first quarter of 2000 until the fourth quarter of 2016. According to Mohr and Fourie (2008:509), Gross Domestic Product (GDP) is a traditionally used reference point for measuring economic growth levels, thus the study uses real GDP as a measurement of economic growth. The use of interest rates in the study was based on its merits as a primary monetary policy tool, whereas South Africa's consumer price index (CPI), was chosen based on its consideration as a yardstick for gauging the aggregate consumer induced general levels in consumption inflation. It should be noted that the South African monetary authorities first implemented the inflation targeting monetary framework in 2000 (SARB, 2016). For that reason, the study's sample period begins from 2000 in order to capture the optimal performance of the monetary framework since inception. In light of this, the study examines three variables, that is, the repo rate, real GDP and inflation. The data for these variables are all derived from the South African Reserve Bank (SARB) database. With all the series constituting of all positive values, the series are transformed to their natural logarithmic values to ensure that variation is reduced within the data sets. Variables are thus subsequently, identified as LREPO, LGDP and LCPI. In conducting the analysis, the statistical software Econometric package, eviews 9 was used.

3.2 Model description

The study investigates the relationship between the repo rate, economic growth and inflation using the following model:

$$LCPI = f(LGDP, LREPO, e) \quad \ldots\ldots (1)$$

Where: LCPI is the log of inflation rate; LGDP is the log of Gross Domestic Product; LREPO is the log of the Repo rate; and *e* is the error term. Thus, to achieve the objective of the study, a regression analysis is used to provide estimates between

the repo rate, economic growth and inflation. This is because a regression analysis is a statistical technique that serves to determine movements in one variable. According to Mosikari (2013), more often than not, there is always variation that is obtained from sources such as the measurement error, incorrect functional form or a completely random and totally unpredictable occurrences. This study considers the existence of such inherent unexplained variation error by clearly incorporating a stochastic error term in the model.

Due to the nature of time series data, the study will have to test whether or not the data series are stationary or non-stationary (Thayaparan, 2014). This is because time series data more often than not is faced with a problem where the independent variable can appear to be significant than it actually is if it has the same underlying trend as the dependent variable (Achen, 2001). Consequently, this results in a situation where the non-stationary series appear to be correlated even if they are not. For that reason, it is essential for this study to test for stationarity conditions of variables in order to avoid spurious results. The study thus employs the Dickey and Fuller's (1981) Augmented Dickey Fuller for all three variables to test whether variables are stationary at either levels (I(0)) or first difference (I(1)). This will then permit the study to test for co-integration among the variables concerned in the study using the Johansen's (1991) co-integration test.

In conducting the latter test, the optimal lag length of the model is estimated using a Vector Autoregressive (VAR) Model. Subsequent to this, the Johansen's co-integration test is then estimated to assess the long-run relationship between the study variables. It should be noted that the Johansen's co-integration test involves two test statistics, namely; the Max-Eigenvalue and the Trace statistic. According to Yadav *et al*. (2016) the long-run association between variables is determined if the calculated value from both tests is greater than their respective critical values. As such, the Johansen's co-integration test procedure is expressed as follows:

Trace test

λ_{trace} *(r)* = - T ∑ *In* (1-λ_t)……………………………………………………………..(2)

Max-Eigenvalue test

λ_{trace} *(r,r + 1)* = - T ∑ *In* (1-λ_{t+1})……………………………………………………(3)

Where λ_{t+1} are the (k-r) small-scale estimated eigenvalues and for both tests, **λ** denotes the estimated coefficients, while T denotes the number of observations captured. The model above indicates the long-run relationship among the study variables. If the output of the model above indicates the existence of a co-integrating equation or long-run relationship among the study variables, the next step will be to estimate the VECM to capture the short-run dynamics of the study variables and the model below expresses the VECM procedure as follows:

$$\Delta G_t = \beta D_t + \sum_{i=1}^{k-1} \Omega_i \Delta Y_{t-1} + \phi Y_{t-1} + \Omega_{k-1} Y_{t-k+1} + \pi_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Matrix Ω = α.β, where α denotes the matrix that consists of the short-run dynamics and β denotes the matrix consisting of the long-run coefficients or long-run equilibrium relationship. Lastly, the granger causality test is estimated to determine the causality among the study variables and to also confirm whether the change in any series is unidirectional or bidirectional.

4. Empirical findings

Table 1 represents the Augmented Dicky-Fuller unit root test results**.** Results reveal that all variables have p-values above 0.05 significance level, suggesting that the variables are non-stationary at levels (I(0)). For that reason, based on the assumption of no stationarity, the null hypothesis may not be rejected. This may imply the presence of a unit root within the series, with trend and without trend at levels. However, output suggests that at first differences, all variables have p-values below 0.05 significance level making them stationary. On this note, the null hypothesis of no stationarity is rejected at first difference or I(1) for LCPI, LGDP and LREPO. Therefore, the next step involves the use of the Johansen co-integration approach to test for long-run relationships or co-integrating vectors in order to establish whether variable are integrated in the long-run.

Table 1: Augmented Dickey-Fuller Unity Root Test

Variables	**Level**				**First Difference**		**Order Of integration**
	Intercept without trend		**With trend**		**Without trend**		
	t-stat	**P-value**	**t-stat**	**P-value**	**t-stat**	**P-value**	
LCPI	-2.0557	0.2630	-2.2719	0.4420	-3.2623	0.0215**	I(1)
LGDP	-1.8151	0.3698	-1.8157	0.6845	-5.0795	0.0001**	I(1)
LREPO	-2.4263	0.1391	-2.3690	0.3914	-4.2342	0.0013**	I(1)

*Note: [ ] * denotes P-value at 1% level of significance and ** at 5% significance.*

A lag order selection criterion was conducted to establish and obtain the optimal lag length for Johansen co-integration examination and the VECM. Having underscored that the variables are all integrated at first differences or I(1) order of integration, the study used four selection criterions, namely; HQ, AIC, FPE, and LR. Therefore, four (4) lags where suggested as the optimal lag length. For that reason, 6 lags are used in Johansen co-integration test as well as VECM, with intercept and no trend. Having established that variables are integrated at first differences and the selection of four lags as the optimal lag length, it is necessary to establish whether there exists a non-spurious and stable relationship with at least a single linear

combination between the regressors. Therefore, the Johansen co-integration test was conducted based on Trace statistic and Max-Eigenvalue statistics as reported in Table 2. Results indicate two co-integrating equations (r≤1) in trace statistic results at 0.05 and 0.1 significance levels. Additionally, Max-Eigenvalue revealed one co-integrating equation at 0.05 level of significance. Therefore, the null hypothesis of no co-integrating equation (r=0) is rejected for both Trace and Max-Eigenvalue tests. Henceforth, variables are co-integrated, simply implying that there exists a long-run relationship within the series.

Table 2: Johansen co-integration test results

H0: No. of CE(s)	Trace Test			Maximum Eigenvalue		
	Trace Statistic	T-critical value	P-values*	Max-Eigen Statistic	T-critical value	P-values*
None*	45.0186	29.7970	0.0004*	28.6566	21.1316	0.0036*
At most 1*	16.3619	15.4947	0.0369*	13.0390	14.2646	0.0774
At most 2	3.3229	3.8414	0.0683	3.3229	3.84146	0.0683

*Note: * denotes rejection of the hypothesis at the 0.05 level*

The presence of co-integrating relationships between the variables LCPI, LGDP and LREPO insists that the long-run equilibrium in INFLA can be explained by LGDP and LREPO. Results in Johansen co-integration test sufficed the requirements of at least one single linear combination between the variables, indicative of a long-run relationship between the variables, the aforementioned is thus expressed in Equation (5) below:

$$LCPI = 0.574030 + 0.235003(LGDP) - 0.324521(LREPO)\ldots\ldots\ldots\ldots\ldots \quad (5)$$

Equation (5) reveals that the long-run exhibits a positive relationship between inflation and Gross Domestic Product (GDP). This simply implies that any increase in South Africa's GDP leads to an increase in inflation. Accordingly, a one percent increase in GDP leads to a 0.23 percent increase in inflation. Notwithstanding, a significant negative relationship between inflation and the repo rate is identified in Equation (5). The latter suggests that a one percent increase in the repo rate induces a decrease in inflation by 0.33 percent. Provided that there exists a long-run relationship between the variables, the VECM is used to assess short-run disequilibrium adjustments towards reaching the long-run equilibrium or co-integration between the variables as indicated in equation (5) (Noumbissie and Mongale, 2014). Additionally, the error correction term (ECT) is further used to convey the speed of short-run dynamic adjustments towards long-run equilibrium (Magee, 2013). Therefore, it follows that conditions for explaining short-run adjustments towards reaching equilibrium in the long-run requires a significant t-value and a negative adjustment coefficient or ECT (Mukhtar and Rasheed, 2010). Results of the ECT are presented in Table 3 below. Accordingly, keeping in mind

that the ECT of the VECM needs to be negative and significant, the ECT of inflation and GDP as represented in Table 3 are the only equations which meet the adjustment requirements towards long-run equilibrium with negative coefficients; -0.214031 and -0.612538, and t-values of; -3.64557 and -2.55878, respectively. Further suggesting that the series LCPI and LGDP present evidence of error correction in the first co-integrating equation.

Table 3: Vector Error Correction Model

Error Correction:	D(LCPI)	D(LGDP)	D(LREPO)
CointEq1	-0.214031	-0.612538	-0.020495
	[-3.64557]*	[-2.55878]*	[-1.47163]
D(LCPI(-1))	-0.977292	-2.423391	-0.036923
	[-4.53647]*	[-2.75884]*	[-0.72253]
D(LCPI(-2))	-0.364500	-0.324970	-0.019667
	[-1.67464]	[-0.36616]	[-0.38091]
D(LCPI(-3))	0.040308	1.551270	0.107285
	[0.20587]	[1.94313]*	[2.30996]
D(LCPI(-4))	-0.345310	-0.280942	0.098121
	[-1.72157]*	[-0.34351]	[2.06225]
D(LGDP(-1))	0.249080	0.796165	0.020054
	[4.78898]*	[3.75420]*	[1.62544]
D(LGDP(-2))	0.126074	0.342351	0.017757
	[2.40712]*	[1.60308]	[1.42923]
D(LGDP(-3))	0.039985	-0.307456	-0.021417
	[0.85774]	[-1.61752]	[-1.93673]
D(LGDP(-4))	0.124794	0.021746	-0.030867
	[2.35569]*	[0.10067]	[-2.45631]
D(LREPO (-1))	-0.265279	1.856702	0.166077
	[-0.42132]	[0.72321]	[1.11194]
D(LREPO (-2))	-2.069248	-5.742123	0.093762
	[-3.14292]*	[-2.13896]*	[0.60035]
D(LREPO (-3))	1.368309	7.057335	0.036650
	[2.03331]*	[2.57200]*	[0.22959]
D(LREPOR (-4))	-0.656083	-1.287810	0.252356
	[-1.06910]	[-0.51466]	[1.73353]

In order to test the robustness of results, underscored in the study are diagnostic tests as indicated in Table 4. Results showed that the model successfully passed the test for heteroscedasticity and serial correlation. Therefore, the null hypothesis of the presence of heteroscedasticity and serial correlation are rejected. Diagnostic test results however revealed that the model failed the Jacque-Bera test or test for normality at 0.01 level of significance. Nevertheless, Kunda (2011:15) reassures that normality testing is highly sensitive to large data samples and it is therefore highly expectant to obtain a failed normality test for such data samples.

Large samples may also possess an "α-stable" distribution leading to inconsistent regression patterns over the period (Frain, 2007:3-15; Ruxanda and Botezatu, 2008:59). Henceforth, Hain (2010:93) highlights that stability testing using the AR root may be conducted to further assess the stability of the model as indicated in Figure 2. Figure 2 reveals that all AR roots are contained within the unit circle, meaning that the model is stable and robust.

Table 4: Diagnostic test results

Test	*H0*	*Probability*	*Decision*
LM Test	No serial correlation	0.2776	With a P-value above 5%, do not reject the H0. Therefore, there is no serial correlation in the model.
White (CT)	No heteroscedasticity	0.5388	With a P-value above 5%, do not reject the H0. Therefore, there is no heteroscedasticity in the model.
Jarque-Bera	Residuals are normally distributed	0.0000	With a P-value less than 5%, reject H0. Therefore, the results show that the data is not normally distributed.

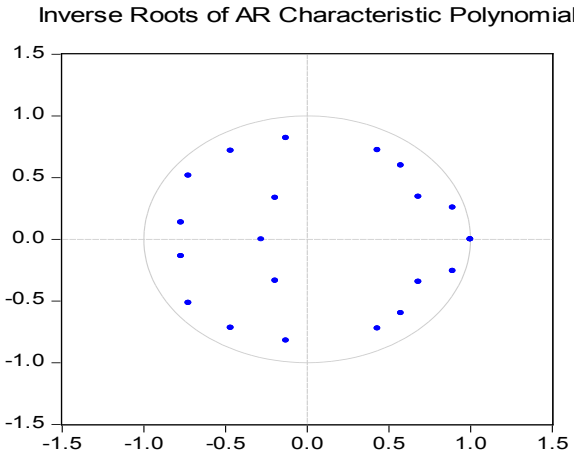

Fig. 2: AR Root test

Granger causality test results are indicated in Table 5. The results suggest a bi-directional causal relationship from LCPI to LGDP, and *vice versa.* This implies that short-run changes in South Africa's inflation cause changes in economic growth, accordingly, short-run changes in economic growth lead to changes in inflation. Results further indicate a uni-directional or one-way causality from LREPO to LCPI, short-run changes in the repo rate cause changes in the inflation. Lastly, causality test results suggest bidirectional causality from LREPO to LGDP, and LGDP to LREPO. Short run changes in the repo rate cause changes in economic growth, likewise, changes in economic growth lead to changes in the repo rate.

Table 5: Pairwise Granger Causality

Null Hypothesis	F-statistic	P-value
LGDP does not Granger Cause LCPI	17.14033	**0.0088***
LCPI does not Granger Cause LGDP	30.90182	**0.0000***
LREPO does not Granger Cause LCPI	11.7901	**0.0668***
LCPI does not Granger Cause LREPO	10.41506	0.1082
LREPO does not Granger Cause LGDP	16.05662	**0.0135***
LGDP does not Granger Cause LREPO	27.52716	**0.0001***

*Note: * indicates the rejection of the null hypothesis of no Granger causality at 5% significance.*

Variance decomposition results indicated in Table 6 further reveal that South Africa's inflation is predominantly affected by its own shocks, whereas shocks in GDP and the repo rate do not substantively affect the country's level of inflation. Although the shock effects of inflation on itself tend to be decreasing, the effect remains substantially high relative to GDP and the repo rate from the first quarter to the tenth quarter. In the first and second quarters, respectively 100 percent and 96 percent of movements in inflation are explained by its own shocks. Whereas, GDP and the repo rate only explain approximately 4.17 percent and 0 percent, respectively during the second quarter. During the tenth quarter, movements in inflation are still predominantly explained by its own shocks with 80 percent of the movements in inflation are explained by inflation shocks. Furthermore, GDP is shown to explain a relatively substantial change in inflation compared to the repo rate along the period. In essence, the repo rate and GDP have shown to have a relatively low percentage in explaining movements in inflation.

Table 6: Variance decomposition results of LCPI

Period	S.E.	LCPI	LGDP	LREPO
1	0.248482	100.0000	0.000000	0.000000
2	0.286115	95.82721	4.172364	0.000422
3	0.319622	92.07608	3.614647	4.309278
4	0.376575	94.22918	2.653779	3.117038
5	0.404673	91.19261	2.621772	6.185619
6	0.452935	87.60693	5.777390	6.615684
7	0.541857	85.47906	9.122114	5.398822
8	0.626159	82.27387	13.31242	4.413711
9	0.710945	79.94590	15.59956	4.454537
10	0.800554	79.48030	16.67378	3.845917

5. Discussion of results

Amongst the most crucial objectives of macroeconomic policy is the attainment of high output and low inflation in correspondence with the inflation-growth trade-off assumed within the precepts of the Philips Curve, as pertains to the short-term (Gokal and Hanif, 2004:8). The identified positive relationship between inflation and economic growth as projected in this study's short-run estimations, show that, at the first lag where growth serves as the dependent variable, past changes in South Africa's inflation significantly pose negative effects on its economic growth trajectories. The short-run results are further reinforced by the short-run Granger-causality results which revealed a bi-directional inflation-growth causal relationship. Moreover, the negative or trade-off relationship is further counteracted by the study's long-run findings of a positive inflation-growth relationship. The preceding findings stipulate that economic growth acts as stimuli for inflation rises in the long-run, any attempt at stimulating South Africa's economic growth would induce an increase in inflationary levels.

These results fulfil the positive growth-inflation relationship governing the precepts of the structuralists, who accentuate that inflation is essential for growth (Bain and Howells, 2009). Moreover, these findings resonate with results established by Mallik and Chowdhury (2001), Majumder (2016) and Makuria (2014), in the context of Ethiopia, and selected South Asian countries. The stipulated positive relationship between inflation and economic growth contradicts the findings of a negative relationship revealed by Mokgola (2015) and Munyeka (2014) in the South African case, with findings of the former being non-significant. The study's findings are also contrary to the findings by Ahmed and Mortaza (2005), Enu *et al*. (2013), Kiliç and Arica (2014), Salian and Gopakumar (2008) in the context of Bangladesh, Ghana, 23 upper-middle income countries and India, respectively. According to Gokal and Hanif (2004:8), despite the short-run trade-off, no permanent trade-off occurs between inflation and output as for inflation to be kept steady at any level, the level of output needs to equal the natural rate (Y*) thus for inflation to decline output must be below the natural rate. Khan (2014:106) also accentuates that variations in the growth-inflation relationship relies significantly on country specific factors or characteristics which range from the level of income, institutional and macroeconomic developments. Khan (2014:106-107) further makes an important assertion that dissimilar growth-inflation nexus amongst various countries are consequent to economies made up of heterogeneous financial development, trade openness or capital accumulation.

Moreover, the current study revealed that South Africa's long-run consists of a significantly negative relationship between the level of inflation and the SARB's repurchase rate or repo rate. In practice, efforts by the SARB to increase (decrease) the repo rate induces a decrease (increase) in South Africa's level of inflation. Such a notion according to these findings mirrors the core function of the inflation targeting framework undersigned within expansionary and contractionary policies. These results are consistent with the findings of a negative repo rate-inflation correlation by Kandel *et al*. (1996). The findings are also consistent with the study by Umoru and

Oseme (2013) as it pertains to the case of Nigeria, and subsequent results underpinned by Asghapur *et al*. (2014) in the context of selected developing countries. Also, no short-run adjustments or relationship between South Africa's repo rate and its level of inflation was revealed in the study. However, further confirmatory results based on the Granger causality test revealed that in the short-run, no causality exists at both 0.01 and 0.05 significance level, existing uni-directional causality only occurs from the repo rate to inflation at 0.1 significance level. This suggests that attempts by the SARB, through effective repo rate usage, negligibly impact changes in South Africa's level of inflation in the short-run. Such an assumption is also reinforced by variance decomposition results which show that changes in inflation are mostly explained by shocks in inflation itself with minimal explanatory effect from both economic growth and the repo rate, especially the repo rate. Nevertheless, the effect of the repo rate is revealed to be relatively higher in the long-run than economic growth, although both at low levels.

6. Conclusion

Maintaining price stability is the main concern of central banks worldwide. In a developing country such as South Africa, a policy dilemma has emerged with high inflation levels accompanied by subsequently low GDP growth rates. Within this scenario, monetary policy still seeks to reaffirm its position in the financial and economic markets through policy adjustments by its utilisation of the repo rate as its primary tool. To further understand the mechanisms behind the dilemma involving the interplay between South Africa's repo rate, inflation rate and GDP, the objective of this study was to establish the effectiveness of the use of the repo rate in controlling and managing inflation. The study thus analysed the short-run and long-run relationships between the aforementioned macro-economic variables. Findings showed that the long-run relationship holds between the repo rate, inflation rate and GDP. The suggested positive long-run relationship between inflation and GDP upholds the undertakings of the classical economic theory. The revelation of a negative relationship between inflation and the repo rate also assures the active application of the quantity theory of money.

Future potential research may include an extension of this model to include other variables such as income levels, institutional quality, trade openness and capital accumulation. Also research could be conducted in assessing other significant policy tools which may be utilized by the SARB in influencing supply specific inflationary pressures led by the cost-push phenomena. In addition, the inflation targets of the reserve bank may be investigated. From the literature review it was found that emerging economies may require higher inflation target if compared to established economies. The research attempted to fill a gap in the research on emerging economics to determine the debatable relationships between inflation, economic growth and the repo rate. South Africa is seen as a proxy for emerging countries and finding of this study could be applied to other emerging economies. The main implications from the research is that, although a long-run relationship

exists amongst the variables, the impact of for example a change in the repo rate on inflation is relatively low. On the short run changes in the repo rate did not even had an effect on the inflation or economic growth rate.

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