Foreign Direct Investment and Economic Growth in South Africa: A Sector Level Causality Analysis

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by

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ABSTRACT

Many empirical studies hypothesise that foreign direct investment (FDI) has a positive impact on economic growth. As a result, FDI has been targeted by many countries in their attempts to increase their standards of economic growth. South Africa (like many developing economies) is not a stranger to this phenomenon. However, there is a dearth of literature analysing the relationship between FDI and economic growth at a sector level in South Africa.

This thesis analyses the causal relationship between FDI and economic growth in South Africa at a sector level comprising primary, secondary and tertiary industries. This study applied a more robust and asymptotically reliable Toda-Yamamoto-Dolado-Lutkephol (1995) methodology in analysing the causal relationship thus addressing the potential biases and asymptotic unreliability relating the traditional Granger causality technique.

The report shows that FDI Granger-causes growth in primary, secondary, tertiary sectors and at an aggregate level. In addition, growth was found to Granger-cause FDI at tertiary and aggregate level. On the other hand growth does not Granger-cause FDI at primary and secondary sector level. The only bi-directional relationship that could be observed was at the tertiary and aggregate sector level, whereas at primary and secondary sector level, the relationship was found to be unidirectional.

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GLOSSARY OF TERMS

ADF	Augmented Dickey/Fuller
DW	Durbin/Watson
Eq	Equation
FDI	Foreign Direct Investment
FDI_PRIM	FDI in Primary Sector
FDI_SECO	FDI in Secondary Sector
FDI_TERT	FDI in Tertiary Sector
FDI_TOTA	FDI in Total
GDP	Gross Domestic Product
GNP	Gross National Product
GVA	Gross Value Added
GVA_PRIM	GVA in Primary Sector
GVA_SECO	GVA in Secondary Sector
GVA_TERT	GVA in Tertiary Sector
GVA_TOTA	GVA in Total
OECD	Organisation for Economic Cooperation and Development
RSA	Republic of South Africa
SSA	Sub Saharan Africa
USD	United States Dollar
VAR	Vector Autoregressive

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1 INTRODUCTION

1.1 Research Area

The relationship between foreign direct investment (FDI) and economic growth expressed as gross value added (GVA), has been widely researched in recent decades. FDI has been found to have a positive direct impact on economic growth by Brems (1970), Ng (2006) as well as Vu et.al (2008) based upon the capital formation theory (i.e. increases in financial and human capital contribute positively towards economic growth). It also relates (to growth) indirectly in the form of positive externalities such as skills and technology transfers as well as productivity amplifiers (Findlay, 1978; Borensztein et.al, 1998).

However, research has shown that there are possible preconditions for a country to attract FDI, which include market size (Morisset 2001, Asiedu, 2006), natural resource endowments (Morisset 2001, Asiedu, 2006), state of infrastructure development (Morisset 2001, Asiedu, 2006), education levels (Borensztein et.al, 1998 and De Mello, 1999), efficiency of institutions (Fedderke and Romm, 2005, Asiedu, 2006) and the state of regulatory development (Bende-Nabende, 2002, Hertzer et al., 2008). In addition, the host country needs to pursue trade and investment policy initiatives (Mwilima, 2003) such as incentives, exchange controls, etc. which are more likely to attract FDI (Rusike, 2008, Hertzer et al., 2008).

Although the relationship between FDI and growth has been and continues to be the subject of much research and debate, this has traditionally remained at a macro level. It is however, evident from the data that the distribution of FDI inflows is not even across sectors. Equally true is the fact that the contribution of various sectors to the economy is not uniform (Vu et.al 2008). Therefore, FDI and growth need to be disaggregated into sector components and analysed heterogeneously.

1.2 Problem Statement

Although South Africa has historically not received as much FDI as other typical emerging countries (Ahmed *et al*., 2005), the country has been one of the primary recipients of FDI in Sub Saharan Africa (SSA) (Anyanwu, 2012). Much of the FDI has been attracted to South Africa by the country's relatively stable democratic government (Sachs and Sievers, 1998); thriving mineral industry (UNCTAD, 2003 and Bjorvatn *et al*., 2002), as well as developed infrastructure (Bjorvatn et al., 2002, OECD, 2001), markets and economy (Bjorvatn *et al*., 2002). Although there is a body of studies that explore the linkages between FDI and growth in South Africa and Sub Saharan Africa (SSA), no study to date specifically focuses on the link between FDI and growth at a sector level. At times the global view does not fairly represent the granular reality as the results may be skewed by dominant segments (Wang, 2002).This study attempts to provide new perspective by examining the causal relationships between sub-components in the primary, secondary, and tertiary economic sectors, that are aggregated to constitute total trade and industry growth.

1.3 Purpose and Significance of the Research

1.3.1 Theoretical perspective

In perfectly competitive environments, FDI has historically been regarded as a production factor moving from the capital-rich countries (with low return on capital) to the capital-poor countries (with high return on capital potential) (Latorre, 2009). The increased capital formation results in increased marginal productivity and hence economic growth (Brems, 1970). However, research suggests that a significant portion of FDI flows to developed countries (Latorre, 2009). The portfolio theory suggests that risks could be diversified by investing in various countries, whilst a higher return is realised (Agarwal, 1980). On the other hand, the product life cycle theory suggests that FDI could be utilised to extend the product life cycle, such that as the product matures locally, the producers actively seek efficiencies by establishing foreign subsidiaries, resulting in access to cheaper labour and or greater markets (Vernon, 1966). Multi-national companies are characterised by (inter alia) advanced technical knowhow, skilled labour and strong research and development capabilities, from which host economies could benefit (Latorre, 2009). In addition,

Dunning's (1993) suggests that a foreign investor should possess ownership (O), location (L) and internalization (I) advantages in order to compete effectively with the domestic firms. OLI advantages refer to foreign investor's privilege in respect of other revenue producing assets and technological know-how; location advantage in relation to the proximity to cheap human and raw material resources and internationalisation to support the exploitation of the imperfect market opportunities.

The existing body of literature suggests that there is a positive relationship between FDI and growth in South Africa at an aggregated level. The question that remains is whether the same relationship exists at a sector level, as Alfaro (2003) identified, FDI flows into the different sectors of the economy (i.e. primary, manufacturing, and services) have varying effects on economic growth. Furthermore, Vu and Noy (2008) posit that FDI has a significant and positive effect on economic growth both directly or through its interaction with labour. However, the effect is not proportionately spread across countries and sectors (Vu et. al, 2008). In addition, Yalta (2011) hypothesises that FDI does not necessarily lead to higher economic growth at the aggregate level and suggests the need for undertaking a disaggregated analysis using industrial and provincial level data for the formulation of effective macroeconomic policies concerning the flows of FDI.

The study detailed herein, sort to extend existing empirical literature by examining the causal relationship between FDI and growth at a sector level with a specific focus on South Africa. Furthermore, there was a quest to validate and or contradict existing theoretical conclusions that were established based on analysis of related aggregated data. An additional tier of insight was explored by investigating the direction of any sector level causal relationship.

Moreover, updated econometric models were applied to enhance established findings of the causal relationship between FDI and economic growth in South Africa. The Toda and Yamamoto (1995) and Dolado and Lutkepohl (1996) non-causality method (TYDL) methods were applied to examine the causal relationships between FDI and economic growth at a sector level in South Africa.

1.3.2 Policy perspective

Although significant strides have been made by South African policy-makers in developing policies conducive to the attraction of FDI, such inflows into South Africa have remained relatively low compared to other emerging economies (Asiedu, 2002, Mosia 2012). Review reports suggest that these policy reforms have somehow been ineffective. Most studies have addressed policy issues such as exchange control restrictions; restrictions on local borrowing by foreign owned entities; black economic empowerment and labour unionisation at a macro level. However, this approach has largely been insufficient to reveal the sector-based nuances, resulting in the design of ineffective policies.

This study disaggregates the relationship between FDI and GVA into a sector based profile which could contribute towards a better understanding and identification of the industries which are more likely to drive economic growth. Hence, the findings could assist policy-makers in channelling the scarce resources in the form of government incentives for FDI into the appropriate industries.

1.4 Research Questions and Scope

This research seeks to answer the following three questions:

i. Does FDI lead to economic growth in South Africa?

ii. Is the causality industry dependent (i.e. primary, secondary, tertiary)?

iii. Is the causality unidirectional or bi-directional?

Whilst this study refers to economic growth, the study of the determinants of economic growth is outside the scope of this study. In addition, although this report refers to the various sectors of the South African economy, the detailed review of the structure of the economy of South Africa is also outside the scope of this report. Furthermore, this study does not seek to review the history of FDI in South Africa.

1.5 Research Assumptions

The following assumptions were made to establish a baseline to guide the investigations:

1. There is a relationship between FDI and growth in South Africa - It was assumed that there is at least some relationship between FDI and economic growth (whether negative or positive) in South Africa.

2. This relationship can be fragmented into various sectors being primary, secondary and tertiary - An assumption was made that this relationship is not only at an aggregate level, but also at a sector level.

3. This relationship is causal - Guided by literature, a view that causality could be established using econometric models was adopted.

4. GVA is a measure of growth - GVA was embraced as an appropriate measure of economic growth, despite the fact that most studies use GDP as a measure of growth.

5. Directions of the causal relationships can be determined - A position was taken that econometric models could be used to establish whether the direction is unidirectional or bidirectional

6. The missing data in the time series can be determined using the log linear interpolation method - A progressive stance was taken that the missing data for the years 1987, 1988, 1990, 1991 could be accurately determined using interpolation method

1.6 Layout of the Study

The ensuing sections of the study start in Chapter two by expanding the diversity of the topic and detailing subject matter expert perspective as presented in supporting literature. Chapter three then outlines the methodology applied in collating the data and explains the rationale for the approach taken. Chapter four details how the data was analysed and then layouts the results attained. Summary conclusions were drawn consolidating the investigation and are outlined in Chapter five. At various points during the process of the study, areas of possible future research to further augment the topic presented themselves and were recorded in chapter six as the concluding chapter of the report.

2 LITERATURE REVIEW

2.1 Introduction

This literature review consists of 10 parts that were sequenced to progressively examine the subject matter and present the following:

(i) A brief definition of FDI.

(ii) Details of the drivers of economic growth.

(iii) Give an explanatory description of the relevant aspects of the structure of the South Africa economy.

(iv) Address lessons from studies which advocate for FDI to supplement domestic financial resources, and the reasons why it is important in the South African context.

(v) Discuss studies that found a positive relationship between FDI and economic growth.

(vi) Examine the pre-requisites for FDI to cause growth.

(vii) Explore the sector level impact of FDI on economic growth.

(viii) Outline studies that found a negative relationship between FDI and economic growth

(ix) Investigate the relationship between FDI and economic growth in the South African context.

(x) Explain the issue of a direction of causal relationship.

2.2 Definition of FDI

According UNCTAD (2013), FDI was defined as follows: “an investment made to acquire lasting interest in enterprises operating outside of the economy of the investor. Further, in cases of FDI, the investor´s purpose was to gain an effective voice in the management of the enterprise. The most important characteristic of FDI, which distinguishes it from foreign portfolio investment, is that it is undertaken with the intention of exercising control over an enterprise”. According to Nunnenkamp (2002), there are essentially three different types of FDI, resource-seeking, market-seeking and efficiency-seeking. The resource seeking FDI is attracted by the availability of cheap natural and human capital resources in the host country (Nunnenkamp, 2002). Although, this type of FDI remains relevant, there has been a marked decrease in this type of FDI (UNCTAD, 1998). The market seeking FDI is characterised by need for foreign entities to grow and gain access to a sizable market share beyond borders (Nunnenkamp, 2002). Although restrictions were observed in the manufacturing sector, the liberation of the services sector has significantly fuelled this type of FDI (Nunnenkamp, 2002). Finally, efficiency seeking FDI was motivated by the need to become more efficient and accordingly search for new sources of efficiency such as competitive cost of doing business, availability of skilled human capital, quality of infrastructure and the ease of doing business (Nunnenkamp, 2002).

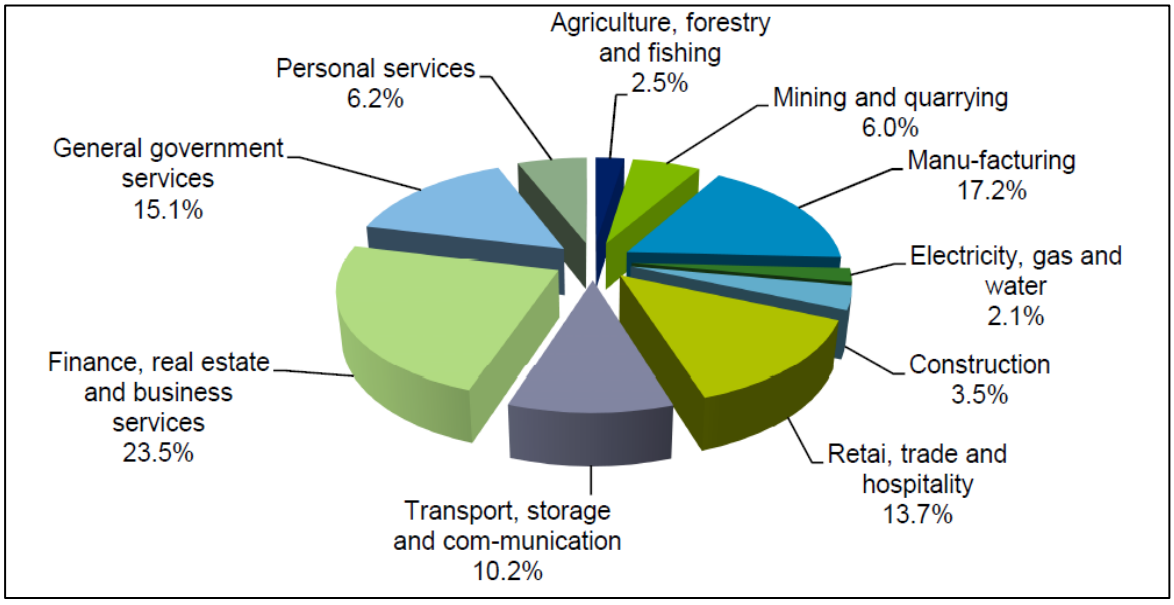
2.3 Drivers of Economic Growth

A myriad of drivers of economic growth including inter alia physical capital formation, skilled human capital formation, investment in research and development, sound macro-economic policies, financial development, international trade openness, political stability have been identified (Bassanini and Scarpetta, 2001).

2.4 The Structure of the South African Economy

According to a Deloitte (2012) report, the services-related sector accounted for at least 67% of GDP in 2010, followed by manufacturing which contributed 17.2% and then the primary sector contributing the balance (15.8%). Although the manufacturing sector has been known to possess considerable backward and forward linkages with other sectors and to provide opportunities for technological transfers, job creation and up-skilling in other economies (Kaplan, 2007); it is interesting to note that it is not a dominant sector in South Africa. Kaplan (2007) highlighted a number of studies[1] which suggested that the South African manufacturing industry has been stagnant and has performed poorly relative to other developing economies. Kaplan (2007) further indicated that export growth has also been relatively slower and has been characterised by the export of primary products and less sophisticated manufactured products.

Figure 1 – Contribution of various sectors to gross domestic product in South Africa



(Deloitte, 2012)

[1]; Alves, P. and Kaplan. D. 2004. "SA's declining export shares: The developing country challenge". Trade and Industry Monitor.;

2.5 FDI as a Supplemental Financial Resource

According to the two-gap model of Chenery and Strout (1966), developing countries were said to be likely to encounter a foreign exchange constraint and / or a savings constrain in a bid to achieve the high investment levels necessary for generating and sustaining economic growth (GDP). Therefore, when one or both of these constraints existed, a void was created which required other sources of funding to fill it. Thus, Reisen and Soto (2001) argued that emerging economies should not place sole reliance on their domestic savings, but should encourage FDI and foreign portfolio equity inflows in order to fuel long-term economic growth prospects, as both have been found to exert significant impact on economic growth.

South Africa as a developing economy has had high domestic investment requirements across all sectors in order to establish and maintain a high development trajectory, resulting in job creation and economic growth in general (National Treasury, 2011). This has consequently required significant financial resources which the country could not afford to raise domestically (National Treasury, 2011). South Africa's private sector has (except for the short periods in the 1960s and the early 1980s) historically produced insufficient savings to meet its requirement for capital formation, implying that South Africa has remained reliant on foreign capital to augment its physical capital formation (Fedderke and Romm, 2005).

2.6 Positive Relationship between FDI and Growth

The theory underpinning the relationship between FDI and growth is premised upon the classical work of (inter alia) Brems (1970) who argued that FDI financed capital formation leading to growth in the host economy and Findlay (1978), found that FDI through amplifier benefits in the form of advanced technology, processes, management practices etc. also accelerated technical progression of the host country. In recent decades studies by (inter alia) Borensztein, De Gregorio and Lee (1998), who, based on a 20 year data frame on FDI flows from industrial countries to 69 developing economies, hypothesized that FDI was an important vehicle for the transfer of technology and also concluded that it contributed more to growth relative to domestic investment. At the same time, De Mello (1999), using a panel data analysis, found that FDI had a positive impact on growth in both technologically advanced countries and the less advanced countries.

Blomström et al. (1994) used cross-country data from a sample of 78 developing countries, over three and half decades (1960-1985) to postulate that developing countries with high income enjoyed extensive economic growth associated with FDI, implying that for a country to reap the benefits of technological transfers from FDI, it had to have a certain minimum level of development. Moreover, Balasubramanyam et al. (1996), using the same methodology as Blomström et al. (1994), over a slightly shorter period of two and half decades (1970-1985) and from a relatively smaller sample of 46 developing countries hypothesised that FDI had a relatively more significant effect on economic growth than domestic investment, thus vindicating the hypothesis that FDI acts as a channel to transfer international know-how to the local economy.

De Mello (1999) echoed Borensztein's et. al. (1998) sentiments by suggesting that in tandem, FDI and domestic investment substantively complemented each other. De Mello (1999) further argued that the quality of FDI was more important than the quantity thereof. For instance, FDI in the form of mergers and acquisitions does not actually increase the capital stock in capital-scarce economies, but rather transfers the ownership of an existing capital base, therefore if the proceeds of the transaction are not spent on capital goods, such FDI does not contribute to capital formation and growth (Agosin and Mayer, 2000).

More recent studies (Wang, 2002; Managi et. al., 2010) postulated that the introduction of new technology in the domestic industry had potential to cause positive externalities which could be enjoyed by the industry. For example, subcontractors or suppliers to the entity were required to adhere to certain quality standards, processes and manner of production. In addition, FDI was found to contribute to economic development of the host country through the augmentation of domestic capital; enhancement of efficiency through the transfer of new technology, marketing and managerial skills as well as bolstering of innovation and best practices (Adewumi, 2006). This was also supported by Bende-Nabende et. al (2003), who found that new technology was the most consistent and positively significant influencing factor on output.

Although the cross-country regression method utilised suggested that FDI has a positive effect on growth, the robustness of this methodology has been the subject of much debate (Hertzer et.al 2008). The main discussion points relate to the drawbacks associated with homogeneity assumptions across different countries such as homogeneous economic structures, policies, technologies and institutions amongst others, whilst the reality was the opposite (Hertzer et.al 2008). This has rendered the results from the model less robust (Ericsson et al., 2001). Furthermore, harmonisation of the variables has tended to result in the omission of certain country-specific variables thus increasing the bias in the estimates (Carkovic and Levine, 2003).

Zhang (2001) studied the Granger-causality between FDI and growth for a sample of 11 emerging economies in Latin America and East Asia over a period of 25 years (1970-1995) and found that there is Granger-causality between FDI and GDP in 5 out of 11 countries and that this was unidirectional from FDI to GDP. Similarly, Cuadros et al. (2004) performed a study for a sample of 3 Latin American economies over a 20 year period (1980 – 2000), and found a unidirectional Granger-causality from FDI to GDP in 2 out of 3 countries. On the other hand, Xiaohui et al. (2002) examined co-integration and Granger causality between FDI and economic growth in China for a period from 1981 to 1997 and found bi-directional causality between economic growth and FDI. Soto (2000) used a dynamic panel and found that FDI and portfolio equity flows revealed a positive correlation with economic growth. Furthermore, Alfaro et al. (2003) investigated the relationship that characterised FDI, financial markets and economic growth using cross-country data from a sample of 71 emerging and developed countries over a period of 4 years (1975-1979), found that the contribution of FDI to economic growth, was subject to the level of local financial market development.

2.7 Prerequisites for FDI to Contribute to Growth

It was evident from the literature that for FDI to have a positive effect on economic growth, certain prerequisites had to be met. These included inter alia human capital absorption capacity; local financial market development; openness of economy and investment in research and development. Borensztein et al. (1998) posit that the effect of FDI on growth depended on the host country having a certain minimum level of human capital absorption capacity. This was supported by Zhang (2002) who found that inflow of FDI had a positive and significant effect on the economic growth of the regions where human capital had been significantly developed. Those regions with poor and insignificant human capital lacked the absorption ability of new knowledge and technology, which resulted in low technology diffusion and transfer.

In addition, Alfaro et al. (2003) found that the level of local financial market development was also required, this was also confirmed by Bailliu (2000) who found that financial sector development was important in ensuring that FDI promoted economic growth. Moreover, Blomström et al. (1994) found that the host country had to have a certain minimum level of development in order to realise the benefits of FDI.

Balasubramanyam et al. (1996) found that more open economies were likely to both attract a higher volume of FDI and promote more efficient utilisation thereof than closed economies. In addition, Busse and Groizard (2008) found that FDI did not stimulate growth in economies with excessive business and labour regulations and further suggested that governments should improve the regulatory qualities to enable their economies to benefit from increased openness to foreign capital.

On the other hand, van Pottelsberghe de la Potterie and Lichtenberg (2001) postulate that technology spill-over emanating from FDI was conditional upon the host country investing in research and development.

2.8 Impact of FDI on Sector Level Economic Growth

Although there was an abundance of theoretical literature on the subject of FDI and its impact on economic growth, there was a dearth of conclusive empirical evidence on the de-aggregated effect at a sector level (Busse and Groizard, 2008). A summary of some the literature on this subject revealed useful insight into the character of the relationship.

1- Vu et al. (2008) found that the significant and positive effect that FDI had on economic growth (either directly or indirectly) was not evenly spread across sectors, and was possibly limited to certain sectors. "FDI was found to have an indirect significant positive effect on growth in the real estate, agriculture, mining and quarrying, and electricity, gas, water, oil–chemical, machinery, electricity, hotels and restaurants, and financial intermediation sectors, but not in the construction, trade and repairs, and other sectors, oil, chemical, machinery, electricity, hotels and restaurants, and financial intermediation" (Vu et al.; p408 2008).

2- Javorcik and Spatareanu (2006) theorised that the ownership structure in foreign investment projects affected the extent of vertical and horizontal capability diffusion from FDI and this could happen in two ways: First, it was possibly cheaper to source goods and services from the local suppliers, leading to vertical overflows in terms of productivity and the quality standards required by the project. Secondly, foreign investors usually transferred less sophisticated technologies to their partially-owned affiliates; therefore the local shareholders and companies in the same sector were able to benefit there-from horizontal transfers.

In contrast however, if the market did not grow, the entrance of FDI could have a negative effect on the local producers operating in the same sector, as they may lose part of their market share and whilst still carrying high fixed cost (Aitken and Harrison, 1999). Overall it was found that the negative competition effect (resulting from the entrance of the foreign company into a local market) negated any the positive effects derived from knowledge spill-overs in developing countries (Djankov and Hoekman, 2000; Konings, 2001). Ahrnstein and Ängmowe (2013) attributed their failure to find a significant effect of FDI in a primary sector to the concept of "natural resource curse" (Auty, 1993), the destructive power of corruption

and the “Dutch disease” (The Economist; p82 1977) being the local currency appreciation typically caused by FDI inflow ultimately affecting the competitiveness of other local industries. However, in the secondary and service sectors the study found insignificant evidence of a direct link and thus could not draw any conclusion on the effect of FDI on economic growth (Ahrnstein and Ängmowe, 2013).

According to Blalock and Gertler, (2004); and Javorcik, (2004) the existence of a foreign investor in the downstream of the sector local value chain has brought about significant productivity upstream in its suppliers. On a different note, foreign investors were very hesitant to share their state-of-the-art technologies with the local entities, unless such units were 100% owned by the affected foreign investors (Ramachandaram, 1993). This finding is corroborated by Mansfield and Romeo (1980) and Desai et. al. (2004) who argued that technology was transferred more readily within wholly-owned subsidiaries than in minority owned entities.

Kugler (2005) found that there were no intra-industry technology transfers, but rather inter-industry ones. This hypothesis is supported by Scherer (1982) and Glaeser et al. (1992) who found an inter-industry cross-pollination of technologies as opposed to within the same industry. In addition, Bwayla (2006) who conducted related research in Zambia, found that there was significant technology upgrade from foreign firms in upstream sectors impacting local firms in downstream sectors in manufacturing industries.

2.9 Negative Relationship between FDI and Growth

Konings (2001) examined the spill-over effect of FDI on a firm-level using the panel-data method in Bulgaria, Romania and Poland and found that there was no over flow impact in Bulgaria and Romania. It is evident from a number of studies (Konings (2001); Glass and Saggi (1998) and Kokko (1994), that the inadequacies of both the human and physical capital impede on the potential for technology diffusion. In addition, the extent of the technology gap between the host country and the foreign investor has discouraged the foreign investors from investing in the latest technologies in such countries (Kokko, 1994). Similarly the local firms needed to have the ability to invest in building their own capacity to absorb foreign technologies (Hertzer et.al 2008). However, at times foreign investors have been very protective of their intellectual property and technology and hence unwilling to diffuse such to the local firms (Görg and Greenway, 2004).

Studies performed by Dutt (1997) and UNCTAD (1999) failed to establish an empirical relationship between FDI and economic growth rates. This was especially true in developing countries as indicated in the study performed using cross-country data from 78 developing countries. The findings suggested that the lower income developing economies did not benefit significantly from the FDI (Blomström et al., 1994). This was further substantiated by Zhang's (2002) study which also found that least developed regions (in terms of human capital) experienced insignificant growth associated with FDI.

Carkovic and Levine (2003) used a panel method to examine the relationship between FDI and economic growth in 72 countries and failed to find robust cross-country empirical evidence that FDI accelerated economic growth. On the other hand, Ng (2006) suggested that FDI from countries which significantly invested in research and development did not seem to increase productivity, implying that such firms were primarily interested in exploiting the host country's technology rather than defusing theirs into the host country. This was supported by the results of the study performed by Lichtenberg and Van Pottelsberghe (2001) who concluded that FDI providers used Trojan horse tactics with the sole intention of taking advantage of the technology base of the host countries. In addition, Busse and Groizard's (2008) study found insufficient evidence to confirm that changes in FDI actually made the

economy more efficient. However, Bende-Nabende et al. (2001) found that FDI actually had a negative impact in the more economically advanced countries like Japan and Taiwan.

2.10 FDI Effect on Domestic Investment

FDI has in instances actually harmed the host economy when foreign investors claimed scarce resources such as import licenses, skilled manpower, credit facilities, or foreclosed investment opportunities for local investors (Hertzer et.al 2008, Smarzynska, 2002). Agosin and Machado (2005) examined whether FDI crowded-in or crowded-out domestic investment in 12 developing countries (in Africa, Asia and Latin America). The results indicated that, in all three regions, FDI has, at best, had no effect on the domestic investment. However, there was some evidence in the Latin America where FDI was found to displace domestic investment (Agosin and Machado, 2005). Furthermore, their dominance may have lead to them acquiring local competitors or driving domestic entities completely out of business giving rise to oligopolies (Agosin and Mayer, 2000; Aitken and Harrison, 1999). Agosin and Mayer's (2000) study found strong evidence of FDI having a crowd-out effect on domestic investment in Latin American examples where the host country had been receptive to all types of FDI in all industries.

Singer (1950) attributed the ability of foreign investors to crowd-out local companies to their access to a larger pool of capital at favourable terms, whereas the same could not be said about the local firms. In addition, Konings (2001) as well as Glass & Saggi (1998) argued that the competitive advantage of foreign entities lay in their possession of more advanced technologies and production processes. However, Mody and Murshid (2005) found that a 1% increase in FDI resulted in a 0.94% increase in domestic investment, implying that FDI had a crowd-in effect on domestic investment.

2.11 Relationship between FDI and Economic Growth in South Africa

South Africa has unparalleled potential to exploit FDI owing to its well-developed financial markets (Heese, 2000). However, Rusike, (2008) argued that the South African market size was a short run determinant of FDI whereas the trade openness, stability of the exchange rate and financial market development were crucial long term determinants thereof.

Bezuidenhout (2009) examined the effect of FDI and growth in 20 countries (including South Africa) in the southern African region and concluded that the impact was limited and suggested that the FDI policies should rather target green-field projects in the manufacturing sector with high potential for technology spill-over and human capital development. Moolman et. al., 2006 found a positive relationship between FDI and growth in South Africa. However, they emphasised the need for suitable skills and a conducive investment climate. Furthermore, South African tax policy was considered less competitive relative to similar emerging economies, hence South Africa was found to be lagging behind in attracting FDI (Kansdorff, 2010). Contrary to common belief that more FDI has led to growth, FDI was found to have a limited contribution to growth in Sub Saharan Africa (Bezuidenhout, 2009). In fact, the current FDI policies needed to be reviewed to target specific types of investments for example those focused on attracting manufacturing green-fields in order to take advantage of the training and technological transfer (Bezuidenhout, 2009).

Agosin and Mayer's (2000) attributed the FDI's positive effect on growth in Africa to inability of the local investors to gain entry in certain markets due to technological or capital constraints. Fedderke and Romm (2005) found that FDI impacted economic growth positively in South Africa and that there was a short-run crowd-out effect between FDI and local investment and a long run crowd-in effect which was prone to technological diffusions into the domestic market. In addition the FDI was found to be capital intensive thus facilitating horizontal rather than vertical capability enhancements. The impact of FDI on the welfare of Southern African countries was relatively insignificant compared to poorer countries such as those in Eastern and Central Africa (Gohou and Soumare´, 2012).

Curtis (1991) identified that all forms of foreign capital supported rapid growth in manufacturing both private and state owned. In fact, UNCTAD (1999) identified services and manufacturing as key sectors for FDI in various African countries. Schoeman et al. (2000) concluded that budget deficit and taxes had a negative impact on FDI in South Africa, and suggested that tax in particular needed to be reviewed. Fedderke and Romm (2006) found that wage costs had a negative impact on FDI whereas they also find that political stability had a positive impact on FDI into South Africa.

Gossel and Biekpe (2012) examined the effects of capital flows on the South African economy and established that portfolio along with other inflows have had more impact on asset prices than FDI. In addition, Gossel and Biekpe (2012) found that FDI and portfolio inflows had a positive impact on household expenditure on durable goods. Gossel and Biekpe (2012) examined the relationship between capital flows and the business cycle fluctuations and found a procyclical relationship between FDI and the domestic business fixed investment.

2.12 Direction of the Causality Relationship between FDI and GDP

It was identified that the direction of the causal relationship between FDI and GDP has not been solely unidirectional but may also have been bi-directional (Chowdhury and Mavrotas, 2005). In fact, Chowdhury and Mavrotas (2005) suggested that GDP has also stimulated FDI in Chile, whereas GDP and FDI caused each other in both Malaysia and Thailand. This hypothesis was supported by Ng (2006) who found that China had strong evidence of a bidirectional causal relationship between FDI and productivity growth, whilst no significant impact on productivity was observed (either way) in the case of the Republic of Korea. Esso (2010), who found that FDI causes economic growth in Angola, Cote d'Ivoire and Kenya, but not in Liberia and South Africa, where the opposite was found to be true. Vijayakumar's (2008) study using the Vector Error Correction Model, found a long run relationship between FDI and growth, ultimately concluding that there was an existence of a bi-directional effect between FDI and growth in Brazil, Russia and South Africa as opposed to a unidirectional impact for India and China respectively. Addison (2006) argued that the bidirectional relationship between FDI and economic growth, in turn attracted more FDI.

2.13 Conclusion

It is evident that there are both supporting and contrasting views on whether FDI has caused growth and the direction this causal relationship has taken. In view of the context laid out by the literature reviewed, this report proceeds to seek to shed some light on the applicability of these hypotheses in South Africa at a sector level.

It was evident from the scholarly presentations that there has been insufficient research on the relationship between FDI and growth at a sector level in South Africa. The graphs below indicate that the tertiary and secondary sectors have typically represented the lion-share of both the GVA and FDI in South Africa (Figures 2 and 3). Therefore, the conclusions drawn at an aggregate level may be skewed by these dominant sectors. In addition, there was a danger of using aggregate level studies to draw conclusions at a sector level, as the relationship dynamics may be totally different. This phenomenon has been termed the "ecological inference fallacy" (Robinson, 1950). Furthermore, it was suggested that the aggregate level studies may have overlooked factors such as intra-industry spill-over effects (Ng, 2006) and therefore, FDI and growth need to be disaggregated into sector components and analysed heterogeneously.

Figure 2: Gross Value Added in South Africa, 1985 - 2010

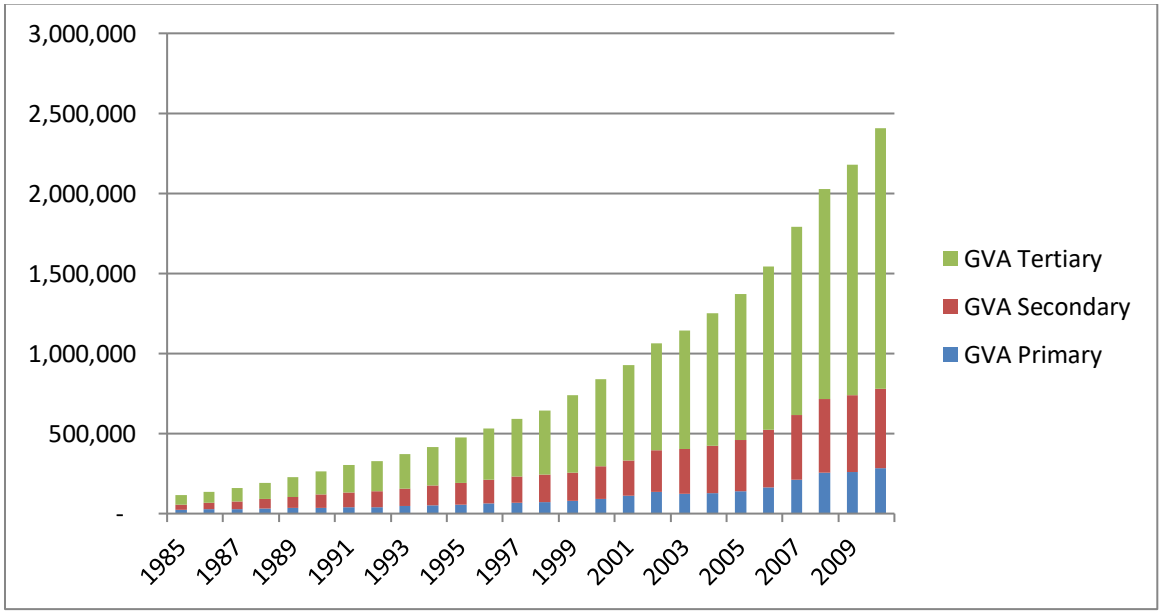
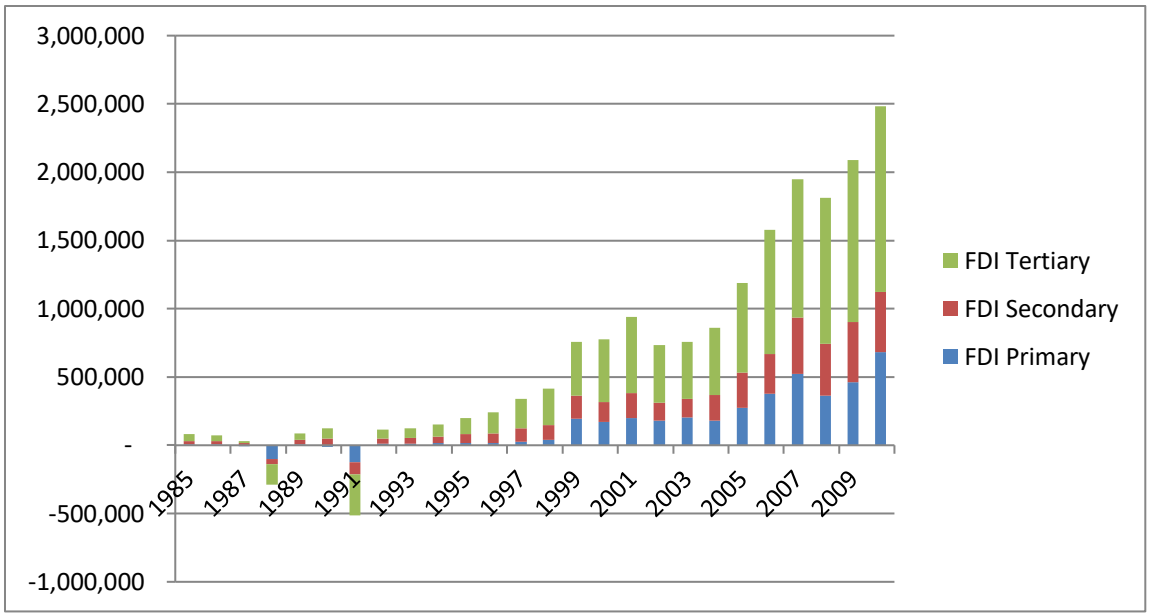


Figure 3: Foreign Direct Investment in South Africa, 1985 - 2010



3 RESEARCH METHODOLOGY

3.1 Research Approach and Strategy

This research was conducted using secondary sources of data. Since the objective of the research was to explain a particular phenomenon or rather to test a certain hypothesis being the relationship between FDI and economic growth using historical numerical records, a quantitative research methodology was considered as a suitable approach. A longitudinal time series, non-experimental, nomothetic causal design was applied in this research in order to examine the relationship between FDI and economic growth. This approach was preferable because the correlation between the FDI and economic growth was considered to have a cause and effect relationship. "The non-experimental approach to establishing causality (sometimes called the descriptive or observational approach) involved studying naturally occurring variation in the dependent and independent variables, without any intervention by the researchers" (Bachman and Schutt, 2008).

The Toda and Yamamoto (1995) and Dolado and Lutkepohl (1996) non-causality method (TYDL) was used in order to examine the causal relationships between FDI and economic growth at a sector level in South Africa. The proceeding research methodology sections outline a description of the data collection method followed, and data analysis method applied.

3.2 Data Collection, Frequency and Choice of Data

This study used annual time series at current prices for FDI and Gross Value Added per sector or economic activity being the primary, secondary and tertiary sectors. The data was extracted from the South African Reserve Bank Quarterly Bulletins for the period 1985 – 2012.[2] However, data for 1987, 1988, 1989 and was not accessible as it was never published and thus the log linear interpolation method was applied to fill in the missing values in the time series.

[2] The start-date is limited by the FDI data,

Furthermore, the second variable utilised in this study was a measure for economic growth which was measured as gross value added (GVA) per individual producer, industry or sector to the economy. GVA has been considered superior to GDP as a measure of growth because it excludes intermediate consumption being goods and services used in the production process hence avoiding double counting (Ortner and Geiger, 2006). In addition, GVA was measured at basic prices and excludes subsidies and taxes (Ortner and Geiger, 2006).

There are economic activities which form the building block of these various sectors. The sectors being primary, secondary and tertiary levels were comprised of the following economic activities:

- Primary sector
    - Agriculture, forestry and fishing
    - Mining and quarrying
- Secondary sector
    - Manufacturing
    - Electricity, gas and water
    - Construction
- Tertiary sector
    - Wholesale and retail trade, catering and accommodation
    - Transport, storage and communication
    - Finance, insurance, real estate and business services
    - Community, social and personal services

Although the start date of the data was limited by the availability of the FDI information, the inputs were still representative of the significant period of FDI history considering that the majority of the FDI flows to South Africa started flowing post democracy. The data utilised represented all the available data from when it was first published at sector level.

3.3 Data Analysis Methods

3.3.1 Granger causality

The empirical analysis conducted in this research used causality testing to examine the long-run associations between sector level FDI and economic growth in South Africa. In econometric analysis, causality has commonly been interpreted within the context of Granger causality (Granger, 1969), which states that if a variable X Granger-causes Y, the historical values of both X and Y can be utilised to better predict the values of Y, as opposed to Y on its own.

$$Y_t = \beta_0 + \sum_{k=1}^{M} \beta_k Y_{t-k} + \sum_{l=1}^{N} \alpha_l X_{t-l} + u_t \qquad \text{(Eq.1)}$$

Where:

- Yt was the variable to be tested
- t represented the time period,
- k and l are number of lags.
- The ut was assumed to denote an independent white noise with elements which were constant over time.

The null hypothesis (Ho) was $\alpha\iota = 0$ and the alternative hypothesis (H1) was $\alpha\iota \neq 0$. If the coefficient αi was statistically significant then X causes Y and vice versa.

However, (Engle and Granger, 1987) argued that Granger-causality could only be considered valid when the variables were stationary and were not co-integrated, otherwise there would be a spurious relationship. In order to test how stationary the data was, ADF was applied.

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 t + \sum_{j=1}^{P} \gamma_j \Delta Y_{t-j} + \varepsilon_t \quad \text{..... (Eq. 2)}$$

The null hypothesis (Ho) being tested was Yt which had a unit root (Yt is not I (0)). The acceptance of the Ho implied that the series was non-stationary at level.

3.3.2 Co-integration Estimation

The following OLS regression equation was applied to perform the Co-integration estimation test:

$$Y_t = a_0 + a_1 X_t + Z_t \quad \text{..... (Eq. 3)}$$

Where Zt represented the residuals.

The null hypothesis (Ho) being tested was Zt and had a unit root (Zt is not I (0)). The acceptance of the Ho implied that the series was non-stationary at the tested level, meaning that the variables were co-integrated. This would imply that the error correction model needed to be applied.

3.3.3 Augmented Granger Causality (Toda and Yamamoto)

The prerequisites for the validity of conventional Granger causality test (1969) were that the variable should not have unit root and that it should not have a long run relationship, otherwise the results of the Granger causality would indicate a spurious relationship (Engle and Granger, 1987). Although further developments of Granger (1969) offered a solution in the form of (ECM) error correction model (Engle and Granger, 1987) and (VECM) vector auto-regression error correction model (Johansen and Josulius, 1990), the results were deemed to be unreliable (Toda and Yamamoto, 1995). In addition, a complicated pretesting procedure was required being the estimation of unit roots, analysis of co-integration properties and sensitivity for improper lag establishment resulted in serious difficulty in empirical applications (Lach, 2010).

Toda and Yamamoto (1995) and Dolado and Lutkepohl (1996) (TYDL) proposed an alternative approach whereby vector autoregressive (VAR) was augmented despite the co-integration. The following steps were followed:

- Determination of the maximum order of integration dmax, expected in the model using information criteria and unit root tests.

- Construction of a VAR in their levels with a total of (k + dmax) lags.

- Application of the standard Wald test to test for causality inferences in the lag augmented model

This approach was deemed to be advantageous because the lag selection procedure and the MWald statistic tend to always be asymptotically valid irrespective of the stationary and co-integration outcomes (Toda and Yamamoto, 1995). In addition, the results from this method are statistically superior in small samples (Herzer et al., 2008).

3.4 Research Reliability and Validity

This study is based upon the latest and most robust econometric models which have been found to return reliable results for studies of this nature. In addition the data utilised was representative of the population and derived from credible sources being the South African Reserve Bank (SARB).

3.5 Limitations

It was evident that the size of the sample utilised in performing the study was small, therefore the Toda-Yamamoto (1995) test may have suffered size distortion and reduced power (Mavrotas and Kelly 2001). However this study did not apply a bootstrap simulation to investigate the performance of the Toda-Yamamoto test.

There is a vast amount of literature on the subject of FDI, therefore the literature review in this study was by no means exhaustive but covered some of the significant studies on this subject.

4 RESEARCH FINDINGS, ANALYSIS AND DISCUSSION

The time series of FDI and GVA are graphically presented in Figures 1 and 2 and they show that there was a gradual upward trend in the findings, suggesting that the data may not be stationary.

The empirical results are reported in four steps.

- Firstly, the stationarity was tested for both GDP and FDI per sector and in total.

- Secondly, the order of integration was tested for both GDP and FDI per sector and in total Johansen and Juselius (1990)

- Thirdly, the optimum lag structure using the Akaike's final prediction error (FPE) and AIC criteria was determined

- Fourthly, VAR Residual Serial Correlation LM Tests conducted on FDI and GVA at primary sector level

- Finally, the performance of the Toda-Yamamoto test.

4.1 Unit Root Testing using ADF

The stationarity was tested for both GDP and FDI per sector and in total. The augmented Dickey-Fuller (ADF, 1979) unit root tests were conducted in order to examine the stationarity conditions of the variables. The unit root tests were performed in sequence starting with lag 0 to a lag whereby the null hypothesis relating to stationarity could be rejected at 5% significance level. The full details of the sequential testing are detailed in appendices 1-5, 12-16, 22-26 and 33-37. The same results are summarised in Table 1 below; and show that all of the variables were non-stationary at lag 0. However, FDI becomes stationary at first differencing (lag 1), whereas GVA becomes stationary at second differencing (lag 2).

Table 1: Augmented Dickey Fuller Test for FDI and GVA at Primary, Secondary and Tertiary Sector Level

ADF Test Results	Prob			ADF Test Results	Prob		
FDI	**Lag 0**	**Lag 1**		**GVA**	**Lag 0**	**Lag 1**	**Lag 2**
primary	**0.9149**	**0.0062**		**primary**	**1.0000**	**0.9959**	**0.000**
Stationary	No	Yes		Stationary	No	No	Yes
Secondary	**0.9998**	**0.0097**		**Secondary**	**0.9999**	**0.9405**	**0.0014**
Stationary	No	Yes		Stationary	No	No	Yes
Tertiary	**0.9896**	**0.0118**		**Tertiary**	**1.0000**	**0.9882**	**0.0000**
Stationary	No	Yes		Stationary	No	No	Yes
Total	**0.9852**	**0.0117**		**Total**	**1.0000**	**0.9882**	**0.0000**
Stationary	No	Yes		Stationary	No	No	Yes

4.2 Co-integration Test Using Johansen and Juselius Procedure

The order of integration was tested using the Johansen and Juselius, 1990 approach for both GDP and FDI per sector and in total at 5% significance level and. The full results of the co-integration test are detailed in Appendices 9, 19, 30 and 41. The results of the co-integration tests have been summarised in Table 2 and both the Trace test and the Max Eigen value indicated two co-integrated equations at primary and tertiary sector level, one co-integrated equation at total level and no co-integrated equation at secondary level. This implied that unrestricted VAR needed to be utilised to perform test for secondary sector, whereas VECM was utilised for primary, tertiary and total sectors.

Table 2: Co-integration Test for FDI and GVA at Primary, Secondary and Tertiary Sector Level

		Hypothesized		Max-Eigen / Trace	0.05	
Sector		No. of CE(s)	Eigen-value	Statistic	Critical Value	Prob.**
FDI and GVA - Primary	Trace	At most 1 *	0.355095	10.52765	3.841466	0.0012
FDI and GVA - Primary	Maximum Eigen-value	At most 1 *	0.355095	10.52765	3.841466	0.0012
FDI and GVA - Secondary	Trace	None	0.309625	15.05544	25.87211	0.5699
FDI and GVA - Secondary	Maximum Eigen-value	None	0.309625	8.892477	19.38704	0.7354
FDI and GVA - Tertiary	Trace	At most 1 *	0.482677	15.81812	12.51798	0.0135
FDI and GVA - Tertiary	Maximum Eigen-value	At most 1 *	0.482677	15.81812	12.51798	0.0135
FDI and GVA - Total	Trace	None *	0.721057	39.90033	25.87211	0.0005
FDI and GVA - Total	Maximum Eigen-value	None *	0.721057	30.64192	19.38704	0.0008

It is interesting to note that the results suggest that there may not be a long-run relationship between FDI and GVA at secondary sector and at an aggregated level.

4.3 Optimum Lag Structure

Thirdly, the optimum lag structure using the Akaike's final prediction error (FPE) and AIC criteria was determined, and the full results of the co-integration test are detailed in Appendices 7, 18, 29 and 39. A summary of these results presented in table 3 below, indicates an optimum lag length of 1 for the primary sector and 2 for the secondary, tertiary and total sectors.

Table 3: VAR Lag Order Selection Criteria -FDI and GVA at Primary, Secondary and Tertiary Sector Level

Sector	Lag	LogL	LR	FPE	AIC	SC	HQ
FDI and GVA - Primary	1	-543.6998	101.3907*	2.69e+17*	45.80832*	46.10283*	45.88645*
FDI and GVA - Secondary	2	-520.0505	18.39889*	5.29e+16*	44.17088*	44.66173*	44.30110*
FDI and GVA - Tertiary	2	-548.3334	11.53615*	5.59e+17*	46.52778*	47.01864*	46.65800*
FDI and GVA - Total	2	-564.8886	10.05609*	2.22e+18*	47.90738*	48.39824	48.03760*

4.4 Residual Serial Correlation LM Test

The Residual serial correlation LM test was performed and the detailed outcomes are presented in Appendices 8, 19, 28 and 40. A summary of these results as presented in table 4 below, indicated that although the results in Table 3 suggest an optimum lag length of 1 for the primary sector and lag length of 2 for the secondary, tertiary and total sectors, the LM Test result in Table 4 below only supports the same lag order in primary and secondary sectors in relation to the residual serial correlations. However, it suggests that different lags are required to remove the residual serial correlation for tertiary and total sectors (i.e. lag 5 and lag 4 respectively).

Table 4: VAR Residual Serial Correlation LM Tests - FDI and GVA at Primary Sector Level

Sector	Lag	LM - Stat	Prob
FDI and GVA - Primary	1	1.724176	0.7863
FDI and GVA - Secondary	2	3.219198	0.5218
FDI and GVA - Tertiary	5	4.472981	0.3458
FDI and GVA - Total	4	2.635574	0.6205

Therefore, an extra lag was added to the lags detailed above in performing the WALD test, but only as an exogenous variable.

4.5 Toda-Yamamoto Non-causality Test Results

The Toda-Yamamoto non causality test was performed and the detailed results are presented in Appendices 11, 21, 32 and 43. The summarised results are presented in table 5 below and indicate the following:

- The null hypothesis was rejected at 5% significance level for the tertiary and total sectors. This implies that there was a bi-directional Granger-causality at tertiary sector and an aggregated level suggesting that FDI Granger causes GVA and FDI also Granger causes GVA).

- The null hypothesis was rejected at 5% significance level for the primary and secondary sectors, but only in relation to FDI Granger-causing GVA.

- However, the null hypothesis relating to GVA not Granger-causing FDI at primary and secondary sector level could not be rejected.

- This implies that there was a unidirectional Granger-causality at primary and secondary sector level therefore FDI Granger causes GVA, but FDI does not Granger cause GVA.

Table 5: Toda Yamamoto Non-causality test for FDI and GVA at Primary, Secondary, Tertiary and Total

Sector	Dependent variable	Excluded	Chi-sq	df	Prob.	Reject
Primary	Dependent variable: D(FDI_PRIM_F)	D(GVA_PRIM)	0.161209	1	0.6880	No
Primary	Dependent variable: D(FDI_PRIM_F)	All	0.161209	1	0.6880	No
Primary	Dependent variable: D(GVA_PRIM)	D(FDI_PRIM_F)	35.09460	1	0.0000	Yes
Primary	Dependent variable: D(GVA_PRIM)	All	35.09460	1	0.0000	Yes
Secondary	Dependent variable: FDI_SECO_F	GVA_SECO	0.820933	2	0.6633	No
Secondary	Dependent variable: FDI_SECO_F	All	0.820933	2	0.6633	No
Secondary	Dependent variable: GVA_SECO	FDI_SECO_F	32.12352	2	0.0000	Yes
Secondary	Dependent variable: GVA_SECO	All	32.12352	2	0.0000	Yes
Tertiary	Dependent variable: D(FDI_TERT_F)	D(GVA_TERT)	11.36069	5	0.0447	Yes
Tertiary	Dependent variable: D(FDI_TERT_F)	All	11.36069	5	0.0447	Yes
Tertiary	Dependent variable: D(GVA_TERT)	D(FDI_TERT_F)	25.11463	5	0.0001	Yes
Tertiary	Dependent variable: D(GVA_TERT)	All	25.11463	5	0.0001	Yes
Total	Dependent variable: D(FDI_TOTA_F)	D(GVA_TOTA)	10.19901	4	0.0372	Yes
Total	Dependent variable: D(FDI_TOTA_F)	All	10.19901	4	0.0372	Yes
Total	Dependent variable: D(GVA_TOTA)	D(FDI_TOTA_F)	12.05180	4	0.0170	Yes
Total	Dependent variable: D(GVA_TOTA)	All	12.05180	4	0.0170	Yes

5 RESEARCH CONCLUSIONS

As has been laid out in this report, the objectives of the study were broadly in three parts to assess whether foreign direct investment in total, firstly Granger-causes economic growth in South Africa. Secondly it was assessed whether the Granger-causality was industry dependent at a disaggregated level being primary, secondary and tertiary. Thirdly, the relationship was assessed for any directional consistency as either unidirectional or bi-directional.

The study showed that FDI Granger-causes growth in primary, secondary, tertiary sectors and at an aggregate level. In addition, growth was found to Granger-cause FDI at tertiary and aggregate level. On the other hand growth does not Granger-cause FDI at primary and secondary sector level. The only bi-directional relationship that could be observed was at the tertiary and aggregate sector level, whereas at primary and secondary sector level, the relationship was found to be unidirectional.

Furthermore, the study revealed that the direction of the Granger causality relationship could be unidirectional and/or bi-directional depending on the sector. This study concurs with Chowdhury and Mavrotas (2005) and Ng (2006) found that the direction of the causal relationship can be bi-directional in other cases. In addition, this study also concurs with Esso (2010) who found that in total growth causes FDI in South Africa, as well as Addison (2006) who postulated that growth attracts FDI in some cases.

6 RECOMMENDATIONS FOR FUTURE RESEARCH

Although this study makes some inroads towards contributing to understanding of the relationship between FDI and growth at a sector level, the period of the study is limited. Further studies over a longer time period should be undertaken in order to further validate the findings of this study. In addition, complimentary studies should go deeper by dissecting the sectors into the various economic activity levels for example, for the primary sector a study should be undertaken for agriculture, forestry and fishing and mining and quarrying respectively, as the economic activities are very different and neither attract equal FDI nor produce the same level of growth.

Moreover, further studies should study the reasons behind the non-existence of a long run relationship between FDI and growth in the secondary sector as well as the reason why growth does not cause FDI in the primary and secondary sectors.

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8. APPENDICES

1 - FDI Primary sector – ADF test at lag 0

Null Hypothesis: FDI_PRIM_F has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.067210	0.9149
Test critical values:	1% level	-4.374307	
	5% level	-3.603202	
	10% level	-3.238054	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(FDI_PRIM_F)
Method: Least Squares
Date: 07/02/13 Time: 21:37
Sample (adjusted): 1986 2010
Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FDI_PRIM_F(-1)	-0.203618	0.190794	-1.067210	0.2974
C	-45862.43	36683.57	-1.250217	0.2244
@TREND(1985)	7693.207	4141.936	1.857394	0.0767

R-squared	0.180813	Mean dependent var	27107.76
Adjusted R-squared	0.106341	S.D. dependent var	75329.81
S.E. of regression	71211.92	Akaike info criterion	25.29687
Sum squared resid	1.12E+11	Schwarz criterion	25.44314
Log likelihood	-313.2109	Hannan-Quinn criter.	25.33744
F-statistic	2.427948	Durbin-Watson stat	1.949936
Prob(F-statistic)	0.111484		

Cannot reject the H0, as the Prob is not <5%, therefore at lag 0, the data is not stationary

2 - FDI Primary Sector – ADF Test at Lag 1

Null Hypothesis: D(FDI_PRIM_F) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.673031	0.0062
Test critical values:	1% level	-4.440739	
	5% level	-3.632896	
	10% level	-3.254671	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(FDI_PRIM_F,2)
Method: Least Squares
Date: 07/02/13 Time: 21:40
Sample (adjusted): 1989 2010
Included observations: 22 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(FDI_PRIM_F(-1))	-2.810186	0.601363	-4.673031	0.0002
D(FDI_PRIM_F(-1),2)	1.306753	0.488461	2.675245	0.0160
D(FDI_PRIM_F(-2),2)	0.599364	0.338881	1.768656	0.0949
C	-66366.72	37506.37	-1.769479	0.0947
@TREND(1985)	9180.978	2826.613	3.248049	0.0047

R-squared	0.714069	Mean dependent var	10023.11
Adjusted R-squared	0.646791	S.D. dependent var	110672.1
S.E. of regression	65774.00	Akaike info criterion	25.22255
Sum squared resid	7.35E+10	Schwarz criterion	25.47052
Log likelihood	-272.4481	Hannan-Quinn criter.	25.28097
F-statistic	10.61370	Durbin-Watson stat	1.835864
Prob(F-statistic)	0.000169		

Can reject the H0, as the Prob is <5%, therefore at lag 1, the data is stationary

Conclusion : For FDI Prim, the data is stationary at I (1)

3 - GVA Primary Sector – ADF Test at Lag 0

Null Hypothesis: GVA_PRIM has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 5 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		4.087658	1.0000
Test critical values:	1% level	-4.498307	
	5% level	-3.658446	
	10% level	-3.268973	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GVA_PRIM)
Method: Least Squares
Date: 07/02/13 Time: 21:41
Sample (adjusted): 1991 2010
Included observations: 20 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GVA_PRIM(-1)	0.781916	0.191287	4.087658	0.0015
D(GVA_PRIM(-1))	-1.439132	0.381949	-3.767861	0.0027
D(GVA_PRIM(-2))	-1.248595	0.296036	-4.217717	0.0012
D(GVA_PRIM(-3))	-1.229309	0.335667	-3.662283	0.0033
D(GVA_PRIM(-4))	-1.734762	0.334749	-5.182271	0.0002
D(GVA_PRIM(-5))	-1.184160	0.421284	-2.810837	0.0157
C	-8884.917	7144.979	-1.243519	0.2374
@TREND(1985)	-212.8598	1114.583	-0.190977	0.8517

R-squared	0.830050	Mean dependent var	12371.95
Adjusted R-squared	0.730913	S.D. dependent var	14918.46
S.E. of regression	7738.748	Akaike info criterion	21.03504
Sum squared resid	7.19E+08	Schwarz criterion	21.43333
Log likelihood	-202.3504	Hannan-Quinn criter.	21.11279
F-statistic	8.372720	Durbin-Watson stat	1.657769
Prob(F-statistic)	0.000811		

Cannot reject the H0, as the Prob is not <5%, therefore at lag 0, the data is not stationary

4 - GVA Primary Sector – ADF Test at Lag 1

Null Hypothesis: D(GVA_PRIM) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 5 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.203144	0.9959
Test critical values:	1% level	-4.532598	
	5% level	-3.673616	
	10% level	-3.277364	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations
and may not be accurate for a sample size of 19

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GVA_PRIM,2)
Method: Least Squares
Date: 07/02/13 Time: 21:43
Sample (adjusted): 1992 2010
Included observations: 19 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GVA_PRIM(-1))	0.332113	1.634868	0.203144	0.8427
D(GVA_PRIM(-1),2)	-1.311900	1.413471	-0.928140	0.3733
D(GVA_PRIM(-2),2)	-1.153127	1.265909	-0.910908	0.3819
D(GVA_PRIM(-3),2)	-1.174551	1.103969	-1.063934	0.3102
D(GVA_PRIM(-4),2)	-1.611592	0.821682	-1.961332	0.0756
D(GVA_PRIM(-5),2)	-1.307576	0.455802	-2.868739	0.0153
C	-7214.167	11146.40	-0.647219	0.5308
@TREND(1985)	760.6972	1414.018	0.537969	0.6013

R-squared	0.817029	Mean dependent var	1077.789
Adjusted R-squared	0.700592	S.D. dependent var	16727.80
S.E. of regression	9153.144	Akaike info criterion	21.37714
Sum squared resid	9.22E+08	Schwarz criterion	21.77480
Log likelihood	-195.0829	Hannan-Quinn criter.	21.44444
F-statistic	7.016952	Durbin-Watson stat	1.688663
Prob(F-statistic)	0.002431		

Cannot reject the H0, as the Prob is not <5%, therefore at lag 1, the data is not stationary

5 - GVA Primary Sector – ADF Test at Lag 2

Null Hypothesis: D(GVA_PRIM,2) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 4 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.010451	0.0000
Test critical values:	1% level	-4.532598	
	5% level	-3.673616	
	10% level	-3.277364	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations
and may not be accurate for a sample size of 19

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GVA_PRIM,3)
Method: Least Squares
Date: 07/02/13 Time: 21:44
Sample (adjusted): 1992 2010
Included observations: 19 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GVA_PRIM(-1),2)	-6.569929	0.820170	-8.010451	0.0000
D(GVA_PRIM(-1),3)	4.542475	0.682323	6.657368	0.0000
D(GVA_PRIM(-2),3)	3.643377	0.595737	6.115750	0.0001
D(GVA_PRIM(-3),3)	2.687982	0.452700	5.937665	0.0001
D(GVA_PRIM(-4),3)	1.235193	0.272653	4.530271	0.0007
C	-9001.628	6563.485	-1.371471	0.1953
@TREND(1985)	1034.248	413.8629	2.499010	0.0280

R-squared	0.923453	Mean dependent var	971.7368
Adjusted R-squared	0.885179	S.D. dependent var	25910.70
S.E. of regression	8779.891	Akaike info criterion	21.27563
Sum squared resid	9.25E+08	Schwarz criterion	21.62358
Log likelihood	-195.1184	Hannan-Quinn criter.	21.33451
F-statistic	24.12770	Durbin-Watson stat	1.639505
Prob(F-statistic)	0.000005		

Can reject the H0, as the Prob is <5%, therefore at lag 2, the data is stationary.

Conclusion : For GVA Prim, the data is stationary at I (2)

Therefore, since FDI Prim is stationary at I(1) and GVA Prim at I(2), then m=2

6 - Estimating VAR FDI GVA at Primary Sector Level

Vector Auto regression Estimates
Date: 07/02/13 Time: 21:46
Sample (adjusted): 1986 2010
Included observations: 25 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	FDI_PRIM_F	GVA_PRIM
FDI_PRIM_F(-1)	0.463432	0.176120
	(0.24832)	(0.02726)
	[1.86627]	[6.46167]
GVA_PRIM(-1)	1.564900	0.725489
	(0.56715)	(0.06225)
	[2.75925]	[11.6543]
C	-46349.73	12433.12
	(27550.6)	(3023.99)
	[-1.68235]	[4.11149]
R-squared	0.891174	0.992113
Adj. R-squared	0.881281	0.991396
Sum sq. resids	9.59E+10	1.16E+09
S.E. equation	66016.34	7246.050
F-statistic	90.07868	1383.629
Log likelihood	-311.3170	-256.0808
Akaike AIC	25.14536	20.72647
Schwarz SC	25.29162	20.87273
Mean dependent	159913.0	102913.4
S.D. dependent	191597.8	78116.01
Determinant resid covariance (dof adj.)		1.97E+17
Determinant resid covariance		1.53E+17
Log likelihood		-565.5352
Akaike information criterion		45.72282
Schwarz criterion		46.01535

7 - VAR Lag Order Selection Criteria at Primary Sector Level

VAR Lag Order Selection Criteria
Endogenous variables: FDI_PRIM_F GVA_PRIM
Exogenous variables: C
Date: 07/02/13 Time: 21:48
Sample: 1985 2010
Included observations: 24

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-601.6373	NA	2.41e+19	50.30311	50.40128	50.32916
1	-543.6998	101.3907*	2.69e+17*	45.80832*	46.10283*	45.88645*
2	-539.9126	5.996436	2.77e+17	45.82605	46.31690	45.95627

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

All the criteria suggest that the maximum lag length is 1.

8 - VAR Residual Serial Correlation LM Tests Primary Sector

VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 07/02/13 Time: 21:50
Sample: 1985 2010
Included observations: 25

Lags	LM-Stat	Prob
1	**1.724176**	**0.7863**
2	5.213513	0.2661
3	3.595299	0.4635
4	16.37450	0.0026
5	7.738641	0.1016
6	5.162853	0.2710

Probs from chi-square with 4 df.

The serial correlations are removed at 5% significance level when the lag length is at 1.

9 - Johanssen Co-integration Test – FDI and GVA at Primary Sector Level

Date: 07/02/13 Time: 21:52
Sample (adjusted): 1987 2010
Included observations: 24 after adjustments
Trend assumption: Linear deterministic trend
Series: FDI_PRIM_F GVA_PRIM
Lags interval (in first differences): 1 to 1

Unrestricted Co integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.496899	27.01480	15.49471	0.0006
At most 1 *	0.355095	10.52765	3.841466	0.0012

Trace test indicates 2 co integrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Co integration Rank Test (Maximum Eigen value)

Hypothesized No. of CE(s)	Eigen value	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.496899	16.48715	14.26460	0.0219
At most 1 *	0.355095	10.52765	3.841466	0.0012

Max-eigenvalue test indicates 2 co integrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

FDI_PRIM_F	GVA_PRIM
-2.86E-05	6.55E-05
2.38E-05	-2.94E-05

Unrestricted Adjustment Coefficients (alpha):

D(FDI_PRIM_F)	41613.95	26659.88
D(GVA_PRIM)	-1831.602	4936.869

1 Co integrating Equation(s): Log likelihood -545.1764

Normalized co integrating coefficients (standard error in parentheses)	
FDI_PRIM_F	GVA_PRIM
1.000000	-2.293490
	(0.15298)
Adjustment coefficients (standard error in parentheses)	
D(FDI_PRIM_F)	-1.188888
	(0.39146)
D(GVA_PRIM)	0.052328
	(0.05422)

H0 cannot be rejected for both Trace Statistics and Max Eigen value, therefore there is at most two co integration.

Unrestricted VAR is utilised irrespective of the co-integration.

Conclusion

As m=4, the VAR is re-estimated with an extra lag of each variable in each equation to take the maximum amount of lags to 5.

The extra lag will be regarded as an exogenous variable.

10 - VAR at Primary Sector Level

Vector Auto regression Estimates
Date: 08/18/13 Time: 18:35
Sample (adjusted): 1987 2010
Included observations: 24 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	FDI_PRIM_F	GVA_PRIM
FDI_PRIM_F(-1)	0.573867	0.177333
	(0.23923)	(0.02993)
	[2.39878]	[5.92407]
GVA_PRIM(-1)	-0.796333	0.741835
	(1.98335)	(0.24817)
	[-0.40151]	[2.98923]
C	-56038.16	12289.53
	(39398.5)	(4929.78)
	[-1.42234]	[2.49292]
FDI_PRIM_F(-2)	-0.127267	-0.007325
	(0.39988)	(0.05004)
	[-0.31826]	[-0.14640]
GVA_PRIM(-2)	2.739988	-0.006853
	(1.45728)	(0.18234)
	[1.88021]	[-0.03758]
R-squared	0.914670	0.991855
Adj. R-squared	0.896706	0.990141
Sum sq. resids	7.31E+10	1.14E+09
S.E. equation	62010.13	7759.086
F-statistic	50.91628	578.4440
Log likelihood	-296.0924	-246.2100
Akaike AIC	25.09103	20.93417
Schwarz SC	25.33646	21.17960
Mean dependent	166345.8	106078.2
S.D. dependent	192941.1	78141.75

Determinant resid covariance (dof adj.)	1.90E+17
Determinant resid covariance	1.19E+17
Log likelihood	-539.9126
Akaike information criterion	45.82605
Schwarz criterion	46.31690

11 - Granger Non-causality Test at Primary Sector Level

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 08/18/13 Time: 18:37
Sample: 1985 2010
Included observations: 24

Dependent variable: FDI_PRIM_F

Excluded	Chi-sq	df	Prob.
GVA_PRIM	0.161209	1	0.6880
All	0.161209	1	0.6880

Dependent variable: GVA_PRIM

Excluded	Chi-sq	df	Prob.
FDI_PRIM_F	35.09460	1	0.0000
All	35.09460	1	0.0000

Cannot reject the first H0, meaning that GVA does not granger causes FDI in primary level in RSA

Can reject the second H0, meaning that FDI does granger cause GVA in at primary level in RSA

12 - FDI Secondary Sector – ADF Test at Lag 0

Null Hypothesis: FDI_SECO_F has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 5 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.220329	0.9998
Test critical values:	1% level	-4.498307	
	5% level	-3.658446	
	10% level	-3.268973	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(FDI_SECO_F)
Method: Least Squares
Date: 07/03/13 Time: 06:43
Sample (adjusted): 1991 2010
Included observations: 20 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FDI_SECO_F(-1)	0.380420	0.311735	1.220329	0.2458
D(FDI_SECO_F(-1))	-0.943795	0.366965	-2.571891	0.0245
D(FDI_SECO_F(-2))	-0.248100	0.336150	-0.738065	0.4747
D(FDI_SECO_F(-3))	-0.507079	0.378802	-1.338641	0.2055
D(FDI_SECO_F(-4))	-0.938527	0.370921	-2.530265	0.0264
D(FDI_SECO_F(-5))	-0.969756	0.358369	-2.706030	0.0191
C	-14215.89	31384.54	-0.452958	0.6587
@TREND(1985)	1927.385	3863.205	0.498908	0.6269

R-squared	0.678670	Mean dependent var	20380.84
Adjusted R-squared	0.491227	S.D. dependent var	38353.16
S.E. of regression	27356.66	Akaike info criterion	23.56048
Sum squared resid	8.98E+09	Schwarz criterion	23.95878
Log likelihood	-227.6048	Hannan-Quinn criter.	23.63823
F-statistic	3.620680	Durbin-Watson stat	1.673827
Prob(F-statistic)	0.024666		

Cannot reject the H0, as the Prob is not <5%, therefore at lag 0, the data is not stationary

13 - FDI Secondary Sector – ADF Test at Lag 1

Null Hypothesis: D(FDI_SECO_F) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 4 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.514822	0.0097
Test critical values:	1% level	-4.498307	
	5% level	-3.658446	
	10% level	-3.268973	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(FDI_SECO_F,2)
Method: Least Squares
Date: 07/03/13 Time: 06:44
Sample (adjusted): 1991 2010
Included observations: 20 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(FDI_SECO_F(-1))	-3.101511	0.686962	-4.514822	0.0006
D(FDI_SECO_F(-1),2)	1.505951	0.552344	2.726474	0.0173
D(FDI_SECO_F(-2),2)	1.563745	0.444052	3.521532	0.0038
D(FDI_SECO_F(-3),2)	1.412738	0.465127	3.037319	0.0095
D(FDI_SECO_F(-4),2)	0.763103	0.321722	2.371933	0.0338
C	-43116.32	20978.31	-2.055281	0.0605
@TREND(1985)	6141.751	1763.729	3.482253	0.0040

R-squared	0.852767	Mean dependent var	-51.80651
Adjusted R-squared	0.784813	S.D. dependent var	60072.59
S.E. of regression	27866.64	Akaike info criterion	23.57747
Sum squared resid	1.01E+10	Schwarz criterion	23.92597
Log likelihood	-228.7747	Hannan-Quinn criter.	23.64550
F-statistic	12.54920	Durbin-Watson stat	1.587788
Prob(F-statistic)	0.000095		

Can reject the H0, as the Prob is <5%, therefore at lag 1, the data is stationary

Conclusion: For FDI Seco, the data is stationary at I (1)

14 - GVA Secondary Sector – ADF test at lag 0

Null Hypothesis: GVA_SECO has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 3 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.249512	0.9999
Test critical values:	1% level	-4.440739	
	5% level	-3.632896	
	10% level	-3.254671	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(GVA_SECO)

Method: Least Squares

Date: 07/03/13 Time: 06:45

Sample (adjusted): 1989 2010

Included observations: 22 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GVA_SECO(-1)	0.156223	0.125027	1.249512	0.2294
D(GVA_SECO(-1))	0.076755	0.261118	0.293948	0.7726
D(GVA_SECO(-2))	-0.243308	0.366874	-0.663192	0.5166
D(GVA_SECO(-3))	-1.088611	0.350201	-3.108534	0.0068
C	7328.346	7342.768	0.998036	0.3331
@TREND(1985)	34.77028	1533.366	0.022676	0.9822

R-squared	0.668128	Mean dependent var	19946.27
Adjusted R-squared	0.564419	S.D. dependent var	12984.66
S.E. of regression	8569.691	Akaike info criterion	21.17685
Sum squared resid	1.18E+09	Schwarz criterion	21.47441
Log likelihood	-226.9454	Hannan-Quinn criter.	21.24695
F-statistic	6.442284	Durbin-Watson stat	2.279326
Prob(F-statistic)	0.001843		

Cannot reject the H0, as the Prob is not <5%, therefore at lag 0, the data is not stationary

15 - GVA Secondary Sector – ADF test at lag 1

Null Hypothesis: D(GVA_SECO) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 5 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.857938	0.9405
Test critical values:	1% level	-4.532598	
	5% level	-3.673616	
	10% level	-3.277364	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations
and may not be accurate for a sample size of 19

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GVA_SECO,2)
Method: Least Squares
Date: 07/03/13 Time: 06:49
Sample (adjusted): 1992 2010
Included observations: 19 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GVA_SECO(-1))	-0.557891	0.650270	-0.857938	0.4092
D(GVA_SECO(-1),2)	-0.591036	0.636865	-0.928040	0.3733
D(GVA_SECO(-2),2)	-0.497904	0.626743	-0.794431	0.4437
D(GVA_SECO(-3),2)	-0.997434	0.508411	-1.961868	0.0756
D(GVA_SECO(-4),2)	-1.413905	0.496473	-2.847901	0.0159
D(GVA_SECO(-5),2)	-0.925909	0.387786	-2.387682	0.0360
C	-7082.602	6290.133	-1.125986	0.2841
@TREND(1985)	1603.756	887.9467	1.806140	0.0983

R-squared	0.786675	Mean dependent var	454.4211
Adjusted R-squared	0.650922	S.D. dependent var	13148.58
S.E. of regression	7768.551	Akaike info criterion	21.04912
Sum squared resid	6.64E+08	Schwarz criterion	21.44677
Log likelihood	-191.9666	Hannan-Quinn criter.	21.11642
F-statistic	5.794920	Durbin-Watson stat	1.622147
Prob(F-statistic)	0.005239		

Cannot reject the H0, as the Prob is not <5%, therefore at lag 1, the data is not stationary

16 - GVA Secondary Sector – ADF test at lag 2

Null Hypothesis: D(GVA_SECO,2) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 4 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.569239	0.0014
Test critical values:	1% level	-4.532598	
	5% level	-3.673616	
	10% level	-3.277364	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations
and may not be accurate for a sample size of 19

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GVA_SECO,3)
Method: Least Squares
Date: 07/03/13 Time: 06:50
Sample (adjusted): 1992 2010
Included observations: 19 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GVA_SECO(-1),2)	-7.167770	1.287029	-5.569239	0.0001
D(GVA_SECO(-1),3)	5.076086	1.084988	4.678474	0.0005
D(GVA_SECO(-2),3)	4.128387	0.815814	5.060452	0.0003
D(GVA_SECO(-3),3)	2.761480	0.657272	4.201426	0.0012
D(GVA_SECO(-4),3)	1.064294	0.348748	3.051755	0.0101
C	-5537.176	5960.043	-0.929050	0.3712
@TREND(1985)	933.9845	418.3996	2.232279	0.0454

R-squared	0.916641	Mean dependent var	20.78947
Adjusted R-squared	0.874961	S.D. dependent var	21726.44
S.E. of regression	7682.640	Akaike info criterion	21.00862
Sum squared resid	7.08E+08	Schwarz criterion	21.35658
Log likelihood	-192.5819	Hannan-Quinn criter.	21.06751
F-statistic	21.99261	Durbin-Watson stat	1.639803
Prob(F-statistic)	0.000008		

Can reject the H0, as the Prob is <5%, therefore at lag 2, the data is stationary.

Conclusion: For GVA Seco, the data is stationary at I (2)

Therefore, since FDI Seco is stationary at I(1) and GVA Seco at I(2), then m=2

17 - Estimating VAR FDI GVA at secondary sector level

Vector Auto regression Estimates
Date: 07/03/13 Time: 06:51
Sample (adjusted): 1986 2010
Included observations: 25 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	FDI_SECO_F	GVA_SECO
FDI_SECO_F(-1)	0.508385	0.104101
	(0.17706)	(0.05559)
	[2.87120]	[1.87266]
GVA_SECO(-1)	0.550605	0.967640
	(0.17146)	(0.05383)
	[3.21123]	[17.9754]
C	-23125.91	10620.58
	(13260.0)	(4163.05)
	[-1.74404]	[2.55115]
R-squared	0.958916	0.996040
Adj. R-squared	0.955181	0.995680
Sum sq. resids	1.91E+10	1.88E+09
S.E. equation	29476.76	9254.394
F-statistic	256.7430	2766.719
Log likelihood	-291.1595	-262.1969
Akaike AIC	23.53276	21.21575
Schwarz SC	23.67902	21.36202
Mean dependent	152422.9	211990.3
S.D. dependent	139234.9	140799.6

Determinant resid covariance (dof adj.)	7.38E+16
Determinant resid covariance	5.71E+16
Log likelihood	-553.2525
Akaike information criterion	44.74020
Schwarz criterion	45.03273

18 - VAR Lag Order Selection Criteria secondary sector

VAR Lag Order Selection Criteria
Endogenous variables: FDI_SECO_F GVA_SECO
Exogenous variables: C
Date: 07/03/13 Time: 06:51
Sample: 1985 2010
Included observations: 24

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-601.0543	NA	2.29e+19	50.25453	50.35270	50.28057
1	-531.6709	121.4210	9.89e+16	44.80591	45.10042	44.88404
2	-520.0505	18.39889*	5.29e+16*	44.17088*	44.66173*	44.30110*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

All suggest that the maximum lag length is 2.

19 - VAR Residual Serial Correlation LM Tests secondary sector

VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 07/03/13 Time: 06:52
Sample: 1985 2010
Included observations: 25

Lags	LM-Stat	Prob
1	19.25819	0.0007
2	**3.219198**	**0.5218**
3	24.01449	0.0001
4	23.35865	0.0001
5	15.95567	0.0031
6	4.542901	0.3375

Probs from chi-square with 4 df.

The serial correlations are removed at 5% when the lag length is at 2.

19 - Johansson Co integration test – FDI and GVA Secondary sector

Date: 07/03/13 Time: 06:54
Sample (adjusted): 1987 2010
Included observations: 24 after adjustments
Trend assumption: Linear deterministic trend (restricted)
Series: FDI_SECO_F GVA_SECO
Lags interval (in first differences): 1 to 1

Unrestricted Co integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None	0.309625	15.05544	25.87211	0.5699
At most 1	0.226470	6.162966	12.51798	0.4399

Trace test indicates no co integration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Co integration Rank Test (Maximum Eigen value)

Hypothesized No. of CE(s)	Eigen value	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.309625	8.892477	19.38704	0.7354
At most 1	0.226470	6.162966	12.51798	0.4399

Max-eigenvalue test indicates no co integration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

FDI_SECO_F	GVA_SECO	@TREND(86)
-1.88E-05	5.39E-05	-0.527938
-3.28E-05	2.45E-05	0.104198

Unrestricted Adjustment Coefficients (alpha):

D(FDI_SECO_F)	7264.914	13676.10		
D(GVA_SECO)	-3120.121	772.9123		

1 Cointegrating Equation(s):	Log likelihood	-520.1771

Normalized co integrating coefficients (standard error in parentheses)

FDI_SECO_F	GVA_SECO	@TREND(86)
1.000000	-2.872478	28121.63
	(0.61737)	(9922.20)

Adjustment coefficients (standard error in parentheses)

D(FDI_SECO_F)	-0.136387
	(0.12895)
D(GVA_SECO)	0.058575
	(0.02071)

H0 cannot be rejected for both Trace Statistics and Max Eigen value, therefore there is at no co integration.

This implies that the Unrestricted VAR should be utilised in estimating the VAR.

As m=2, the VAR is re-estimated with an extra lag of each variable in each equation to take the maximum amount of lags to 3.

The extra lag will be regarded as an exogenous variable.

20 - Vector Auto Regression Estimates Secondary Sector

Vector Auto regression Estimates
Date: 07/03/13 Time: 06:59
Sample (adjusted): 1988 2010
Included observations: 23 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	FDI_SECO_F	GVA_SECO
FDI_SECO_F(-1)	0.433642	0.267371
	(0.20698)	(0.05014)
	[2.09505]	[5.33254]
FDI_SECO_F(-2)	0.670604	-0.364671
	(0.37501)	(0.09084)
	[1.78822]	[-4.01432]
GVA_SECO(-1)	-0.821838	1.949871
	(1.08996)	(0.26403)
	[-0.75401]	[7.38503]
GVA_SECO(-2)	1.843964	-1.334653
	(2.04732)	(0.49594)
	[0.90067]	[-2.69116]
C	-31166.67	4870.934
	(16369.8)	(3965.39)
	[-1.90392]	[1.22836]
FDI_SECO_F(-3)	-0.859088	0.103849
	(0.40201)	(0.09738)
	[-2.13697]	[1.06640]
GVA_SECO(-3)	-0.201313	0.382101
	(1.39939)	(0.33899)
	[-0.14386]	[1.12719]
R-squared	0.973494	0.998387
Adj. R-squared	0.963554	0.997783
Sum sq. resids	1.14E+10	6.68E+08
S.E. equation	26679.44	6462.787
F-statistic	97.93823	1650.956
Log likelihood	-262.8701	-230.2599
Akaike AIC	23.46696	20.63130

Schwarz SC	23.81255	20.97688
Mean dependent	163552.2	226598.6
S.D. dependent	139749.6	137246.8

Determinant resid covariance (dof adj.)	2.92E+16
Determinant resid covariance	1.41E+16
Log likelihood	-492.9313
Akaike information criterion	44.08099
Schwarz criterion	44.77216

21 - Granger Non-causality Test at Secondary Sector

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 07/03/13 Time: 07:01
Sample: 1985 2010
Included observations: 23

Dependent variable: FDI_SECO_F

Excluded	Chi-sq	df	Prob.
GVA_SECO	0.820933	2	0.6633
All	0.820933	2	0.6633

Dependent variable: GVA_SECO

Excluded	Chi-sq	df	Prob.
FDI_SECO_F	32.12352	2	0.0000
All	32.12352	2	0.0000

Can reject the first H0, meaning that GVA granger causes FDI in Secondary level in RSA
Can reject the second H0, meaning that FDI does granger cause GVA in at Secondary level in RSA

22 - FDI Tertiary Sector – ADF Test Lag 0

Null Hypothesis: FDI_TERT_F has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.188926	0.9896
Test critical values:	1% level	-4.374307	
	5% level	-3.603202	
	10% level	-3.238054	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(FDI_TERT_F)
Method: Least Squares
Date: 07/03/13 Time: 06:06
Sample (adjusted): 1986 2010
Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FDI_TERT_F(-1)	-0.016513	0.087405	-0.188926	0.8519
C	-32703.86	32994.58	-0.991189	0.3324
@TREND(1985)	6987.024	4288.048	1.629418	0.1175

R-squared	0.357592	Mean dependent var	52245.96
Adjusted R-squared	0.299191	S.D. dependent var	77043.96
S.E. of regression	64496.82	Akaike info criterion	25.09879
Sum squared resid	9.15E+10	Schwarz criterion	25.24505
Log likelihood	-310.7348	Hannan-Quinn criter.	25.13935
F-statistic	6.123079	Durbin-Watson stat	1.409046
Prob(F-statistic)	0.007690		

Cannot reject the H0, as the Prob is not <5%, therefore at lag 0, the data is not stationary

23 - FDI Tertiary Sector – ADF Test Lag 1

Null Hypothesis: D(FDI_TERT_F) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.359965	0.0118
Test critical values:	1% level	-4.440739	
	5% level	-3.632896	
	10% level	-3.254671	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(FDI_TERT_F,2)
Method: Least Squares
Date: 07/03/13 Time: 06:10
Sample (adjusted): 1989 2010
Included observations: 22 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(FDI_TERT_F(-1))	-1.374135	0.315171	-4.359965	0.0004
D(FDI_TERT_F(-1),2)	0.606188	0.249243	2.432120	0.0264
D(FDI_TERT_F(-2),2)	0.496447	0.217261	2.285022	0.0354
C	-59185.13	34051.34	-1.738115	0.1003
@TREND(1985)	9223.141	2774.046	3.324797	0.0040

R-squared	0.548094	Mean dependent var	7844.534
Adjusted R-squared	0.441763	S.D. dependent var	78910.94
S.E. of regression	58958.53	Akaike info criterion	25.00377
Sum squared resid	5.91E+10	Schwarz criterion	25.25174
Log likelihood	-270.0415	Hannan-Quinn criter.	25.06219
F-statistic	5.154602	Durbin-Watson stat	2.086578
Prob(F-statistic)	0.006617		

Can reject the H0, as the Prob is <5%, therefore at lag 1, the data is stationary

Conclusion

For FDI Tert, the data is stationary at I (1)

24 - GVA Tertiary Sector – ADF Test Lag 0

Null Hypothesis: GVA_TERT has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		4.851351	1.0000
Test critical values:	1% level	-4.416345	
	5% level	-3.622033	
	10% level	-3.248592	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GVA_TERT)
Method: Least Squares
Date: 07/03/13 Time: 06:13
Sample (adjusted): 1988 2010
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GVA_TERT(-1)	0.217599	0.044853	4.851351	0.0001
D(GVA_TERT(-1))	-0.303966	0.236096	-1.287470	0.2142
D(GVA_TERT(-2))	-0.667350	0.260405	-2.562743	0.0196
C	15578.08	9223.639	1.688930	0.1085
@TREND(1985)	-785.8139	1395.991	-0.562908	0.5804

R-squared	0.942583	Mean dependent var	67048.00
Adjusted R-squared	0.929824	S.D. dependent var	48062.72
S.E. of regression	12732.16	Akaike info criterion	21.93131
Sum squared resid	2.92E+09	Schwarz criterion	22.17816
Log likelihood	-247.2101	Hannan-Quinn criter.	21.99339
F-statistic	73.87462	Durbin-Watson stat	1.997936
Prob(F-statistic)	0.000000		

Cannot reject the H0, as the Prob is not <5%, therefore at lag 0, the data is not stationary

25 - GVA Tertiary Sector – ADF Test Lag 1

Null Hypothesis: D(GVA_TERT) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.210568	0.9882
Test critical values:	1% level	-4.440739	
	5% level	-3.632896	
	10% level	-3.254671	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GVA_TERT,2)
Method: Least Squares
Date: 07/03/13 Time: 06:14
Sample (adjusted): 1989 2010
Included observations: 22 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GVA_TERT(-1))	-0.059963	0.284766	-0.210568	0.8357
D(GVA_TERT(-1),2)	-0.596468	0.271273	-2.198774	0.0420
D(GVA_TERT(-2),2)	-0.715040	0.243748	-2.933525	0.0093
C	-6791.250	10800.84	-0.628770	0.5379
@TREND(1985)	1749.558	1657.650	1.055445	0.3060

R-squared	0.523097	Mean dependent var	7800.318
Adjusted R-squared	0.410884	S.D. dependent var	20913.69
S.E. of regression	16052.07	Akaike info criterion	22.40178
Sum squared resid	4.38E+09	Schwarz criterion	22.64974
Log likelihood	-241.4196	Hannan-Quinn criter.	22.46019
F-statistic	4.661660	Durbin-Watson stat	2.219716
Prob(F-statistic)	0.010064		

Cannot reject the H0, as the Prob is not <5%, therefore at lag 1, the data is not stationary

26 - GVA Tertiary Sector – ADF Test Lag 2

Null Hypothesis: D(GVA_TERT,2) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.048994	0.0000
Test critical values:	1% level	-4.440739	
	5% level	-3.632896	
	10% level	-3.254671	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GVA_TERT,3)
Method: Least Squares
Date: 07/03/13 Time: 06:14
Sample (adjusted): 1989 2010
Included observations: 22 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GVA_TERT(-1),2)	-2.370811	0.336333	-7.048994	0.0000
D(GVA_TERT(-1),3)	0.738744	0.210379	3.511497	0.0025
C	-5399.003	8310.759	-0.649640	0.5241
@TREND(1985)	1420.685	540.4527	2.628695	0.0170

R-squared	0.783582	Mean dependent var	2663.955
Adjusted R-squared	0.747512	S.D. dependent var	31085.98
S.E. of regression	15620.14	Akaike info criterion	22.31348
Sum squared resid	4.39E+09	Schwarz criterion	22.51185
Log likelihood	-241.4482	Hannan-Quinn criter.	22.36021
F-statistic	21.72409	Durbin-Watson stat	2.268153
Prob(F-statistic)	0.000003		

Can reject the H0, as the Prob is <5%, therefore at lag 2, the data is stationary.

Conclusion: For GVA Tert, the data is stationary at I (2)

Therefore, since FDI Tert is stationary at I(1) and GVA Tert at I(2), then m=2

27 - Estimating VAR FDI GVA at Tertiary Sector Level

Vector Auto regression Estimates
Date: 07/03/13 Time: 06:16
Sample (adjusted): 1986 2010
Included observations: 25 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	FDI_TERT_F	GVA_TERT
FDI_TERT_F(-1)	0.622913	0.054486
	(0.17431)	(0.03930)
	[3.57358]	[1.38653]
GVA_TERT(-1)	0.436776	1.066235
	(0.15257)	(0.03440)
	[2.86273]	[30.9984]
C	-31579.30	10185.21
	(22485.4)	(5069.18)
	[-1.40443]	[2.00924]
R-squared	0.981215	0.999250
Adj. R-squared	0.979508	0.999182
Sum sq. resids	7.47E+10	3.80E+09
S.E. equation	58280.28	13138.86
F-statistic	574.5861	14655.76
Log likelihood	-308.2010	-270.9588
Akaike AIC	24.89608	21.91670
Schwarz SC	25.04235	22.06297
Mean dependent	408418.1	562088.0
S.D. dependent	407123.7	459340.1
Determinant resid covariance (dof adj.)		5.37E+17
Determinant resid covariance		4.16E+17
Log likelihood		-578.0669
Akaike information criterion		46.72535
Schwarz criterion		47.01788

28 - VAR Lag Order Selection Criteria at Tertiary Sector Level

VAR Lag Order Selection Criteria
Endogenous variables: FDI_TERT_F GVA_TERT
Exogenous variables: C
Date: 07/03/13 Time: 06:17
Sample: 1985 2010
Included observations: 24

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-646.3754	NA	1.00e+21	54.03128	54.12945	54.05733
1	-555.6193	158.8231	7.28e+17	46.80161	47.09613	46.87975
2	-548.3334	11.53615*	5.59e+17*	46.52778*	47.01864*	46.65800*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

All suggest that the maximum lag length is 2.

29 - VAR Lag Order Selection Criteria

VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 07/03/13 Time: 06:19
Sample: 1985 2010
Included observations: 25

Lags	LM-Stat	Prob
1	10.69522	0.0302
2	13.37291	0.0096
3	12.71655	0.0127
4	5.343483	0.2538
5	**4.472981**	**0.3458**
6	6.228023	0.1828

Probs from chi-square with 4 df.

The serial correlations are removed at 5% when the lag length is at 5.

30 - Johanssen Co integration test – FDI and GVA at Tertiary Sector Level

Date: 07/03/13 Time: 06:20
Sample (adjusted): 1987 2010
Included observations: 24 after adjustments
Trend assumption: Linear deterministic trend (restricted)
Series: FDI_TERT_F GVA_TERT
Lags interval (in first differences): 1 to 1

Unrestricted Co integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.645528	40.70911	25.87211	0.0004
At most 1 *	0.482677	15.81812	12.51798	0.0135

Trace test indicates 2 co integrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Co integration Rank Test (Maximum Eigen value)

Hypothesized No. of CE(s)	Eigen value	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.645528	24.89099	19.38704	0.0071
At most 1 *	0.482677	15.81812	12.51798	0.0135

Max-eigenvalue test indicates 2 co integrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

FDI_TERT_F	GVA_TERT	@TREND(86)
-3.57E-06	1.26E-05	-0.069032
1.94E-05	-1.52E-05	0.194237

Unrestricted Adjustment Coefficients (alpha):

D(FDI_TERT_F)	25207.65	-36341.55
D(GVA_TERT)	13619.46	4030.803

1 Cointegrating Equation(s):	Log likelihood	-554.6172

Normalized co integrating coefficients (standard error in parentheses)

FDI_TERT_F	GVA_TERT	@TREND(86)
1.000000	-3.526082	19347.54
	(0.54717)	(22459.3)

Adjustment coefficients (standard error in parentheses)

D(FDI_TERT_F)	-0.089941
	(0.04431)
D(GVA_TERT)	-0.048594
	(0.00929)

H0 cannot be rejected for both Trace Statistics and Max Eigen-value therefore there is at most two co-integration.

This implies that the VAR should be utilised irrespective of the co-integration

As m=5, the VAR is re-estimated with an extra lag of each variable in each equation to take the maximum amount of lags to 6.

The extra lag will be regarded as an exogenous variable.

31 - VAR Estimates at Tertiary Sector

Vector Auto-regression Estimates
Date: 08/18/13 Time: 18:00
Sample (adjusted): 1991 2010
Included observations: 20 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	FDI_TERT_F	GVA_TERT
FDI_TERT_F(-1)	0.899357	0.304461
	(0.47237)	(0.10359)
	[1.90393]	[2.93909]
FDI_TERT_F(-2)	-1.200078	-0.266473
	(0.48324)	(0.10597)
	[-2.48340]	[-2.51451]
FDI_TERT_F(-3)	-0.439104	0.184521
	(0.48249)	(0.10581)
	[-0.91008]	[1.74390]
FDI_TERT_F(-4)	0.232948	0.114491
	(0.40647)	(0.08914)
	[0.57311]	[1.28443]
FDI_TERT_F(-5)	-0.166291	-0.219506
	(0.38741)	(0.08496)
	[-0.42923]	[-2.58364]
GVA_TERT(-1)	2.651684	0.118433
	(1.95639)	(0.42904)
	[1.35539]	[0.27604]
GVA_TERT(-2)	2.630433	-0.367126
	(1.58354)	(0.34727)
	[1.66111]	[-1.05718]
GVA_TERT(-3)	-2.601832	0.059513
	(1.71877)	(0.37693)
	[-1.51377]	[0.15789]
GVA_TERT(-4)	3.477407	1.492113
	(2.54775)	(0.55872)
	[1.36490]	[2.67059]

GVA_TERT(-5)	-6.683878	-0.945407
	(2.78942)	(0.61172)
	[-2.39616]	[-1.54549]
C	-260253.8	53976.70
	(145260.)	(31855.6)
	[-1.79164]	[1.69442]
FDI_TERT_F(-6)	0.030813	-0.012478
	(0.43359)	(0.09509)
	[0.07107]	[-0.13123]
GVA_TERT(-6)	0.590562	1.132063
	(2.79762)	(0.61352)
	[0.21109]	[1.84520]
R-squared	0.996011	0.999839
Adj. R-squared	0.989172	0.999562
Sum sq. resids	1.26E+10	6.06E+08
S.E. equation	42414.14	9301.408
F-statistic	145.6446	3613.864
Log likelihood	-230.9853	-200.6390
Akaike AIC	24.39853	21.36390
Schwarz SC	25.04576	22.01112
Mean dependent	499040.9	676444.8
S.D. dependent	407605.2	444409.6
Determinant resid covariance (dof adj.)		5.97E+16
Determinant resid covariance		7.31E+15
Log likelihood		-422.0426
Akaike information criterion		44.80426
Schwarz criterion		46.09871

32 - Granger Non-causality Test at Tertiary Sector

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 08/18/13 Time: 18:01
Sample: 1985 2010
Included observations: 20

Dependent variable: FDI_TERT_F

Excluded	Chi-sq	df	Prob.
GVA_TERT	11.36069	5	0.0447
All	11.36069	5	0.0447

Dependent variable: GVA_TERT

Excluded	Chi-sq	df	Prob.
FDI_TERT_F	25.11463	5	0.0001
All	25.11463	5	0.0001

Can reject the first H0, meaning that GVA granger causes FDI in Tertiary level in RSA
Can reject the second H0, meaning that FDI does granger cause GVA in at Tertiary level in RSA

33 – FDI Total Sector – ADF Test at Lag 0

Null Hypothesis: FDI_TOTA_F has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.317802	0.9852
Test critical values:	1% level	-4.374307	
	5% level	-3.603202	
	10% level	-3.238054	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(FDI_TOTA_F)

Method: Least Squares

Date: 07/02/13 Time: 17:52

Sample (adjusted): 1986 2010

Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FDI_TOTA_F(-1)	-0.033879	0.106605	-0.317802	0.7536
C	-70489.43	73388.11	-0.960502	0.3472
@TREND(1985)	14438.16	9341.679	1.545564	0.1365

R-squared	0.285165	Mean dependent var	96040.60
Adjusted R-squared	0.220180	S.D. dependent var	162934.1
S.E. of regression	143882.9	Akaike info criterion	26.70355
Sum squared resid	4.55E+11	Schwarz criterion	26.84982
Log likelihood	-330.7944	Hannan-Quinn criter.	26.74412
F-statistic	4.388171	Durbin-Watson stat	1.893931
Prob(F-statistic)	0.024904		

Cannot reject the H0, as the Prob is not <5%, therefore at lag 0, the data is not stationary

34 – FDI Total Sector – ADF Test at Lag 1

Null Hypothesis: D(FDI_TOTA_F) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.364551	0.0117
Test critical values:	1% level	-4.440739	
	5% level	-3.632896	
	10% level	-3.254671	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(FDI_TOTA_F,2)
Method: Least Squares
Date: 07/02/13 Time: 17:57
Sample (adjusted): 1989 2010
Included observations: 22 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(FDI_TOTA_F(-1))	-1.715196	0.392983	-4.364551	0.0004
D(FDI_TOTA_F(-1),2)	0.712884	0.326569	2.182953	0.0434
D(FDI_TOTA_F(-2),2)	0.608802	0.254080	2.396105	0.0283
C	-151745.8	81051.12	-1.872223	0.0785
@TREND(1985)	22140.66	6489.316	3.411864	0.0033

R-squared	0.625122	Mean dependent var	17714.99
Adjusted R-squared	0.536916	S.D. dependent var	205677.5
S.E. of regression	139964.2	Akaike info criterion	26.73288
Sum squared resid	3.33E+11	Schwarz criterion	26.98084
Log likelihood	-289.0616	Hannan-Quinn criter.	26.79129
F-statistic	7.087029	Durbin-Watson stat	1.883942
Prob(F-statistic)	0.001508		

Can reject the H0, as the Prob is <5%, therefore at lag 1, the data is stationary

Conclusion

For FDI Tota, the data is stationary at I(1)

35 – GVA Total Sector – ADF Test at Lag 0

Null Hypothesis: GVA_TOTA has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		4.851351	1.0000
Test critical values:	1% level	-4.416345	
	5% level	-3.622033	
	10% level	-3.248592	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GVA_TOTA)
Method: Least Squares
Date: 07/02/13 Time: 18:01
Sample (adjusted): 1988 2010
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GVA_TOTA(-1)	0.217599	0.044853	4.851351	0.0001
D(GVA_TOTA(-1))	-0.303966	0.236096	-1.287470	0.2142
D(GVA_TOTA(-2))	-0.667350	0.260405	-2.562743	0.0196
C	15578.08	9223.639	1.688930	0.1085
@TREND(1985)	-785.8139	1395.991	-0.562908	0.5804

R-squared	0.942583	Mean dependent var	67048.00
Adjusted R-squared	0.929824	S.D. dependent var	48062.72
S.E. of regression	12732.16	Akaike info criterion	21.93131
Sum squared resid	2.92E+09	Schwarz criterion	22.17816
Log likelihood	-247.2101	Hannan-Quinn criter.	21.99339
F-statistic	73.87462	Durbin-Watson stat	1.997936
Prob(F-statistic)	0.000000		

Cannot reject the H0, as the Prob is not <5%, therefore at lag 0, the data is not stationary

36 – GVA Total Sector – ADF Test at Lag 1

Null Hypothesis: D(GVA_TOTA) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.210568	0.9882
Test critical values:	1% level	-4.440739	
	5% level	-3.632896	
	10% level	-3.254671	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GVA_TOTA,2)
Method: Least Squares
Date: 07/02/13 Time: 18:03
Sample (adjusted): 1989 2010
Included observations: 22 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GVA_TOTA(-1))	-0.059963	0.284766	-0.210568	0.8357
D(GVA_TOTA(-1),2)	-0.596468	0.271273	-2.198774	0.0420
D(GVA_TOTA(-2),2)	-0.715040	0.243748	-2.933525	0.0093
C	-6791.250	10800.84	-0.628770	0.5379
@TREND(1985)	1749.558	1657.650	1.055445	0.3060

R-squared	0.523097	Mean dependent var	7800.318
Adjusted R-squared	0.410884	S.D. dependent var	20913.69
S.E. of regression	16052.07	Akaike info criterion	22.40178
Sum squared resid	4.38E+09	Schwarz criterion	22.64974
Log likelihood	-241.4196	Hannan-Quinn criter.	22.46019
F-statistic	4.661660	Durbin-Watson stat	2.219716
Prob(F-statistic)	0.010064		

Cannot reject the H0, as the Prob is not <5%, therefore at lag 1, the data is not stationary

37 – GVA Total Sector – ADF Test at Lag 2

Null Hypothesis: D(GVA_TOTA,2) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.048994	0.0000
Test critical values:	1% level	-4.440739	
	5% level	-3.632896	
	10% level	-3.254671	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GVA_TOTA,3)
Method: Least Squares
Date: 07/02/13 Time: 18:05
Sample (adjusted): 1989 2010
Included observations: 22 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GVA_TOTA(-1),2)	-2.370811	0.336333	-7.048994	0.0000
D(GVA_TOTA(-1),3)	0.738744	0.210379	3.511497	0.0025
C	-5399.003	8310.759	-0.649640	0.5241
@TREND(1985)	1420.685	540.4527	2.628695	0.0170

R-squared	0.783582	Mean dependent var	2663.955
Adjusted R-squared	0.747512	S.D. dependent var	31085.98
S.E. of regression	15620.14	Akaike info criterion	22.31348
Sum squared resid	4.39E+09	Schwarz criterion	22.51185
Log likelihood	-241.4482	Hannan-Quinn criter.	22.36021
F-statistic	21.72409	Durbin-Watson stat	2.268153
Prob(F-statistic)	0.000003		

Can reject the H0, as the Prob is <5%, therefore at lag 2, the data is stationary.

Conclusion

For GVA Total, the data is stationary at I(2)

Therefore, since FDI Total sector is stationary at I(1) and GVA Tota at I(2), then m=2

38 - Estimating VAR FDI GVA at Total Sectors

Vector Auto-regression Estimates
Date: 07/02/13 Time: 18:51
Sample (adjusted): 1986 2010
Included observations: 25 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	FDI_TOTA_F	GVA_TOTA
FDI_TOTA_F(-1)	0.524887	0.025125
	(0.19971)	(0.02080)
	[2.62828]	[1.20810]
GVA_TOTA(-1)	0.942150	1.074594
	(0.31223)	(0.03252)
	[3.01752]	[33.0490]
C	-77660.34	9719.881
	(49213.6)	(5125.08)
	[-1.57803]	[1.89653]
R-squared	0.972355	0.999235
Adj. R-squared	0.969842	0.999166
Sum sq. resids	3.57E+11	3.87E+09
S.E. equation	127404.9	13267.87
F-statistic	386.8991	14371.93
Log likelihood	-327.7537	-271.2031
Akaike AIC	26.46029	21.93625
Schwarz SC	26.60656	22.08251
Mean dependent	720787.7	562088.0
S.D. dependent	733638.4	459340.1

Determinant resid covariance (dof adj.)	2.01E+18
Determinant resid covariance	1.56E+18
Log likelihood	-594.5610
Akaike information criterion	48.04488
Schwarz criterion	48.33741

39 - VAR Lag Order Selection Criteria at Total Sector Level

VAR Lag Order Selection Criteria
Endogenous variables: FDI_TOTA_F GVA_TOTA
Exogenous variables: C
Date: 07/02/13 Time: 18:54
Sample: 1985 2010
Included observations: 24

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-662.2826	NA	3.77e+21	55.35688	55.45505	55.38293
1	-571.2398	159.3249	2.67e+18	48.10331	48.39783*	48.18145
2	-564.8886	10.05609*	2.22e+18*	47.90738*	48.39824	48.03760*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

All except for SC suggest that the maximum lag length is 2.

40 - VAR Residual Serial Correlation LM Tests at Total Sector Level

VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 07/02/13 Time: 19:02
Sample: 1985 2010
Included observations: 25

Lags	LM-Stat	Prob
1	10.00723	0.0403
2	13.34228	0.0097
3	8.373613	0.0788
4	**2.635574**	**0.6205**
5	3.722003	0.4449
6	6.033026	0.1967

Probs from chi-square with 4 df.

The serial correlations are removed at 5% when the lag length is increased to 4.

41 - Johanssen Co-integration Test – FDI and GVA at Total Sector Level

Date: 07/02/13 Time: 18:34
Sample (adjusted): 1987 2010
Included observations: 24 after adjustments
Trend assumption: Linear deterministic trend (restricted)
Series: FDI_TOTA_F GVA_TOTA
Lags interval (in first differences): 1 to 1

Unrestricted Co-integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.721057	39.90033	25.87211	0.0005
At most 1	0.320071	9.258414	12.51798	0.1650

Trace test indicates 1 co-integrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Co-integration Rank Test (Maximum Eigen value)

Hypothesized No. of CE(s)	Eigen value	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.721057	30.64192	19.38704	0.0008
At most 1	0.320071	9.258414	12.51798	0.1650

Max-eigenvalue test indicates 1 co-integrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Co-integrating Coefficients (normalized by b'*S11*b=I):

FDI_TOTA_F	GVA_TOTA	@TREND(86)
6.80E-08	9.55E-06	-0.025856
1.15E-05	-1.62E-05	0.197089

Unrestricted Adjustment Coefficients (alpha):

D(FDI_TOTA_F)	86909.14	-60212.03
D(GVA_TOTA)	15816.25	1072.287

1 Co-integrating Equation(s): Log likelihood -568.8084

Normalized co-integrating coefficients (standard error in parentheses)		
FDI_TOTA_F	GVA_TOTA	@TREND(86)
1.000000	140.4189	-380208.7
	(24.5367)	(986988.)

Adjustment coefficients (standard error in parentheses)	
D(FDI_TOTA_F)	0.005910
	(0.00182)
D(GVA_TOTA)	0.001076
	(0.00015)

H0 cannot be rejected for both Trace Statistics and Max Eigen-value, therefore there is at most one co-integration.

As m=4, the VAR is re-estimated with an extra lag of each variable in each equation to take the maximum amount of lags to 5.

The extra lag will be regarded as an exogenous variable

42 - VAR at Total Sector Level

Vector Auto-regression Estimates
Date: 08/18/13 Time: 18:10
Sample (adjusted): 1990 2010
Included observations: 21 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	FDI_TOTA_F	GVA_TOTA
FDI_TOTA_F(-1)	1.209751	0.131458
	(0.48397)	(0.04468)
	[2.49962]	[2.94200]
FDI_TOTA_F(-2)	-0.605190	-0.092961
	(0.49628)	(0.04582)
	[-1.21946]	[-2.02887]
FDI_TOTA_F(-3)	-0.860352	0.025182
	(0.36772)	(0.03395)
	[-2.33968]	[0.74174]
FDI_TOTA_F(-4)	0.837444	0.070065
	(0.58817)	(0.05430)
	[1.42382]	[1.29026]
GVA_TOTA(-1)	-4.679635	-0.196462
	(4.22495)	(0.39007)
	[-1.10762]	[-0.50366]
GVA_TOTA(-2)	11.85741	0.697359
	(4.52453)	(0.41773)
	[2.62070]	[1.66941]
GVA_TOTA(-3)	-6.093410	-0.353733
	(5.60089)	(0.51710)
	[-1.08794]	[-0.68407]
GVA_TOTA(-4)	2.489163	1.039518
	(5.51841)	(0.50949)
	[0.45107]	[2.04032]
C	-162210.6	35725.81
	(176289.)	(16275.9)
	[-0.92014]	[2.19501]

FDI_TOTA_F(-5)	-0.322290	-0.128610
	(0.56704)	(0.05235)
	[-0.56838]	[-2.45665]
GVA_TOTA(-5)	-2.519000	0.216976
	(4.62742)	(0.42723)
	[-0.54436]	[0.50787]
R-squared	0.988412	0.999731
Adj. R-squared	0.976824	0.999462
Sum sq. resids	1.27E+11	1.08E+09
S.E. equation	112676.7	10402.89
F-statistic	85.29457	3714.596
Log likelihood	-266.2852	-216.2540
Akaike AIC	26.40811	21.64324
Schwarz SC	26.95525	22.19037
Mean dependent	843030.1	651159.4
S.D. dependent	740134.9	448387.5
Determinant resid covariance (dof adj.)		3.64E+17
Determinant resid covariance		8.25E+16
Log likelihood		-468.5822
Akaike information criterion		46.72211
Schwarz criterion		47.81637

43 - Granger Non-causality Test at Total Sector Level

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 08/18/13 Time: 18:12
Sample: 1985 2010
Included observations: 21

Dependent variable: FDI_TOTA_F

Excluded	Chi-sq	df	Prob.
GVA_TOTA	10.19901	4	0.0372

All	10.19901	4	0.0372

Dependent variable: GVA_TOTA

Excluded	Chi-sq	df	Prob.
FDI_TOTA_F	12.05180	4	0.0170
All	12.05180	4	0.0170

Can reject the first H0, meaning that GVA granger causes FDI in total in RSA

Can reject the second H0, meaning that FDI granger cause GVA in total in RSA