INSTITUTIONALISATION OF DERIVATIVES TRADING AND ECONOMIC GROWTH: EVIDENCE FROM SOUTH AFRICA

by

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DECLARATION

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I, Audrey NGUEMA BEKALE, hereby declare that the present dissertation entitled "*Institutionalisation of Derivatives Trading and Economic Growth: Evidence from South Africa"*, is the product of my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references. I further declare that this work, or part of it, was not submitted for examination at any other higher education institution.

SIGNATURE DATE

(NAME)

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ABSTRACT

Given ongoing advocacy for the institutionalisation of derivatives trading in sub-Saharan Africa (SSA) as a convenient way for enhancing regional countries' growth prospects, this study examines the impact of derivatives trading on the economy of South Africa, with reference to output growth and growth volatility, in order to illustrate the likely developmental impact that derivatives markets could ensue for SSA countries. The literature of the study essentially explores the possible ways of derivatives markets' influence on economic growth, alongside the infrastructural requirements for ensuring well-functioning derivatives markets. While accounting for implied capital market development, the GMM estimation could not evidence a significant relationship between the existing derivatives exchange and real GDP growth using South Africa's data. Similarly, a causal relationship from SAFEX's trading volumes to GDP growth could not be inferred. However, the study shows evidence of the reducing effect of derivatives trading on growth volatility.

Key terms:

African derivatives markets; capital market development; derivatives-growth relationship; GMM estimation; ARDL-bound co-integration analysis; Granger causality; VECM; growth volatility; GARCH model

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ABBREVIATIONS AND ACRONYMS

2SLS	two-stage least squares
ABS	asset-backed security
ADB	African Development Bank
ADF	Augmented Dicky-Fuller
AIC	Akaike Information Criterion
ARDL	Autoregressive Distributed Lag
ATS	Advanced Trading System
BESA	Bond Exchange of South Africa
BIS	Bank for International Settlements
CCP	central counterparty
CDO	collaterised debt obligation
CDS	credit default swap
CFD	contract for difference
CFTC	Commodity Futures Trading Commission
CPI	Consumer Price Index
CRD IV	Capital Requirements Directive IV
DERIV_DUM	dummy variable
DERVOL	derivatives trading volumes
DNSF	Dividend Neutral Stock Futures
eCFD	exchange-traded contract for difference
ECT	error correction term
EGARCH	Exponential Generalised Autoregressive Conditional Heteroscedasticity
EMIR	European Markets Infrastructure Regulation
ETF	exchange-traded fund
EXPENDITURE	gross national expenditures
FDI	Foreign Direct Investment
FEED	Financial Engineering for Economic Development
FIEA	Financial Instruments and Exchange Act
FMB	Financial Markets Bill, 2012

FSB	Financial Services Board
FSOC	Financial Stability Oversight Council
FX	foreign exchange
G-10	Group of Ten
G-20	Group of Twenty
(G)ARCH	(Generalised) Autoregressive Conditional Heteroscedasticity
GDP	gross domestic product
GDP_GW	(real) gross domestic product growth
GED	Generalised Error Distribution
GMM	Generalised Method of Moments
IFCI-Risk Institute	International Financial Risk Institute
INFLCPI	inflation, measured as growth in CPI
IMEX Qatar	International Mercantile Exchange of Qatar
IOSCO	International Organisation of Securities Commission
IV	instrumental variables
JB	Jarque-Bera
JIBAR	Johannesburg Interbank Agreed Rate
JSE	Johannesburg Stock Exchange
LM	Lagrange multiplier
LTCM	Long-Term Capital Management
M2	Broad Money Stock
M3	Liquid liabilities
MBS	mortgage-backed security
MCX India	Multi Commodity Exchange of India
MDG	Millennium Development Goal
MFW4A	Making Finance Work for Africa
MiFID	Market in Financial Instruments Directive
NCDEX India	National Commodity and Derivatives Exchange of India
NEPAD	New Partnership for Africa’s Development
NIST	National Institute of Standards and Technology

OECD	Organisation for Economic Cooperation and Development
OLS	Ordinary Least Squares
OTC	over the counter
PRIVCREDIT	private sector in percentage of GDP
RMB	Rand Merchant Bank
SAFCOM	SAFEX Clearing Company
SAFEX	South African Futures Exchange
SARB	South African Reserve Bank
SAVI	South African Volatility Index
SAVINGS	Gross National Savings
SEC	Security and Exchange Commission
SEMATECH	Semicondictor Manufacturing Technology
SIV	Special Investment Vehicle
SSA	Sub-Saharan Africa
SSF	single stock future
Strate	Share Transaction Totally Electronic
TR	trade repository
UK	United Kingdom
UNCTAD	United Nations Conference on Trade and Development
US	United States (of America)
VAR	Vector Autoregression
VEC(M)	Vector Error Correction (Model)
WFE	World Federation of Exchanges

To my mother

CHAPTER 1: INTRODUCTION

1.1. BACKGROUND

The Task Force on Financial Engineering for Economic Development (FEED)[1] holds the view that countries such as those in Africa are now more than ever in need of modern tools for risk management in order to hedge against the risks inherent in the volatile prices, interest rates and exchange rates of international financial markets. The use of derivatives for managing such risks is widely acknowledged. As a consequence, the task force, with the collaboration of the World Bank, held its very first teleconference on Africa in January 2012. This covered the topic “Derivatives and economic development: African case studies” (FEED & World Bank 2012).

Derivatives are financial instruments of which the value is derived from the price of underlying products such as equities and equity indices, bonds, loans, interest rates, exchange rates, commodities, mortgages, and even the effects of catastrophes such as earthquakes and droughts (Dodd 2008; FEED & World Bank 2012; Ruiz 2010; Vander Stichele 2010). These instruments consist of contracts that strive to derive payoffs from changes in the value/price of their underlying asset/product. As such, these contracts come in many shapes and forms, including forwards, futures, options, swaps, and various combinations thereof. Derivatives are traded either over-the-counter (OTC) or on organised exchanges, depending on their type. While OTC derivatives are bilaterally agreed between two parties without passing through an exchange, exchange-traded derivatives, on the other hand, are standardised products that trade on (stock) exchanges, which facilitate their regulation (Dodd 2008; FEED n.d.; Stulz 2004).

The role of derivatives in the latest financial crisis has been widely publicised. Derivatives have also made headlines as the cause of other financial disasters such as the Mexican financial crisis of 1994, the East Asian financial crisis of 1997 and the crisis that hit the euro-zone in 2010. All along, derivatives have been associated with the collapse of well-known institutions such as the Queen’s banker (Barings), Long-Term Capital Management (LTCM), Enron and Lehman Brothers (FEED & World

[1] FEED was created to promote the creation of well-functioning capital market frameworks in developing countries and facilitating the use of derivatives and other financial products by such countries in managing the risks that obstruct sustainable development. FEED provides advice to countries with the least developed financial markets on derivatives, capital markets, microfinance and structured products.

Bank 2012; Fender & Gyntelberg 2008; Stulz 2004). Despite this, Warren Buffet, the main promoter of the well-known claim that “derivatives are instruments of mass destruction”, still defends that “the problem with derivatives is with OTC derivatives and not exchange-traded derivatives” (Rodrigues, Schwarz & Seeger 2012). These so-called OTC derivatives represent 50% of the derivative contracts trading in developing countries, compared to only 38% in advanced economies (Mihaljek & Packer 2010). Such a large amount of obscure transactions in derivatives markets make them a high-risk factor for the financial environment of developing countries (Wahl 2009).

Many believe that derivatives can enhance the development process of developing countries (FEED & World Bank 2012). For instance, the use of these instruments can help to reduce countries’ economic volatility (Tiberiu 2007). In fact, many developing countries, including those in Africa, remain beset by highly unstable macro-performance indicators that impair economic growth and the welfare of the population, perpetuating underdevelopment and undermining efforts to meet the Millennium Development Goals (MDGs) (Loayza, Rancière, Servén & Ventura 2007; UNCTAD 2009). These MDGs are the eight interrelated international development goals that all United Nations member states have agreed to achieve by the year 2015. They represent a partnership between developed and developing countries to create an environment, at both national and global levels, which is conducive to development and the elimination of poverty. Essentially, these goals entail (1) the eradication of extreme poverty and hunger, (2) the achievement of universal primary education, (3) the promotion of gender equality and empowerment of women, (4) the reduction of child mortality, (5) the improvement of maternal health, (6) the combating of HIV/Aids, malaria and other diseases, (7) the guarantee of environmental sustainability, and (8) the development of global cohesion in development (United Nations Development Group 2003:3–4).

It is observed on the Making Finance Work for Africa (MFW4A) website that countries in Africa, except for South Africa and the North African economies of Morocco, Egypt and Tunisia, do not have derivatives markets. Even for these North African countries, the volume of derivative transactions remain small since the derivative markets are mostly in their infancy. Moreover, these derivatives markets mostly focused on foreign-exchange derivative contracts. A few countries in Sub-Saharan Africa (SSA) are equipped with agricultural commodity exchanges, including Ghana, Ivory Coast, Kenya, Malawi, Nigeria, Uganda and Zambia, and these also are still in the early stages of trading. As emphasised by Goromonzi (2010:11), this lack of proper derivatives trading infrastructure in Africa (e.g. derivatives exchanges and central counterparty clearing houses) shrinks countries' exchange, brokerage and investment environments. MFW4A (n.d.) does note, however, the imminent establishment of a commodities and derivatives exchange in Botswana, which will serve as a hub for pan-African trading.

In essence, the institutionalisation of derivatives trading in Africa will contribute to the deepening of financial markets through the introduction of new products that will assist the enhancement of risk management operations (Bahgat 2002:5). Derivatives are expected to improve the performance of financial markets (MFW4A n.d.) by allowing for advanced price discovery mechanisms, by providing opportunities for hedging risk and by permitting investments to become more productive, thereby leading to a higher rate of economic growth (Şendeniz-Yüncü, Akdeniz & Aydoğan 2007:2). Derivatives markets will provide the market users with some tools of self-insurance against volatile capital flows (Adelegan 2009:2).

Of all the African countries, South Africa has the most active and a well-functioning derivatives markets (Adelegan 2009). The country trades a wide range of derivatives products, including forwards, futures, options and swaps based on commodities, equities, interestrates and currencies exchange rates (Johannesburg Stock Exchange n.d.). In particular, the South African agricultural commodities futures market has grown into a very active segment of the country's financial system and now provides important risk-management facilities that are used extensively by producers in the region (MFW4A n.d.). South Africa's derivatives experience is a step in the right direction not only for the country's increasing access to finance, financial risk management, and financial market deepening, but also in meeting the challenges of globalisation (Adelegan 2009).

1.2. PROBLEM STATEMENT

The World Bank predicts that by 2030 more than three quarters of the population of Sub-Saharan Africa (SSA) might be among the world's poorest (Wahl 2009:1). In effect, growth in Africa has been neither sustainable nor fully inclusive, and this was the case even before the crisis hit the continent in 2008 (NEPAD & OECD 2009:6). As a result, some major financial institutions such as the World Bank and the African Development Bank (ADB) are advocating the development of derivatives markets within African milieus as a means of achieving wider spread development throughout the continent. In 2002, the ADB had already worked on initiatives to assist the development of domestic derivatives markets in African countries. In addition, the World Bank has often undertaken derivatives transactions to manage weather and financial risks for its sovereign clients in Africa (Bahgat 2002; FEED & World Bank 2012).

Derivatives markets will create an atmosphere conducive to better risks transfer, enhanced public information, and lower transaction costs (Tsetsekos & Varangis 2000), thereby allowing a climate of effective price discovery and market transparency to develop throughout Africa. However, these instruments may also create new risks, which make them a potential threat to financial systems and economies in general.

Prior to this study, Şendeniz-Yüncü et al. (2007), Baluch and Ariff (2007), Haiss and Sammer (2010) as well as Rodrigues et al. (2012) examined the link between the development of derivatives markets and economic growth. While Haiss and Sammer's (2010) emphasised the relationship between derivatives trades and growth in the United States, the studies by Şendeniz-Yüncü et al. (2007), Baluch and Ariff (2007) and Rodrigues et al. (2012) focused on some panels of both developed and developing countries. Particularly, Rodrigues et al. (2012) examined the impact of derivatives trading on economic growth and growth volatility using 45 different countries, including South Africa. Yet, the issue of the impact of derivatives trading on economic growth has not been examined adequately in a SSA context yet. South Africa has been among the countries investigated by Rodrigues et al. (2012) and Şendeniz-Yüncü et al. (2007) but the link between derivatives and growth has never been considered in an exclusive emerging market setting, let alone any SSA context.

1.3. OBJECTIVES

1.3.1. Primary objective

This research emphasises the case of South Africa to illustrate the likely developmental impact that the institutionalisation of derivatives trading could have on SSA countries.

1.3.2. Secondary objectives

In an attempt to meet the primary objective, the enquiries of the study are aimed at achieving the following sub-objectives:

(1) Finding out the possible channels of influence of locally operating derivatives exchanges on economic growth, and the infrastructures that need to be in place to ensure well-functioning derivatives exchanges

(2) Assessing whether the introduction of derivatives markets contributed to economic development in South Africa

(3) Examining whether a causal relationship exist between the local derivatives trades and South Africa’s economic growth

(4) Evaluation how South Africa’s derivatives exchange has affected the country’s economic (real GDP growth) volatility/economic stability.

1.4. LITERATURE REVIEW

Derivatives markets function in a way that is complementary to capital markets (Dodd 2008). At this point, most capital market development initiatives undertaken on the African continent have been characterised by inefficiency. Most of the continental capital markets are illiquid and unable to generate adequate economic growth and development (Applegarth 2004; Ewah, Esang & Bassey 2009; Ly 2011). Despite the fact that the existence of derivatives markets relies on the existence of liquid underlying markets, derivatives could contribute towards making capital markets more efficient and better developed. As a result, it has been suggested that the development of markets for derivatives should be pursued parallel to that of capital markets, as the development of both financial markets would spur on growth (Chami, Fullenkamp & Sharma 2009; Dodd 2008).

This literature review addresses the themes of capital market development and economic growth, the development of derivatives markets and economic growth, the impact of derivatives on economic volatility, as well as the infrastructure of a formal derivatives market.

1.4.1. Capital market development and economic growth

According to Ewah et al. (2009), a capital market is one in which medium- to long-term finance can be raised. Encompassing markets for stocks, bonds and other financial instruments, the capital market is thought of as an exchange or centralised institution that eases transactions between willing investors (lenders) and those companies (borrowers) that are in need of funding. It has been suggested that the development of capital markets will create the appropriate systems, mechanisms, and incentives that can help boost economic growth and promote long-term poverty reduction in Sub-Saharan Africa (Applegarth 2004).

Among others, the development of financial markets entails an improvement of financial instruments, markets and intermediaries in order to better trade, diversify and manage risks (Levine 2005). The various studies that have examined the relationship between financial development and economic growth have divided the literature on the relationship between financial development and economic growth into three main groups, each with a different point of view. For instance, McKinnon (1973), Shaw (1973) and Rajan and Zingale (1998) defend that financial development leads to economic growth (supply-leading response). Accordingly, Odhiambo (2011) support the view that the establishment and promotion of financial institutions in developing countries should be brought about according to a belief in the "supply-leading" relationship between the development of the two (Baluch & Ariff 2007). Others authors such as Ahmed and Ansari (1998), Calderon and Liu (2003), Darrat (1999), Ghali (1999), Habibullah and Eng (2006), Jalilian and Kirkpatrick (2002), Jung (1986), King and Levine (1993), Spears (1992), Suleiman and Abu-Qaun (2008) and also Xu (2000), have supported this view that it is financial development that drives economic growth. Conversely, Agbetsiafa (2003), Waqabaca (2004) and Odhiambo (2004), just to cite a few, argued that it is economic growth that leads to the development of the financial sector (demand-following response). Moreover, an ultimate argument that is defended by Al-Yousif (2002), Odhiambo (2005), Demetriades and Hussein (1996), Luintel and Khan (1999), and Wood (1993), is that both financial development and economic growth Granger-cause one another, meaning that they follow bi-directional causal relationships (Odhiambo 2009a, 2011).

Mishra, Mishra, Mishra and Mishra (2010:131) advocate that the most important contribution to the literature on financial and economic development has been made by Schumpeter (1912), who stated that financial development promotes economic growth by allowing the funding of entrepreneurs, and particularly by channelling capital to entrepreneurs with high-return projects. Furthermore, in support of more recent literature, Mishra et al. (2010) suggest that financial development by means of capital market liberalisation can influence a country's economic growth through three fundamental channels: firstly, by increasing the savings rate; secondly, by positively affecting investments; and thirdly, by increasing efficiency of capital allocation. An argument made by Stiglitz, Ocampo, Spiegel, Ffrench-Davis and Nayyar (2006) is that developed capital markets can enhance stability, as they permit countries to draw resources from diversified sources of funds, including international sources, thereby helping to stimulate economies. The development of capital markets, in the opinion of Stiglitz et al. (2006), may also improve growth and welfare by allowing investors to invest and diversify risk. Well-developed capital markets may exert a disciplinary force on adherence to a country's good policies, which will help to keep it on a solid reform path.

Conversely, the development of capital markets is often affected by market failures, especially because such markets generally expose countries to greater risks (Stiglitz et al. 2006). In effect, Stiglitz (2000) disputes the notion that capital markets produce instability and not growth. Adding to this, Ocampo, Spiegel and Stiglitz (2008) observe that capital markets generally create risks, especially in developing countries where such markets make it more difficult to achieve macroeconomic stability, and thus fail to help to achieve higher levels of investment or faster rates of economic growth. Similarly, Charlton (2008) claims that the development of capital markets does not always enhance welfare, except when it involves capital flows such as foreign direct investment (FDI). As emphasised by Stiglitz (2000), FDI can generate the resources, technology, access to markets, valuable training and improvement in human capital required for economic growth and the alleviation of poverty; and FDI is not as volatile or disruptive as other (short-term) capital flows that can suddenly rush in and out a country. Charlton (2008) therefore claims that the development of capital markets is more of an inducer of inequalities and poverty in developing countries, because these markets generally increase these countries' macroeconomic volatility, sensitivity to international markets and systemic risk.

In the end, as capital markets develop, financial markets move towards becoming complete markets (Ngugi, Amanja & Maana 2009). Financial development has clearly been supported, considering the role that financial intermediaries such as banks play in the economic growth and development of developing countries, which is necessary for a sustained and widespread reduction in poverty. However, capital markets are the principal source of banks' intermediation. With adequate depth, capital markets can play an essential role in economic development by mobilising funds for the financing of longer-term projects (Badun 2009; Levine, Loayza & Beck 2000; Mboweni 2006). Consequently, the existence of well-functioning capital markets is essential to ensure developed and efficient financial sectors (Baluch & Ariff 2007; Kirkpatrick 2000; United Nations 1999).

Since the early 1990s, SSA countries have undergone financial reforms aimed at facilitating the establishment of capital markets (Ly 2011). South Africa stands as a country with relatively well-developed capital markets among emerging markets (Mboweni 2006). The country has the most advanced capital market structure in SSA and distinguishes itself by its strong economic performance. The development of capital markets in South Africa has helped to drive the country's growth (Ly 2011).

1.4.2. The development of derivatives markets and economic growth

Baluch and Ariff (2007) note that the studies that have empirically tested the relationship between financial development and economic growth have often shown disparities in measurement issues regarding economic and financial development, as well as in their interpretations of these measures.

When studying the relationship between the existence of futures markets and economic development in a set of developed and developing countries, Şendeniz-

Yüncü et al. (2007) used the ratio of the total value of stock index futures contracts to nominal gross domestic product (GDP) to measure futures markets' development. Şendeniz-Yüncü et al. (2007) revealed that countries with medium-sized futures market value relative to their GDPs exhibited a more significant positive relationship between their futures market development and economic growth. Moreover, Şendeniz-Yüncü et al. (2007) suggest that the impact of futures market development on economic growth is less important for both the countries that have large futures market values relative to their GDPs and those with small futures market values relative to their GDP. They thus caution that well-functioning financial markets are essential for stimulating the growth of the economy.

The study carried out by Baluch and Ariff (2007) gauged the relationship between derivatives markets and economic growth in a set of countries using the market value of outstanding exchange-traded derivative contracts relative to GDP as a measure of derivative usage. Baluch and Ariff (2007) indicated that a positive relationship exists between the development of derivatives markets and economic growth through increased capital formation over time and, accordingly, confirmed the finding of Şendeniz-Yüncü et al. (2007) that countries with well-functioning derivatives markets experience a higher growth than countries without. Nonetheless, Baluch and Ariff (2007) admit that the effect that derivatives markets may have on economic growth is dependent on the utilisation of such markets, suggesting that the risk transfer function of derivatives markets is likely to contribute towards economic growth. According to Baluch and Ariff (2007), the liquidity of the underlying markets is the most critical factor driving the successful operation of any derivatives market; developing countries must therefore launch derivatives products on their most liquid financial markets.

In turn, Haiss and Sammer (2010) used the amounts outstanding of derivatives reported by the Bank of International Settlement (BIS) as an indicator for derivatives usage, while Rodrigues et al. (2012) used a dummy variable – that is, as an indicator of the institutionalisation of derivatives trading. Haiss and Sammer (2010) examined the impact of derivatives markets on the United States' economic growth and found a very weak link between the two. On the other hand, Rodrigues et al. (2012) found that the existence of derivatives markets made a significantly positive contribution to these countries' per capita GDP growth. Despite these somewhat different findings, Haiss and Sammer (2010) and Rodrigues et al. (2012) have suggested some channels through which derivatives markets influence the economic development of countries.

It is interesting to note, however, that when considering the risk of derivatives markets on development, Haiss and Sammer (2010) raise the question of "whom the welfare generated by derivatives benefit, if not the whole economy?" In actual fact, Haiss and Sammer's (2010) main concern is that the welfare effects of derivatives trading are generally absorbed by financial intermediaries such as banks. This is quite consistent with Wahl's (2009) objection that the majority of derivatives instruments are the ensuing products of the prevailing system of deregulated international markets that have been labelled "the casino economy"[2]. As it happened, the latest financial crisis was believed to be a product of this casino system. The casino system, according to Wahl (2009), chiefly promotes the finance principle of "profit/wealth maximisation at all times" and fails to allow adequate progress to be made in the domain of development, thereby creating more and more social inequalities. For example, Wahl (2009) claims that in the face of the prevalence of this system, only about 87 000 Africans, i.e. less than 0.01% of the total African population, benefit from the continent's growing integration into the global market. As a result, Wahl (2009:1) cautions that "*the casino has to be closed*".

In spite of all this, derivatives have remained well established as instruments for financial and investment management in a number of emerging markets, including South Africa (Schwegler 2010). Producers of agricultural commodities are now able to derive significantly positive payoffs from their use of derivatives through the more efficient allocation of resources to their production (Gemech, Mohan, Reeves & Struthers 2011).

Derivative instruments play such a central role in the South African financial environment that experts in the South African financial services industry encourage investors to make more use of them. Many local and foreign institutional investors

[2] After the elimination in 1973 of the political regulation of the Bretton Woods system, which at its core promoted stable rates of exchange between important currencies and the control of capital transactions, new derivatives were being invented for various businesses. For example, from the fluctuation of rates, derivatives contracts were created that applied to underlyings varying from rates of exchange to shares, and up to aggregated indicators such as the Dow Jones or Dax (Wahl 2009).

are already interacting within South African derivatives markets (Schwegler 2010). In 2008, the overall South African derivatives trading activity grew almost 56% from its 2007 level (Futures Industry Association 2009). That same year, as Schwegler (2010) observes, the Johannesburg Stock Exchange (JSE) was listed among the world's tenth largest derivatives exchanges in terms of the number of contracts traded, and was named the derivatives exchange with the largest number of single stock futures contracts traded in the world. The exchange traded 431.2 million single stock futures in 2008, corresponding to a 62.4% increase from the preceding year's numbers (Futures Industry Association 2009; Schwegler 2010).

1.4.3. The impact of derivatives trading on economic volatility

Economic instability can have adverse effects on a country's growth through different channels. Indeed, uncertainty about the economic environment could significantly reduce investors' willingness to take risks, including banks' ability and willingness to lend, as well as the willingness and ability of firms to invest. Similarly, just as economy instability may discourage firms from investing, volatility may discourage individuals from investing in human capital, and as human capital deteriorates, unemployment spreads and becomes prejudicial to growth and welfare (Stiglitz et al. 2006).

The examination of the stabilising effect of derivative trading involves the study of its impact on volatility behaviour. It is possible that derivatives trading could impact on the volatility of the underlying spot markets by stabilising or reducing their volatility; on the other hand, derivatives trading may destabilise and increase the volatility of these spot markets (Ray & Panda 2011).

A study of the effect of the use of derivative products on countries' macroeconomic volatility was carried out by Tiberiu (2007) in the context of those countries of which the financial markets are members of Euronext[3], excluding Portugal. Tiberiu (2007) believes that the use of derivative products has a positive impact on the reduction of

[3] Euronext is a cross-border European electronic stock exchange based in Amsterdam, Netherlands. Created in 2000 from the merger of the Amsterdam, Brussels and Paris stock exchanges, the Euronext group was expanded in 2001 and 2002 through the acquisition of the London International Financial Futures and Options Exchange (LIFFE) and the Portuguese stock exchange, Bolsa de Valores de Lisboa e Porto (BVLP), respectively, and it thus became one of the world's largest exchanges. On April 4, 2007, Euronext completed its agreed merger with the NYSE Group, resulting in the formation of NYSE Euronext. In addition to equities and derivatives markets, the Euronext group provides clearing and information services (investopedia.com).

the volatility of investments and commercial transactions, and he therefore acknowledges the existence of a significant relationship between the amount of the derivatives products traded on the market and the reduction in a country's economic instability.

Subsequently, Rodrigues et al. (2012) had a quick look at the effect of the institutionalisation of derivatives markets on GDP volatility. While a more detailed investigation of this important question of the relationship between derivatives exchanges and growth volatility is postponed for later research, Rodrigues et al. (2012) nonetheless hint that the establishment of derivatives exchanges can lower GDP growth volatility.

1.4.4. The infrastructures of a formal derivatives market

The establishment of adequate market infrastructures plays a fundamental role in enhancing a country's economic performance. More precisely, the presence of strong institutions that guarantee financial stability and market security is considered an equally important prompter of growth (Infante & Smirnova 2010). Well-functioning derivatives and capital markets are essential if the markets are to operate efficiently, and the conditions required for this to happen include a stable macroeconomic environment, appropriate market infrastructures, as well as adequate regulatory and supervisory frameworks for protecting investors, promoting public confidence and guaranteeing market discipline (United Nations 1999).

The world of derivatives continuously creates innovative ways of risk management by allowing the emergence of new products. Pickel (2006) explains that this evolution of derivatives would not be possible if the infrastructures to support such innovative financial products had not been carefully put in place. Pickel (2006) therefore maintains that the mandatory regulation, market practices and operations, and the building blocks of derivatives need to be implemented in conformity with international standards in order to facilitate the functioning of derivatives markets. Accordingly, the success of a derivatives exchange is dependent on the soundness of the foundations on which it is built (Tsetsekos & Varangis 2000), and the fundamentals of a derivatives trading system may be borrowed to form the foundation for new businesses in derivatives dealing (Pickel 2006). Other SSA countries can therefore model their derivatives exchange structure upon that of South Africa (Adelegan 2009).

1.4.5. International perspective

The global derivatives market has witnessed ample market entries in recent years, expanding its scope beyond the boundaries of the industrialised world.

Several developed countries such as the US and the UK have significantly improved their economic performance by allowing the development of a wide range of new financial instruments and techniques for managing risks (De Rato 2007; Deutsche Bundesbank 2008; Dodd 2008). Derivatives markets have therefore become a critical component of the financial scene in the Group of Ten (G-10) countries.[4] Financial development in these countries has mainly entailed the increasing use of products that allow for the trade of illiquid assets and credit risks, such as credit derivatives and structured products. The intensive use of these instruments has helped broaden financial markets, thereby making them even more complete. The recognised products for credit derivatives in the G-10 are credit default swaps (CDSs). CDSs rose to a nominal value of US$58 trillion at the end of 2007, from less than US$1 trillion in 2001. The G-10 countries trade mostly interest rate derivatives, followed by foreign exchange contracts, and lastly credit derivatives (Deutsche Bundesbank 2008).

Structured products, including structured credit-linked securities and other asset-backed securities, are not really derivatives instruments. However, these products are usually constructed using derivatives. The principal products for structured products are asset-backed securities (ABSs) and, within this category, collateralised debt obligations (CDOs), for which the underlying assets consist of CDSs. The value of structured products issued in the United States and Europe alone totalled US$2.6 trillion in 2007, compared with US$500 billion in 2000. Structured products make it difficult to prevent risks from spreading from one financial system to another. Because these products are capable of closely connecting market participants'

[4] G-10 is a group of 11 developed countries, including France, Germany, Belgium, Italy, Japan, the Netherlands, Sweden, the United Kingdom, the United States, Canada and Switzerland that meet on an annual basis to debate and cooperate on international financial matters (Investopedia.com).

derivatives positions, they can easily generate crises on a very wide scale, as they did in 2007 (Deutsche Bundesbank 2008).

The growing role of derivatives in developing economies was first emphasised by Dodd (2006). New derivatives exchanges in the developing world have been competing with those in developed countries. Four new derivatives exchanges were set up in India between 2000 and 2003 (National Stock Exchange of India, Bombay Stock Exchange, MCX India and NCDEX India); three derivatives operations have commenced in the Middle East since 2005 (Dubai Gold and Commodities Exchange, Kuwait Stock Exchange and IMEX Qatar); China has seen the establishment of two formal derivatives markets since 2005 (Shanghai Futures Exchange and China Financial Futures Exchange); both Brazil and Chile have developed foreign exchange derivatives markets that are among the most sophisticated and transparent in the world; and South Africa now has one of the most active derivatives markets outside the G-10 (Deutsche Börse group 2008; IFCI-Risk Institute n.d.). Furthermore, the derivatives activity of developing economies has witnessed considerable growth in the past years. The daily average turnover of derivatives exchanges in developing economies has increased by 300% since 2001, and by 25% between 2007 and 2010; this despite the crisis in 2008–09. These rates were even higher than those in the more advanced economies where the growth of turnover has stood at 250% and 22% since 2001 and 2007 respectively (Mihaljek & Packer 2010). These developments have helped enhance the stability and growth of these countries (De Rato 2007).

In contrast to countries in the industrialised world, developing nations, and particularly those in Africa, have remained more concerned with managing the adverse effects of commodity price instability, although other circumstances arise that add to the risk exposure of these commodity-dependent countries. Africa’s openness to global markets causes the continent’s international finance flows to grow exponentially. Countries in SSA, in particular, have exhibited the most significant increases in the form of capital flows as a result of their external debt accumulation, FDIs, portfolio investment flows and bank flows. More to the point, the risk exposure of African economies increases as their participation in the global market grows. Aside from commodity price risks, other risks include those associated with the servicing of debts, as well as the risks inherent in the movements in exchange rates (Geda 2009). The prevailing global marketplace has major implications for the design of the trading practices used throughout Africa and therefore requires that innovative trading mechanisms are made available for African countries to employ in an open macroeconomic environment. The trade of derivatives contracts is closely linked to transactions involving international capital flows (Dodd 2008). Hence, derivatives markets could be useful in hedging the risks that come from countries' cross-border commercial and finance-related transactions (Tsetsekos & Varangis 2000).

Ultimately, the financial crisis in 2008 contracted the world's derivatives activity, but did not put a stop to this lively segment of the global financial market. Following the sharp decrease in the overall turnover on global derivatives exchanges from its $690 trillion peak in early 2008 to $408 trillion at the end of that year, the activity on global derivatives exchanges eventually started to recover from mid-2009, rising by 5% in the last quarter of that year (Baba, Gadanecz & McGuire 2008, 2009; Gadanecz, Gyntelberg & McGuire 2009; Avdjiev & Upper 2010). The world's overall amount of outstanding derivatives reached $1.28 quadrillion in 2009, an amount more than twenty times the GDP of the whole world (Van den Nieuwenhuijzen 2010).

1.5. DEMARCATION AND DELIMITATION OF THE STUDY

This study attempts to highlight the effect that the institutionalisation of derivatives could have on the development of SSA countries by examining the link that may potentially exist between the development of a derivatives trading system and economic growth in South Africa. South Africa is the only country in SSA with a derivatives exchange, and this country's derivatives exchange is renowned as one of the most efficient among the developing countries. Showing how the trade of derivatives has impacted on South Africa's economic development could clarify the potential role that these instruments might play in SSA economies. This may well have the effect of driving more derivatives initiatives in SSA, which would enhance countries' competitiveness within the global markets, as well as promoting growth and bringing about social welfare improvements. In reality, as observed by Ishola (2008), the SSA region's overall economic growth remains below the level required if countries are to meet the target established by the MDGs of reducing poverty by half by 2015. New mechanisms are required to accelerate and sustain regional countries' growth processes.

In the aftermath of the financial crisis, confusion about the role the use of derivatives may play in the market place has surely grown among developing countries (FEED n.d.:1). It can therefore be important to reiterate the importance of establishing domestic derivatives markets in such countries.

1.6. RESEARCH METHODOLOGY

1.6.1. Research approach

The study uses a mixed research approach, combining both a literature review and an empirical investigation in meeting its stated objectives.

A literature study/review entails the search of secondary sources for relevant information regarding the subject of the research in order to expand on the theory that relates to the topics of interest (Polonsky & Waller 2011). In the context of the current study, this theoretical aspect of the study first explores the literature dealing with the effects of derivatives markets on both capital market development and economic growth. Thereafter, by mainly examining the structure of the South African derivatives exchange, the study goes on to reveal the infrastructures necessary for the functioning of an efficient derivatives exchange. Compiling the literature review has required the accessing of secondary sources of information, including books, journal articles, theses, as well as government and other institutional publications.

On the other hand, the purpose of empirical research is to obtain data with the intention of performing a statistical analysis that will generate valuable information regarding a given population of elements. The design of such a study involves planning the methods and procedures to be employed in collecting and analysing the data (Polonsky & Waller 2011). The subsequent sections therefore deal with this planning.

1.6.2. Data collection

Surveys, secondary data studies, experiments and observation constitute data collection methods useful for obtaining data and information (Polonsky & Waller 2011; Zikmund 2003). This study seeks to examine how the establishment of a derivatives exchange can affect a country's capital market development and economic growth. The empirical study entails the investigation of longitudinal data of a secondary nature, the sources of which comprise the online databases of the South African Reserve Bank (SARB), the World Bank and the World Federation of Exchange (WFE). As a measuring indicator for economic development, the study uses the growth in GDP, while the exchange-traded derivatives volumes proxies the development of the derivatives markets. Following Rodrigues et al.'s (2012), other independent factors that may influence economic growth need to be acknowledged and also accounted for. Rodrigues et al. (2012) group these factors according to two broad categories of control variables, including the Solow model variables and some variables capturing the development of the financial system and, hence, of the capital markets. The table below presents both sets of control variables along with their respective proxies as reported by Rodrigues et al. (2012).

Macroeconomic/ Solow model factors	Proxies	Financial development factors	Proxies
The investment rate and capital accumulation	The gross national savings in percentage of GDP	The sophistication of the stock markets	The market capitalisation of companies listed at stock exchanges as percentage of GDP
The aggregated private and public consumption of the country	The gross national expenditures in percentage of GDP	The liquidity and depth of the stock market	The turnover ratio (turnover) calculated as the number of stocks bought and sold during the year, divided by the average of the number of stocks outstanding at the beginning and at the end of the trading period
Inflation	The growth rate in the consumer price index	The depth of the banking sector	The liquid liabilities (M3) as a percentage of GDP serve as indicator for the depth of the banking system in the economy
The openness of the economy	Trade in percentage of GDP	The sophistication of the debt market	The domestic credit to private sector in percentage of GDP, measuring the volume of debt financing of the private sector
The growth of the labour force	Population growth in percentage of GDP		
The accumulation of human capital	Secondary school enrolment as percentage of gross population		

Table 1.1: The control variables and respective proxies of Rodrigues et al. (2012)

Source: Researcher’s own construct based on information provided by Rodrigues et al. (2012)

1.6.3. Sampling

Sampling is the procedure of using a smaller portion of items or a target population to draw an inferred conclusion about a larger set of items or the whole population (Zikmund 2003). This study seeks to focus on both the pre- and post-1990's implementation of the South African derivatives exchange.

Yearly time-series samples of the relevant variables were selected that comprise data variables covering a time period from 1971 to 2012.

1.6.4. Data analysis

A myriad empirical techniques exist that can be used to analyse data from a quantitative research perspective (Polonsky & Waller 2011). Using historical time-series data, the study mainly employs three econometric models to assess the relationships between the existence of a system of derivatives trading and the country's GDP growth. First, the linear regression between economic growth and its potentially influential variables was assessed. Subsequently, the causal relationship-between the existence of the derivatives exchange and the country's GDP growth was determined. Finally, the impact of derivatives trading on the country's GDP volatility was dealt with.

More specifically, the study intends to establish whether or not there is a link between derivatives activity in South Africa and the country's GDP growth from the establishment of its derivatives exchange in 1990 to 2012, using the Generalised Method of Moments (GMM) estimator and the Granger causality test. However, the assessment of the causal relationship between the development of the derivatives exchange and the country's GDP growth is addressed only for the period 1994 to 2012, as the WFE's publication of the country's derivatives activity only covers this period, perhaps as a result of the limited nature of the exchange's pre-1994 derivatives activity, which may be reflective of the country's history. In effect, unlike many other African and emerging-market countries, South Africa has long relied on its domestic financial markets rather than on international financial markets because of the anti-apartheid sanctions that were imposed on the country.

On the other hand, the assessment of the impact of the existence of the derivatives exchange on the country's economic volatility/stability was performed for the original period. A Generalised Autoregressive Conditional Heteroscedasticity (GARCH) model was used to test for the effect of South Africa's derivatives usage on the country's economic (GDP growth) volatility. The econometrics methods used are presented below.

1.6.4.1. The Generalised Method of Moments (GMM)

The GMM was derived from the method of moments, a special case of the Ordinary Least Squares (OLS) methods of estimation. The OLS models of estimation are frequently used for estimating linear regression among variables, which consists of an appraisal of the linear relationship that might exist between an outcome variable *Y* (i.e. a regressant) and one or a set of regressors *X*. The OLS is more reliable for regression assessment in the context of simple static settings than dynamic ones (Asteriou & Hall 2011). The OLS methods are likely to produce biased estimators in the context of an empirical growth regression (Bond, Hoeffler & Temple 2001). Because OLS methods ignore the error component present in the regression equation, OLS estimates will be inconsistent if any one regressor is endogenous, that is, if it is correlated with an error term (Asteriou & Hall 2011; Verbeek 2012). In addition, when using the OLS model, the possible omission of variables in the linear regression equation, either as a result of incorrect exclusion of a variable for which data are available or through the exclusion of a variable that is not directly observable, could also result in the OLS being inconsistent and biased (Cameron & Trivedi 2005). An efficient way of avoiding the bias problem of the OLS is to use the GMM estimator (Asteriou & Hall 2011). The GMM model is used extensively by growth researchers in the context of empirical growth regression testing (Bond et al. 2001).

The GMM estimation applies to a multivariate regression analysis that is used to determine whether the introduction of derivatives trading in South Africa has contributed to growth. The regression between the variables of interest in the study is analysed, where growth in GDP passes for the regressant (dependent variable) and the derivatives and capital markets development factors are the regressors in the linear model.

1.6.4.2. The Granger causality test

The Granger causality test establishes the direction of the causal relationship between variables, and thus seeks to determine the ability of one variable to predict and cause the other. A variable *Y* is said to Granger-cause *X* if *X* can be predicted with greater accuracy by using past values of the *Y* variable. Granger's test may yield four different results as follows (Asteriou & Hall 2011):

- Case 1: *X* causes *Y*; in this instance, there would be a one-way (unidirectional) causality running from *X* to *Y.*
- Case 2: *Y* causes *X*; depicting a one-way causality running from *Y* to *X.*
- Case 3: *X* causes *Y* and *Y* causes *X*; there would be a bi-directional causality between *X* and *Y.*
- Case 4: *X* does not cause *Y* and *Y* does not cause *X*; this would entail no causal relationship between *X* and *Y.*

The Granger causality test is applied to a bi-variate system, as the test entails only the examination of the direction of the causal relationship between the development of derivatives markets in South Africa and the country's economic growth, using a series on South African Futures Exchange (SAFEX)'s trading volumes as a proxy for the development of South Africa's derivatives trading.

1.6.4.3. The ARCH models

For some time series, heteroscedasticity (as opposed to homoscedasticity, also called the consistency of error variance assumption) is an indication of how the volatility of the corresponding variable changes over time. The Autoregressive Conditional Heteroscedasticity (ARCH) model was proposed in 1982 as a tool for determining such volatility in terms of the variance of the error term (Darnell 1994). In 1986, the Generalised ARCH (GARCH) model appeared as a remarkable improvement on the ARCH in the existence of conditional variances. The GARCH has many variations, including the Exponential GARCH (EGARCH), which can also be used as models in describing or predicting the volatility in time series, including data such as stock prices, interest rates and exchange rates. The GARCH models are also applicable to macroeconomic questions (Hamilton 2010).

In terms of the assessment of the impact of derivatives on South Africa's economic volatility, the study emphasises the pre- and post-1990 implementation of derivatives trading facilities in South Africa, and seeks to cover the period from 1971 to 2012. The study makes use of a GARCH(1,1) estimation to ascertain the change in country's economic growth volatility as a result of derivatives trading by considering the periods running from 1971 to 1990 and from 1990 to 2012 so as to establish whether the existence of a derivatives exchange has contributed to reducing or raising the country's economic volatility/stability. As is the case in the GMM estimation, the selected approach entails the modelling of a dummy variable that portrays the existence of the local derivatives exchange. This will effectively permit an examination of the actual impact of the exchange's growth in volatility over the targeted period.

1.7. RELIABILITY AND VALIDITY

The reliability of the methodology and the validity of the data collected must be considered to ensure that the selected research methods produce data that are suitable for addressing the research question and objectives. Reliability is the capacity of the chosen method of research to assemble reliable sets of data, while validity, on the other hand, refers to the ability of the selected data to measure what is intended, and to provide valid answers to the research questions (Polonsky & Waller 2011).

This research uses secondary data that was sourced from the databases of the South African Reserve Bank (SARB), the World Bank and the World Federation of Exchanges (WFE). Notably, the data linked to GDP as well as data relating to the sets of control variables, including the modelled macroeconomic variables and the variables pertaining to the development of capital markets were gathered from both SARB and the World Bank, while the variables describing the exchange-traded derivatives volumes were sourced from the WFE.

SARB, the World Bank and WFE are considered reliable sources of data. Moreover, the utilisation of similar data sources and techniques of analysis by recent studies – including Ishola (2008), Vuranok (2009) and Rodrigues et al. (2012) – in solving similar problems adds to the confidence in the reliability and validity of the data collected and any source thereof.

1.8. LIMITATIONS OF THE STUDY

The section dealing with limitations aims to present the unforeseen or unanticipated problems or difficulties that arose during the research or issues that might make the results less conclusive than hoped (Polonsky & Waller 2011).

The study suffers from two major limitations. Firstly, it is important to remember that each country is unique and faces circumstances that are pertinent to its specific situation. The outcome of this type of study may differ from country to country. Accordingly, the findings of the present study on the specific case of South Africa might not be the same for any other country, including countries in SSA.

Secondly, misspecification errors constitute a recurring problem in the domain of empirical econometrics. An example of a limitation that can occur is that the use of bi-variate causality tests may suffer from an omission-of-variable bias, and thus be unreliable. In effect, as indicated by Odhiambo (2009b), the introduction of a third variable affecting both variables in the bi-variate causality system may change the direction of causality and the magnitude of the estimates. A causality test could therefore be conducted based on a trivariate structure, where an additional variable is included as a proxy for capital market development so as to assess the causal relationship among derivatives, capital market development and economic growth in South Africa, even though the problems of endogenous and omitted variables also remain a major issue in that context (Stern 2011).

1.9. STRUCTURE OF THE STUDY

The study will be composed of six chapters as follows:

Chapter 1: Introduction

Chapter 2: Derivatives, Capital Market Development and Economic Growth

Chapter 3: The Infrastructures of the South African Derivatives Market

Chapter 4: Methodology

Chapter 5: Empirical Results

Chapter 6: Conclusion

1.10. SUMMARY

The global derivatives market is increasingly expanding its scope beyond the boundaries of the industrialised world. Many developing countries worldwide have started local derivatives exchanges that enhance their competitiveness within international markets. By using derivatives, countries with more advanced financial systems, both in the developed and the developing world, are able to improve their economic performance through the expansion of the financing and risk management techniques available to them. Derivatives markets can therefore be an important factor in the development of those nations that have implemented them.

In Africa, the majority of countries have not yet been affected by the wave of derivatives utilisation. The SSA countries, in particular, lack derivatives trading infrastructures. Consequently, the introduction of derivatives is being encouraged in these countries, with the intention of attracting further continental development. In normal circumstances, derivatives and capital markets develop simultaneously, so derivatives could encourage Africa's anticipated capital market development. These markets would complement each other in achieving faster and greater economic growth throughout the continent. Domestic derivatives markets are also likely to influence countries' economic stability positively.

Before this can happen, however, the establishment of vibrant, well-regulated and well-supervised derivatives markets is vital to prevent the risks of derivatives-aggravated disasters occurring in African contexts. As in any other sphere of financial sector development, it is essential to consider the issue of how derivatives markets would affect economies, and also to make sure that the tools of risk management contribute efficiently to the achievement of their stated benefits instead of impeding stability and facilitating unproductive activities.

The present study focuses on the only SSA country with a derivatives exchange, South Africa, in order to examine the impact that the institutionalisation of derivatives trading has had on GDP growth and growth volatility. In addition, it investigates the infrastructures required for operating a formal derivatives market. South Africa's derivatives markets serve as a tool for achieving better risk management and deeper financial markets. It is therefore a model for other SSA countries to follow. Using predetermined econometric models, the study mainly seeks to find empirical support for the positive or negative impact of the development of derivatives markets on South Africa's economic growth and economic volatility, as evidence of how the institutionalisation of derivatives trading could affect the growth of other SSA countries. Figure 1.1 below maps out the approach that is employed to solve the research problem at hand.

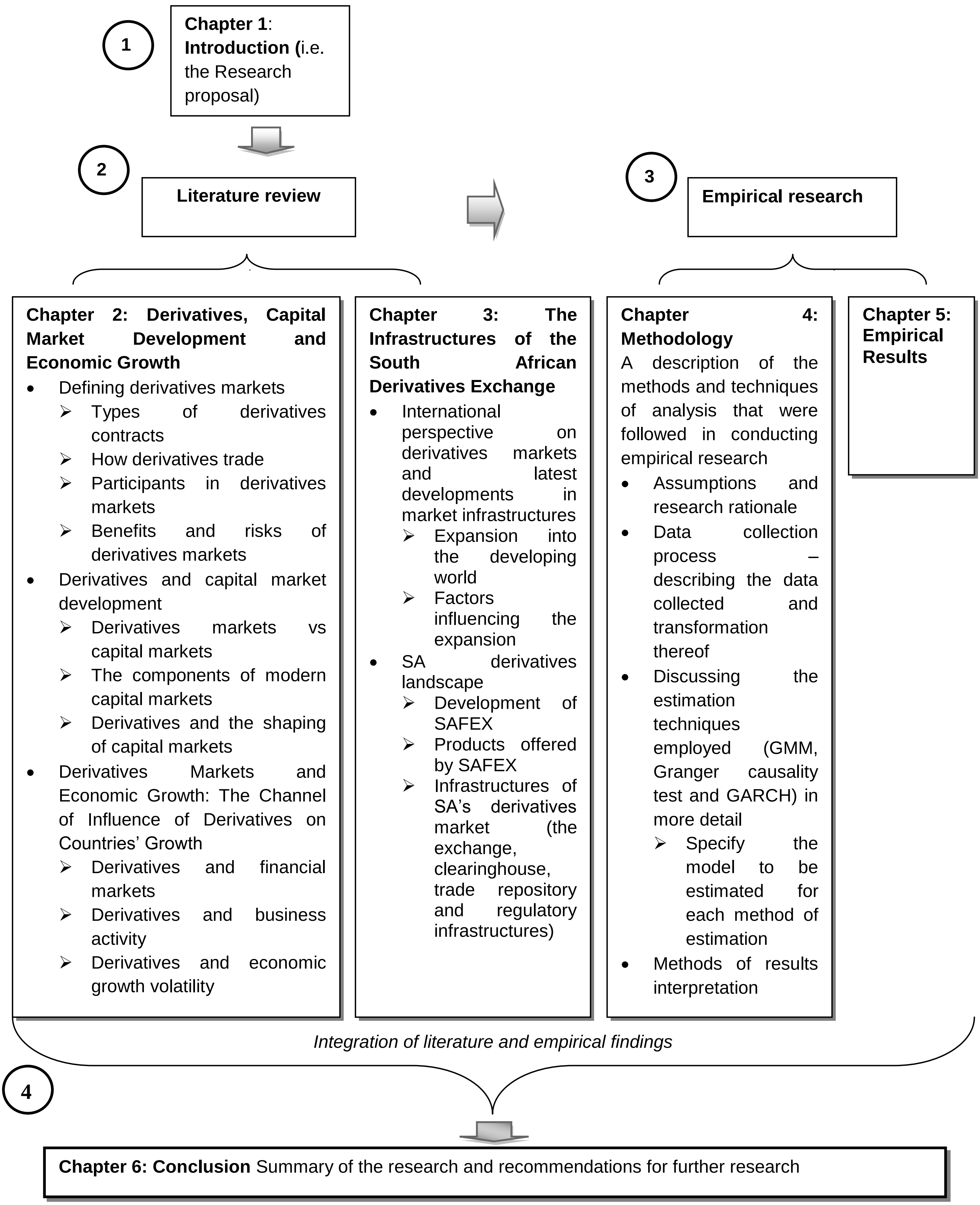


Figure 1.1: Mind map of the research

Source: Researcher's own construct

CHAPTER 2: DERIVATIVES, CAPITAL MARKET DEVELOPMENT AND ECONOMIC GROWTH

2.1. INTRODUCTION

Derivatives have had commercial uses for centuries. Called “grain loans”, the first of these financial products emerged as devices for avoiding fluctuations in the price of grains: for a price (in grain or silver) paid at the time the contract was entered into (before planting), a seller agreed to deliver a large amount of grain in the future (after harvest) (Swan 2000).

Among modern SSA countries, only South Africa has an active derivatives market. The lack of derivatives trading infrastructures in the region is perceived to be prejudicial to Africa’s investment environment and growth prospects. Hence, the advocacy for derivatives markets to appear in African milieus is made with the conviction that these markets will spur continental financial and economic development. In this regard, the markets are offered as a solution against the risks that countries face in the extremely volatile international financial markets. Moreover, given underdeveloped capital markets, expectations are that transactions like those involving derivatives need to develop along capital markets so as to drive the financial development and boost countries’ growth (Bahgat 2002; FEED n.d.; FEED & World Bank 2012; Dodd 2002; Goromonzi 2010; MFW4A n.d.).

However, views regarding the role of derivatives markets in the economy remain diverse among field experts. While, for instance, Warren Buffet referred to derivatives instruments as “financial weapons”, others, including the BIS, see them as valuable tools for financial improvements that bear economic growth merits (Van Wyk, Botha & Goodspeed 2012:387; Baluch & Ariff 2007; Haiss & Sammer 2010; Rodrigues et al. 2012).

This chapter therefore seeks to uncover the enhancing role of derivatives markets in capital market development and economic growth. The chapter begins by defining derivatives markets. Thereafter, the effect of derivatives trading on capital market development is investigated. Lastly, the examination of how the institutionalisation of derivatives markets may impact on countries’ economic development concludes the chapter.

2.2. DEFINING DERIVATIVES MARKETS

The newly enacted South African Financial Market Bill (2012) provides the following description of a derivative instrument (Minister of Finance 2012:8):

> ***"derivative instrument''*** *means any*:
>
> *(1) financial instrument; or*
>
> *(2) contract,*
>
> *that creates rights and obligations and that derives its value from the price or value of some other particular product or thing called underlying asset or simply underlying.*

The name "derivative" therefore comes from the fact that the value of the financial instruments is "derived" from that of an underlying (physical or financial) asset, such as a share or an equity index, a bond, a foreign currency, a commodity, a credit event or even another derivative (Chui n.d.; National Treasury 2009).

The market for derivatives instruments merely provides a forum for the buying and selling of these intangible products. With the modernisation of trading, derivatives markets no longer require a physical location, because trade can now occur via electronic platforms (Hublet n.d.).

2.2.1. The different types of derivatives contracts

Normally, there are four different types of instruments that underpin the construction of derivatives, including forwards, futures, swaps and options. Structured products, including Collateralised Debt Obligations (CDOs) and other Asset-Backed Securities (ABSs) such as mortgage-backed securities that can be created by mixing derivatives with cash or other derivatives instruments (Blundell-Wignall 2007; National Treasury 2009; Schwegler 2010). The basic derivative instruments are discussed below.

2.2.1.1. Forward and futures contracts

Both forward and futures contracts are legal agreements between two parties to buy or sell a particular asset at a specified future date and at a price agreed upon today. However, these types of contracts differ in that forwards are privately customised between two entities, while futures trade with standardised terms and are subject to the trading rules of an exchange. The underlying asset, size, expiry date and price quotation of futures contracts are therefore determined by the exchange where the contracts are traded. Such an exchange orientation of trade in futures contracts guarantees futures agreements against the risk of counterparty failure, which differs for a forward contract (Collier & Agyei-Ampomah 2008; National Stock Exchange of India 2009; Srivastava 2010).

2.2.1.2. Swaps

A swap is an agreement between two parties to exchange a series of future cash flows for another at specified future times (Collier & Agyei-Ampomah 2008). Swaps commonly involve one party making a series of fixed payments and receiving a series of variable payments. Although they may also involve both parties making fixed payments, the values of the payments must depend on a varying factor such as a fluctuating exchange rate. There four basic types of swaps, as described below (Chance & Brooks 2008):

(1) ***Currency swaps*** are contracts in which the parties make either fixed or variable interest payments in two different currencies.

(2) ***Interest rate swaps*** entail one party making a series of fixed-interest payments to another in exchange for variable interest payments from its counterpart, with both payments being in the same currency.

(3) In ***equity swaps***, at least one of the two parties makes payments determined by either the price of a share, the value of a portfolio, or the level of a stock index, while the payments made by the other party is determined by another share, portfolio, index or interest rate, otherwise the payment can be fixed.

(4) Lastly, in ***commodity swaps***, the payment made by one party is based on the value of a fluctuating commodity, such as oil or gold, while the other party makes either fixed or variable payments that are determined by some other variable.

2.2.1.3. Options

Options give a buyer the right (but not the obligation) to buy or sell an underlying asset at a predetermined price, either on a specific future expiry date (i.e. European options) or before the expiry date (i.e. American options), and this for an upfront payment of a *premium*. The price of an option is known as the *exercise price* or *strike price*, and the date in the contract is known as the expiration or maturity date (Hull 2009; Srivastava 2010).

Two forms of options are generally traded (Chance & Brooks 2008; Collier & Agyei-Ampomah 2008; Hull 2009):

(1) Calls give the buyer of the option the right to buy a given quantity of an underlying asset, at a given price, and on or before a given date.

(2) Puts are contracts in terms of which the buyer of the option acquires the right to sell a given quantity of an underlying asset at a given price, on or before the predetermined date.

The family of options comprises a large variety of simple (vanilla) and complex (exotic) instruments trading either on-exchange or OTC, such as warrants, baskets, swaptions, spreads, straddles, strips and straps, strangles, etc. This particular feature of option markets enables a wide variety of alternative strategies for meeting the risk management needs of investors (Chance & Brooks 2008; Collier & Agyei-Ampomah 2008; National Treasury 2009; National Stock Exchange of India 2009). Moreover, unlike other derivatives, hedging with options protects investors against adverse movements in prices, while retaining their potential of gain or loss from price movements (Hull 2009; Srivastava 2010).

The markets for forwards, futures, swaps, options and other possible combinations of the four instruments are the tools for innovative risk management strategies (Gomber 2009; Miloš Sprčić 2007; Srivastava 2010). Bahgat (2002) supports that the institutionalisation of derivatives markets aims for the deepening of African financial markets. The new tools of risk management can attract innovative financial techniques that would enhance the ability of investors to self-insure against financial risks, and thereby enhance economic performances (Adelegan 2009; Gomber 2009; Miloš Sprčić 2007; Şendeniz-Yüncü et al. 2007; Srivastava 2010). In addition, Sylla (2003) indicates that the management facilities provided by derivatives trading can lead to the sophistication of financial systems and may allow entrepreneurial activity to be invigorated, which can lead to better welfare to be achieved in these economies.

Yet, the modernisation of the financial environment may also present unfortunate consequences. Kohler (2012) and Sylla (2003) emphasise that banks are the pillar of financial systems and most derivatives trading involve these financial institutions. Very risky bets on movements in the price of underlying assets, in particular, can be made in the so-called OTC markets whereby incomes can flow among market participants without them actually trading in any underlying assets. Paradoxically, Sylla (2003) insists that by allowing better hedging facilities, the modernisation of financial systems through derivatives markets would encourage higher levels of risk-taking culture by promoting entrepreneurship, and such higher levels of entrepreneurial risk-taking can result in more prosperous, rapidly growing and developing economies. In effect, Schwegler (2010) emphasises that derivatives' energisaing of entrepreneurial activity will accompany significant development in the financial sector and the creation of businesses, leading to better employment opportunities and thus better economies.

2.2.2. How derivatives trade

Derivatives contracts are traded either on an organised derivatives exchange or in the OTC markets (Srivastava 2010).

2.2.2.1. Exchange-traded derivatives markets

A derivatives exchange refers to an organised trading venue that formalises and secures the buying and selling of derivatives contracts to reduce defaults on the transactions that are entered into by market participants. A derivatives exchange provides for market liquidity, making it easier for willing buyers and sellers to transact (National Treasury 2009).

A derivatives exchange provides the following key features to the arrangements that are offered on such an organised exchange market (National Treasury 2009:18–19):

(1) Standardisation and fungibility

(2) Central trading platform

(3) Clearing, settlement and the management of counterparty credit risk

(4) Limits for permissible open interest and curbs/controls to limit excessive fluctuations during periods of market turbulence

2.2.2.2. OTC derivatives markets

OTC markets are not organised in the sense that OTC trading occurs over sophisticated telecommunications networks where market makers, rather than an exchange, provide market liquidity so as to facilitate the selling or buying of securities to investors (Mishkin & Eakins 2012). As such, OTC derivatives are privately negotiated between the transacting parties (National Stock Exchange of India 2009).

The OTC derivatives markets are said to have the following features compared to their on-exchange counterparts (Chavan 2010; National Stock Exchange of India 2009; Schinasi, Craig, Drees & Kramer 2000):

(1) The management of counterparty (credit) risk is decentralised and located within individual institutions.

(2) There are no formal centralised limits on individual positions, leverage or margining.

(3) There are no formal rules for risk- and burden-sharing.

(4) There are no formal rules or mechanisms for ensuring market stability and integrity, or for safeguarding the collective interests of market participants.

(5) The OTC contracts are generally not regulated by a regulatory authority.

2.2.3. The participants in the derivatives markets

Participation in derivatives markets is diverse and may include the following (Zimmermann & Gibson 1996; Stulz 2005):

(1) Institutional investors such as non-financial corporations that can, for example, use derivatives to minimise earnings volatility or reduce their tax liability.

(2) Banks and other financial intermediaries: although banks are the market makers for certain derivatives, they also take positions in derivatives to manage risks.

(3) Individuals are normally attracted by derivatives because the instruments can provide them with disproportionately large rewards out of much smaller capital investment requirements.

Regardless of participants' varied activities in derivatives markets, derivatives are generally used to (1) hedge, (2) speculate or (3) engage in arbitrage. Correspondingly, the traders in a derivatives market are categorised either as hedgers, speculators or arbitrageurs.

(1) Hedgers use derivatives as a kind of insurance against a bad future outcome in order to reduce or eliminate a pre-existing risk, such as the risk of price

movement by taking offsetting positions in both cash and futures markets. In a hedging transaction, a derivatives instrument simply transfers risk from the hedger, who is unwilling to bear the risk to another party that is better able or more willing to bear that risk. This allows for better and more efficient risk allocation among the different players in a particular economy (Kapadia 2006; Mihaljek & Packer 2010; National Stock Exchange of India 2009).

(2) In contrast to hedgers who want to reduce or eliminate their risk, speculators are traders who take positions in the market with the view to increase their own risk, buying and selling derivatives to make profit, and not to reduce risk (Kapadia 2006). Speculators are the gamblers in the market, as they normally make bets on the price of an underlying asset, expecting that it will move in a particular direction over the life of the derivatives contract. The leverage provided by derivatives allows speculators to increase both the potential gains and potential losses in their speculative transactions (Mihaljek & Packer 2010; National Stock Exchange of India 2009).

(3) Arbitrageurs seek to take advantage of prevailing discrepancies between the prices in different markets by simultaneously taking positions in two or more financial markets in order to earn riskless profits and, thus, to benefit from the markets' imperfection (Mihaljek & Packer 2010; National Stock Exchange of India 2009). As arbitrageurs step into the particular markets upon the spotting of the arbitrage opportunity, they help realign market prices back to normal, thereby pushing towards price consistency across the markets.

Together, hedgers, speculators and arbitrageurs complement each other in the economy. Hedgers' trade is complementary to that of speculators, as speculators prosper on the uncertainties that a hedger seeks to avoid. Speculators can incur huge financial losses on derivatives positions, but the market could not operate effectively without them acting as the providers of the liquidity needed for hedgers to transact (Ruiz 2010; Johannesburg Stock Exchange n.d.). Arbitrageurs, on the other hand, usually enter riskless profit-earning transactions, and in their exploitation of markets' imperfections they generally come across hedgers and speculators as trade counterparts (Kapadia 2006). In fact, Kapadia (2006) recapitulates that all three types of participants must co-exist for a healthy derivatives market because of the following:

(1) The market would become a mere tool of gambling without hedgers as the providers of the markets' economic substance.

(2) Speculators provide depth and liquidity to the markets.

(3) Arbitrageurs help in bringing price discovery and price uniformity within markets.

Notwithstanding derivatives' recognised economic virtues, derivatives markets have remained controversial, as they have often been blamed for causing a number of financial turbulences (National Stock Exchange of India 2009).

2.2.4. Benefits and risks associated with derivatives markets

The institutionalisation of derivatives markets presents both benefits and risks to countries' financial and economic health (Rajkumar n.d.; Sill 1997).

2.2.4.1. Benefits of derivatives markets

Major economic benefits have been put forward that can be derived from the operation of derivatives markets. These benefits can be summarised as risk management, price discovery and transactional efficiency.

(1) The risk management attribute of derivatives is widely accepted as their primary function, which justifies the need for derivatives markets. The markets can facilitate the transfer of risks among economic agents from those who have them but may not like them (risk-adverse people) to those who have an appetite for them (risk-oriented people) (Abumustafa & Al-Abduljader 2011; Lien & Zhang 2008).

(2) The price discovery function of derivatives markets implies better processes of price formation and real-time dissemination of information about market prices as a result of derivatives trading, which effectively makes financial

markets more transparent (Abumustafa & Al-Abduljader 2011; Lien & Zhang 2008; National Stock Exchange of India 2009; Rajkumar n.d.).

(3) The transactional efficiency function of derivatives markets encompass their magnifying of the volume traded in underlying markets (Lien & Zhang 2008). Furthermore, the enhanced entrepreneurial activity, creation of new business and provision of new products can enhance financial markets' efficiency, and thereby make participants' borrowing and investments less costly and more effective (Schwegler 2010; Sill 1997).

2.2.4.2. Risks associated with derivatives markets

Some of the risks associated with the use of derivatives markets include the following (National Treasury 2009; Rajkumar n.d.; Sill 1997; Srivastava 2010):

(1) ***Credit risk*** involves the possibility that one of the parties involved in a derivative transaction will suffer a loss because of the failure of its counterpart to fulfil its contractual obligations (Rajkumar n.d.).

(2) ***Market risk*** arises when it becomes possible that the value of a position will adversely change before the positions can be liquidated or offset with other positions because of changes in the price of a financial asset, interest rates, or foreign exchange rates (Rajkumar n.d.).

(3) ***Liquidity risk*** may arise if there are problems with the liquidity of derivative securities or the ease with which they can be traded (Sill 1997).

(4) ***Operational risk*** arises from the possibility that losses may occur because of inadequate systems and controls, human error or mismanagement (Rajkumar n.d.).

(5) ***Legal risk*** comes about because derivatives are contracts (Sill 1997) and involve the possibility of loss arising from a contract not being enforceable as a result of poor documentation, insufficient capacity/authority of a counterparty, or from the enforceability of the contract in the event of bankruptcy or insolvency (Rajkumar n.d.).

(6) ***Systemic risk*** manifests itself when a major player in the derivatives markets or a clearinghouse fails, which then puts other market participants in the economy at risk (Rajkumar n.d.). Systemic risk represents the most significant danger posed by derivatives. This risk is mostly the result of the leverage provided by derivatives to market participants and the interconnectedness of participants' positions. Leverage helps increase the volumes of trade in the markets. At the same time, investors could gain or lose large amounts of money as a result of derivatives' leverage. The occurrence of such large losses can expose investors to bankruptcy, and if a major player in the markets goes bankrupt, more individuals, banks and other institutions that invested in it or assumed relatively larger counterpart positions in derivatives with such a user will also face the possibility of losing on their positions (Srivastava 2010; Rajkumar n.d.; National Treasury 2009; Sill 1997). Consequently, derivatives' leveraging can increase the speed and extent of financial losses, leading to rapidly spreading financial ruin (National Treasury 2009). It is the likelihood of such a series of synchronised losses and failures that is known as systemic risk (Rajkumar n.d.).

Certain features of derivatives markets effectively embody risks to financial stability (Zimmermann & Gibson 1996). As Zimmermann and Gibson (1996) emphasised, the OTC markets, in particular, can be a source of severe instability at the level of institutions, markets, or even the whole financial system and the economy. Financial crises usually originate upon occurrence of a financial shock, such as counterparty credit events or sharp movements in underlying asset prices, which subsequently can alter the investors' perceptions of their current and future credit exposure (National Stock Exchange of India 2009). Subsequently, investors' *lack of confidence* as result of uncertainty about the health of the financial sector can lead to a run on major markets' players, such as banks. This causes a *contagion effect* whereby the failure of one bank accelerates the failure of another and that of other institutions in the economy, leading to financial turmoil, as in the case of the economic crisis in 2008 (Mishkin & Eakins 2012).

In spite of the risks attributed to derivatives markets, the World Economic Forum (2012) reaffirms that countries' long-term economic growth and welfare prospects are dependent on the size, depth, access, efficiency and stability of their financial systems. A greater degree of financial development will allow for the diversification of risk that is needed for countries to increase long-term growth and welfare. Furthermore, financial development will allow for the wider availability of financial services and will improve the prosperity of people who have access to these financial services. Derivatives markets will contribute to the sophistication of countries' financial settings, including the development of a competitive business atmosphere where non-banking institutions would complement banks. Likewise, the consequential advancement in the domain of finance could substantially contribute to changing the structure of the financial systems as the new techniques and ways of financial risk management emerge (Haiss & Sammer 2010; Miloš Sprčić 2007; Zimmermann & Gibson 1996).

2.3. DERIVATIVES AND CAPITAL MARKET DEVELOPMENT

Applegarth (2004), Ewah et al. (2009), Mishra et al. (2010) and Stiglitz et al. (2006) summarise the idea that well-developed capital markets are essential for countries to tap into a diversified number of sources for the necessary resources, including international sources, which may stimulate local economies and enhance their growth and stability prospects.

2.3.1. Derivatives markets vs capital markets

Table 2.4 summarises the main aspects that differentiate derivatives markets from capital markets.

Capital markets	Derivatives Markets
• A market where a government or a company can raise money (capital) to fund long-term investment.	• A market for the buying and selling of the financial instruments that derive their value from underlying securities or assets, including interest rates, exchange rates, commodity prices – practically anything that is characterised as being volatile. • Derivatives markets are not for raising capital (i.e. not for financing) but instead for protecting oneself against adverse changes in external factors.
Instruments are as follows: • Equity instruments • Insurance instruments • Derivatives instruments • Bonds • Asset-backed securities • Mortgage-backed securities	Instruments (basic) are as follows: • Forwards • Futures • Options • Swaps NB: There are various additional instruments that can be formed by making increasingly complex combinations involving the above basic instruments through the process of financial engineering (e.g. CDSs).
Types of capital market securities: • Bonds • Equity (including shares and stock indices) • Cash As a market for the buying and selling of bond and equities.	Types of derivatives market securities: • Pass-through securities, including the following: (1) Mortgage derivatives (2) Structured notes • Standard securities can be embedded in capital market instruments, i.e. the following: (1) Bonds (2) Shares (3) Cash

Table 2.1: Derivatives markets vs capital markets

Source: Researcher's own construct based on information produced by Scribd.com (n.d).

A better understanding of how capital markets differ from those for derivatives instruments can be provided by comparing capital markets with money markets, and derivatives markets with cash markets. Tables 2.5 and 2.6 below provide such comparisons (scribd.com n.d.).

Capital market	Money market
• Extends beyond one year • Term loan and financial leases, corporate equities, and bonds • Fixed capital requirement • Instruments have primary and secondary markets • Formal place for transaction, e.g. equity market	• Up to one year or less • Government agency securities and commercial paper • Working capital requirement • Instruments have only primary market • No formal place for transaction

Table 2.2: Capital markets vs money markets

Source: scribd.com (n.d).

Derivatives market	Cash market
• High risk involved • Has a definite expiry • Need to buy in fixed-lot sizes • Need to pay margin amount for purchase • Can trade all instruments of financial market • Can buy or sell index	• Risk involved is less • Has no expiry • Can buy any number of shares • Need to pay full amount of purchase • Can trade only equity shares • Cannot sell index

Table 2.3: Derivatives markets vs cash markets

Source: scribd.com (n.d)

Table 2.3 shows that derivatives and capital markets are interconnected. In effect, Dudley and Hubbard (2004) confirm that, together, the markets for debt (bonds) and equity instruments, as well as those for the derivatives associated with the respective debt and equity instruments, are generally considered as the constituents of a particular country's capital market. The debt and equity markets help allocate capital in an economy by intermediating funds from savers, who own them, to borrowers, who are in need of capital. Derivatives markets help investors to manage the risks inherent to capital instruments, and thus form an integral part of the capital markets.

2.3.2. The components of a modern capital market: The case of South Africa

Mboweni (2006) asserts that South Africa's capital market consists of the following three main complementary components:

(1) Cash, consisting of long-term bank loans and deposits

(2) Bond markets, formalised by a bond exchange where bonds are issued by corporates and government to fund larger projects because of the lower and fixed-funding costs they provide

(3) Equity markets, including the markets for shares, stock indices and exchange-traded funds (ETFs), which also need to be governed by a local exchange responsible to raise funds and to mobilise capital using these equities

The banking sector in South Africa is highly integrated with the bond and equity markets and is a crucial element to the functioning of the capital markets (Dudley & Hubbard 2004; Mboweni 2006). Developments in equities and corporate and government bonds have contributed to the development of the country's financial infrastructures and have facilitated economic growth (Mboweni 2006). Therefore, Mishkin and Eakins (2012) suggest that it is essential that an efficiently functioning capital market is available to the business sector, as, in the absence of an efficient bond and equity markets, funds for business expansion tend to shrink, resulting in a reduction of business activity, high unemployment, and slow growth.

Dudley and Hubbard (2004:14–17) maintain that the capital markets on their own help facilitate superior and improved economic performance for the following reasons:

1) They induce higher productivity growth.

2) Higher productivity growth accrues to workers in the form of higher real-wage growth.

3) Both higher productivity growth and higher real-wage growth result in greater employment opportunities.

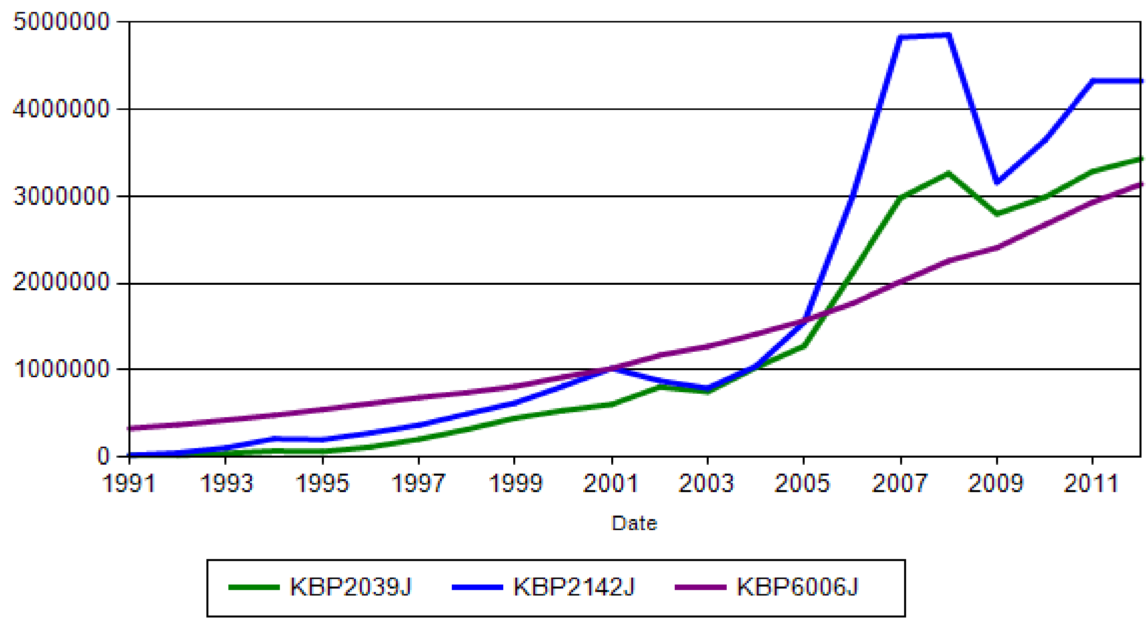
4) Economies become less volatile, resulting in greater macroeconomic stability.

5) The capital market development result in greater asset ownership by households.

Charlton (2008), Ocampo et al. (2008), Stiglitz (2000) and Stiglitz et al. (2006) disapprove of capital market liberalisation. They argue that capital markets might not always be associated with stronger economies because the markets could fail to achieve higher levels of economic growth and could instead make it more difficult for countries to achieve macroeconomic stability. However, Foreign Direct Investment (FDI) is perceived as less volatile and not too disruptive. Capital markets are said to be generally associated with market failures, less attractive investment prospects, sudden capital flights and instabilities that could weaken economies in the developing world.

Stiglitz (2000) acknowledges that opening up the capital markets can impose discipline and force countries to have good economic policies out of fear that capital would flow out of the country. However, he explains that the reason why capital market liberalisation produce instability and not growth is the fact that capital markets expose countries to the changes in economic circumstances outside the country. Under such rapidly changing conditions, investors may have swinging perceptions about the risks of domestic markets, which may create huge capital outflows, and this can significantly undermine the viability of an entire financial system. In addition, Stiglitz (2000) argues that capital markets make short-term capital unstable, weaken investments, and are associated with higher risks of recessions. Subsequently, the costly constraints that capital markets impose on countries in the form of corporate or capital taxes generally hinder the ability of governments to pursue their legitimate objective of economy stability. Charlton (2008) argues that eventually, capital markets are leaning more towards being inducers of inequalities and poverty in the developing countries, because they expose countries to increased macroeconomic volatility, sensitivity to international markets and systemic risk.

Compared to other developing countries, South Africa has a relatively well-developed market for derivatives and other capital instruments, which all operate rather efficiently (Adelegan 2009; World Economic Forum 2012). Figure 2.1 below depicts the evolution of South Africa's equity derivatives trading, capital market capitalisation and GDP over the period 1991 to 2012, where the trading values of equity derivatives and capital market capitalisation (i.e. the JSE's total turnover on shares traded) are respectively the proxies for the country's levels of development in derivatives and capital markets. Overall, Figure 2.1 shows concurrently growing derivatives and capital markets and GDP. While the country's derivatives and capital markets appear to be associated with high-volatility characteristics, it appears that their instable characteristics have not transmitted to the economy, which has continued to grow at a rather steady pace over the years.



Note: Unit of measure = R millions; KBP2039J =*Total value (turnover) of shares traded on the JSE*; KBP2142J = *Derivatives market (SAFEX): Equity derivatives: Traded value*; KBP6006J = *Gross domestic product at market prices (GDP)*.

Figure 2.1: South Africa's derivatives trade, capital market capitalisation and GDP from 1991 to 2012

Source: South African Reserve Bank (n.d)

Derivatives markets can become a factor of development in capital markets and an important contributor towards financial markets' completeness in developing countries (Kumari 2011; Ngugi et al. 2009). Well-developed capital markets, including the provision of efficient financial intermediary institutions like banks, may play a vital role in creating and sustaining countries' growth and development (Badun 2009; Levine et al. 2000). In other words, as the principal source of efficient financial intermediation, deeper capital markets are essential for economic development because of their mobilising of countries' available funds towards longer-term project financing. As such, capital markets can ensure financial markets' efficiency and foster development (Baluch & Ariff 2007; Kirkpatrick 2000; Mboweni 2006; United Nations 1999).

2.3.3. Derivatives and the shaping of capital markets

The size and depth of the financial system is an important component of financial and economic development across countries. Derivatives markets are expected to become a remarkable factor of development in capital markets and for financial systems in general (World Economic Forum 2012).

2.3.3.1. Derivatives and the efficiency of the banking sector

The banking sector permits effective lending and borrowing to promote the mobilisation of a nation's savings and the channelling of saved funds into high-investment projects, so as to ensure the better utilisation of countries' available resources. Banks' activities are subject to different types of risks, such as interest rate risk, foreign exchange risk and credit risk. Interest rate risk, in particular, is integral to banking and can be an important source of profitability or loss, because changes in interest rates significantly affect banks' earnings. Hedging with derivatives therefore comes in handy to manage the risks associated with changing interest rates and can thus prove essential for the safety and soundness of banks (Srivastava & Srivastava 2010).

The participation of banks in derivatives markets generally results in the modernisation of banking through increased globalisation of banks' financial activities, and thus leads to the sophistication and efficiency of banks (National Stock Exchange of India 2009; Rivas, Ozuna & Policastro 2006). Sophisticated banks can stimulate the lively participation of the private and public sectors on the capital markets, and as they permit more capital to flow from savers to investors, they contribute to financial development. Furthermore, the existence of efficient banking systems can speed up the process of economic growth by increasing investment in high-return and illiquid assets (World Economic Forum 2012).

Derivatives markets therefore play a crucial role in banks' efficiency by assisting these financial institutions in hedging their operational risks. Nevertheless, the use of these instruments by banks may yet again adversely affect the stability of the banking sector, and therefore that of the economy. The losses incurred on derivatives by a major player or a substantial number of relatively small market users may cause the synchronised failure of banks, and consequently pose threats to the stability of the banking system. Furthermore, increasingly volatile exchange rates, interest rates and asset prices may add to macroeconomic instability and make the environment in which banks operate more risky (Carse 1997; World Economic Forum 2012).

Derivatives markets can significantly change the way banking systems operate. Therefore the regulation and supervision of the banking sector also need to be adapted so as to ensure that banks have adequate systems of prudential risk management in place. Supervisors must ensure that these institutions' are properly managed and that they maintain sufficient capital in place to support their risk-taking activities (Carse 1997).

2.3.3.2. Derivatives and the development of the markets for debt (bonds) and equity instruments

More complete financial markets in a number of developing countries require the launch of new financial instruments, including equities, debt instruments and derivatives, in order to broaden and enhance these countries' investment opportunities (Raghu & Zeineddine 2007; Sreenu 2012).

Wells (2004) argues that high levels of derivatives trading are usually associated with a high level of stock trading. His opinion is that an active equity derivatives market does not harm the equity cash markets. Derivatives trading and its application to equity markets are perceived as the means for creating a more stable source of local currency funding for both the public and corporate sectors. Because of increased equity market liquidity, investors may become able to hedge their equity investment positions easily, and as they interact while hedging, speculating and arbitraging they could provide a certain extent of stability in the underlying equity markets. Conversely, volatility in the underlying equity markets might also increase after the introduction of derivatives markets (Kapadia 2006; Mathieson & Roldos 2004; Siopis & Lyroudi 2007).

Debt markets, in turn, may similarly develop as a result of derivatives usage. The use of derivatives can, in fact, be conducive to significant transformation within these markets and thus be favourable to developing countries. The increasing availability of derivatives instruments normally facilitates the broadening of debt markets in emerging market countries. Investors in the bond markets are indeed exposed to risks such as those pertaining to changing interest rates. Fluctuating interest rates can affect the investors' coupon receipts, the capital gains or losses on debt instruments, and reinvestment income. Debt derivatives may allow for the hedging of such risks and, correspondingly, may also add to the offering of debt instruments (Narayan 2003; OECD, World Bank & International Monetary Fund 2007).

Despite some possibility of market instability, efficient and well-established markets for equity and debt instruments may significantly contribute towards growing economies. Liquidity in equity markets could positively impact on capital accumulation, productivity growth, and the current and future rates of economic growth. Actually, the equity markets may encourage long-term growth by promoting specialisation, the acquisition and dissemination of information, and the mobilisation of efficient savings towards investments. The bond markets, on the other hand, may contribute to financial development, and thus economic development through effective capital allocation and by providing some extra avenues for accurate price discovery in the financial markets (World Economic Forum 2012; Kohler 2012).

CHAPTER 2: DERIVATIVES, CAPITAL MARKET DEVELOPMENT AND ECONOMIC GROWTH

Derivatives instruments can effectively allow investors to generate additional profits on equities and bonds. The simultaneous emergence of derivatives and capital markets can enhance the confidence of investors, which may subsequently lead to thriving, well-functioning bond and equity markets (Dodd 2002; World Economic Forum 2012; Schwegler 2010).

Overall, the paradoxical issue with the emergence of derivatives markets is that they are likely to add some volatile elements to financial systems and economies, but the markets are also expected to add to continental financial markets by making them more efficient and stable, thereby enhancing growth and sustainability in economies. By promoting capital market development, the introduction of derivatives may enhance the financial intermediation function of banks and contribute towards economic growth through some more efficient banking sectors. Furthermore, derivatives markets can assist with the development of some efficient local capital markets by supporting the creation and development of increasingly deeper equity and bond markets. The development of derivatives markets can reduce countries' dependency on bank credit as a source of funding, and increase the influence of both the debt and equity components of the capital markets as financing methods for governments and firms' long-term investment projects in order to improve economic performance. Deeper primary financial markets and the creation of some efficient secondary markets may eventually constitute some extra avenues for impelling further financial development and national growth relying on expanding trade in bonds and equities. The use of derivatives instruments may be conductive to poverty reduction through welfare increases as a result of their inducing economic growth (Ly 2011; Mathieson & Roldos 2004).

2.4. THE INSTITUTIONALISATION OF DERIVATIVES MARKETS AND ECONOMIC GROWTH: THE CHANNELS OF INFLUENCE OF DERIVATIVES ON A COUNTRY'S GROWTH

Rodrigues et al. (2012:3–8) discuss three major channels through which derivatives markets can influence a country's economic growth, which are:

(1) As an integral part of the financial markets, and through the influence they exert on the development of these markets

(2) Through the role they hold in expanding business activities within a given country

(3) Via their effects on economic growth volatility

2.4.1. Derivatives and financial markets

As an integral part of modern financial markets, derivatives can impact on the investment behaviour of the users of these markets, assisting in channelling the resources available on the markets into growth (Rodrigues et al. 2012). Haiss and Sammer (2010:5–8) argue that there are three channels through which derivatives may influence economic development as valuable enabling instruments of the effects of financial markets on a country's growth. Essentially, these entail (1) a *volume channel*, (2) an *efficiency channel*, and (3) a *risk channel*.

2.4.1.1. The volume channel

First, the *volume channel* of derivatives' influence on financial markets and economic development refers to derivatives markets' aptitude in facilitating the accumulation of capital and the markets' subsequent mobilisation of savings towards investments into diversified portfolios of risky projects. Derivatives markets, in effect, are very successful in pooling enormous amounts of capital into the financial markets, and this effectively allows them to take advantage of economies of scale to fund activities capable of yielding higher returns, and thus to drive economic growth.

The emergence of derivatives exchanges can entice the creation of a broad variety of instruments on their own, which can lead to more complete financial markets. In addition, the markets' enhanced hedging opportunities effectively allow market participants to diversify their financial risks by constructing any needed risk-return profiles on their financial market investments. The more the activity of a derivatives exchange increases, the more resources become available to finance diverse investment projects in the economy. Furthermore, the management of financial risks become enhanced, thus resulting in better growth perspectives for countries that have afforded such exchanges (Haiss & Sammer 2010; Rodrigues et al. 2012).

2.4.1.2. The efficiency channel

The second channel by which derivatives indirectly influence growth through the financial markets is called the *efficiency channel*. This channel groups together several functions of derivatives markets, including the markets' efficiency in substituting cash market trades, their ability in transferring resources across time and space, and their role in managing risk and providing pricing information, which all result in improved efficiency in the ways in which the economy combines capital and labour in production (Haiss & Sammer 2010). For instance, the use of derivatives by South African producers has improved productivity in the agricultural sector, because farmers are able to concentrate their efforts on managing production risks, including the risks associated with variables such as the weather, production management and seasonal conditions (Johannesburg Stock Exchange n.d.). In the same way, exposure to price, interest and exchange rate fluctuations can also be better hedged using derivatives markets, as derivatives have become a powerful tool for reducing such risks in the ordinary course of individual and institutional investors' business (Haiss & Sammer 2010).

Corporations, financial institutions and governments are able to lower the cost of investments via the more diversified funding sources provided by these markets. By using derivatives, investors can also improve asset yields by increasing exposure in some attractive asset classes and in the markets with poor liquidity. In addition, companies can borrow in the cheapest capital markets, either domestically or abroad, regardless of the currency in which the debt is denominated or the form in which interest is paid (fixed or floating) using currency or interest rate swaps. Foreign currency flows derived from entrepreneurial activity can also be hedged in the home currency in order to eliminate currency risk arising for participants' involvement in foreign financial markets (Haiss & Sammer 2010).

On top of everything else, as derivatives markets become liquid, their informational function is achieved more timely such that the price of financial assets is reflected even faster in these markets than in the equity or bond markets. The near-to-real-time reflection of information provided by liquid derivative markets thus assists in the financing of more promising firms, thereby contributing to more efficient capital allocation (Rodrigues et al. 2012).

The net effect of the resulting enhanced risk allocation, lower transaction costs and improved informational efficiencies is a better and growing economy (Haiss & Sammer 2010). Essentially, derivatives are vital to modern financial markets, because they help make these markets more complete. In the presence of derivatives, traders are able to shape the risk and return characteristics of their portfolio investment more accurately, leading to increased wealth for market participants. Derivatives' influence on growth through efficient financial markets is achieved because derivatives allow efficient capital allocation, facilitate trade and enhance risk management in these markets. Likewise, the ability of derivatives to drive financial markets towards one common price for specific financial assets is an equally important aspect of their contribution towards economic growth.

2.4.1.3. The risk channel

The *risk channel* through which derivatives may rather amplify the potentially negative effects of financial markets on economic development is by adding unnecessary risks to the economy, especially because derivatives markets encourage speculation in their underlying markets. Financial crises are, in fact, designated as the reason for the existence of a weak relationship between financial development and economic growth, as it appears that finance positively impact growth in non-crisis situations, but is negatively correlated with growth when a crisis occurs (Haiss & Sammer 2010). According to Haiss and Sammer (2010), the destabilising power of derivatives markets flows from their ability to create new risks for market participants, especially their ability to increase systemic risk, as this is what makes them capable of causing trouble in a banking system in isolation and in the entire financial system at large.

In clarifying the different causes of the latest financial crisis, Haiss and Sammer (2010) discuss five sources of systemic risk as the inciters of financial fragility. Tables 2.4 and 2.5 below respectively present the sources of systemic risk/financial fragility, as well as the sources of the 2008 crisis and the role held by derivatives markets in this crisis.

Elements of a model of systemic risk				
1. "A systemic crisis originates in, or is substantially magnified by financial markets. More precisely, systemic risk must originate in the process of funding."	2. "A systemic crisis involves contagion. That is, problems in one institution cause insolvency in other, otherwise healthy, institutions."	3. "A systemic crisis involves a 'loss of confidence' by investors. Typically, this means that investors or financial institutions cut back the amount of liquidity they are willing to provide to firms or other financial institutions."	4. "A systemic crisis involves substantial real cost, in terms of losses to economic output and/or reductions in economic efficiency."	5. "A systemic crisis calls for policy response."
Sources of systemic risk and financial fragility				
1. Excessive debt: Highly leveraged firms and the possibility of small shocks to induce multiple simultaneous corporate defaults	**2. Moral hazard:** Excessive risk taking and indebtedness induced by government-provided safety-net institutions and the presence of a lender of last resort	**3. Complex internetworking among counterparties:** Contagion due to the complexity of trading networks and payment systems	**4. Abrupt reduction in aggregate liquidity:** Rapid reduction in the amount of liquidity in financial markets	**5. Coordination failure:** "…a particular strategy chosen by an economic agent (investor) becomes profitable only if a sufficient number of other agents choose the same strategy"

Table 2.4: Elements and sources of a model of systemic risk and systemic crisis

Source: Haiss & Sammer (2010:26)

The recent crisis				
1. Excessive debt: Excessive private consumption (due to loose monetary policies) and high level of private and corporate debt, high leverage due to demand for higher-yielding investment opportunities	**2. Moral hazard:** Expansion of the traditional (commercial) banking model and engagement in investment banking activities (rising fee and trading income), development of the "origination and distribution" model (securitisation), excessive risk taking due to "to big to fail" mentality	**3. Complex inter-networking among counterparties:** Securitisation (originating, bundling, selling, repackaging, investing), granting of back-up credit lines to special investment vehicles (SIVs), complex linkages between market players due to financial innovations	**4. Abrupt reduction in aggregate liquidity:** Devaluation of MBSs and *CDOs*, loss of confidence, collapse of short-term funding possibilities, hoarding of cash, drying up of money markets, deleveraging and downward spiralling of prices and confidence, defaults and domino effects	**5. Coordination failure:** "Origination and distribution" model, development of massive leverage, expansion of the traditional banking model due to deregulation and demand for higher profits
⇧	⇧	⇧	⇧	⇧
The role of derivatives markets				
Derivatives met the demand for higher-yielding investment opportunities and strongly encouraged the development of massive financial leverage, derivatives as amplifier in times of financial turmoil	Excessive risk taking via derivatives by banks and other financial institutions due to "too big to fail" mentality, financial institutions far too much leveraged to provide adequate capital in the event of a systemic collapse of confidence	CDSs encouraged the issuing and selling of bonds, MBSs and CDOs of questionable quality, as the credit risks of these assets were separated and shifted to other parties, widely unknown risk exposure of key financial players and difficult assessment of counterparty risks due to the lack of transparency and oligopolistic structure of derivatives markets	The lack of transparency and the oligopolistic structure of the deregulated market for derivatives exacerbated an adequate assessment of the risk exposure of key financial players and contributed to the loss of confidence at the peak of the financial crisis, massive deleveraging through derivatives contributed to the reduction in aggregate liquidity	CDS market fostered the "origination and distribution" model of financial institutions, leverage via derivatives as perfect tool for enhancing profits in rising markets and destructive weapon in decreasing markets

Table 2.5: The sources of the recent crisis and the role of derivatives markets

Source: Haiss & Sammer (2010:30)

Rodrigues et al. (2012:5–8) discussed two additional channels through which the institutionalisation of derivatives markets in itself can influence economic growth. These include the ability of derivatives markets to drive business activity within the economy and the capacity of such markets to reduce economic growth volatility.

2.4.2. Derivatives and business activity

In terms of the influence of derivatives markets on a country's level of business activity, Rodrigues et al. (2012) assert that derivatives markets can make risk management cheaper on a firm level. With the institutionalisation of derivatives markets, institutional investors that exist in an economy can transfer risk more easily to the counterparty with the special expertise for managing the particular risk. Furthermore, the enhanced corporate hedging as a result of derivatives trading helps corporations reduce their expected taxes, the transaction costs of financial distress, underinvestment costs associated with investment opportunities in the presence of financial constraints, and agency costs.

In fact, it has been argued that the use of derivatives to hedge variability in firms' expected stream of taxable income can reduce expected taxes. In addition, hedging with derivatives allows corporate managers to drive down corporate cash flow volatility and to enhance their financing and investment opportunities. Furthermore, firms' lower probabilities of default as a result of their use of derivatives hedge can reduce unemployment. Subsequently, the reduced cash flow volatility of firms enhance their possibilities to invest in growth-enhancing projects, because they can allow the use of less costly internal funds to finance investments, instead of external capital that are more costly (Wysocki 1998). Therefore, Rodrigues et al. (2012) argue that firms that hedge using derivative instruments have more growth opportunities, because they can reduce the costs of running their businesses and thus free up capital to invest in new value-enhancing and growth-driving projects, which can lead to higher macroeconomic levels of growth.

Kirkpatrick (2000) posits that the institutionalisation of derivatives trading can promote the development of more sophisticated and competitive business environments, which may contribute to greater growth in developing countries.

2.4.3. Derivatives and economic growth volatility

Ultimately, Rodrigues et al. (2012) reflect on the effect of derivatives markets on economic growth volatility and suggest that the introduction of derivatives markets can reduce economic volatility and even eliminate the likelihood of financial distress under perfect capital markets.

Lien and Zhang (2008) emphasise that derivatives can have a stabilising effect on volatility in developing countries. They predict that derivatives markets can reduce price volatility in their underlying markets. For example, the fact that derivatives markets insure producers against price losses and encourage a more efficient process of private storage in agricultural markets is a natural mechanism for achieving stabile spot prices. According to Lien and Zhang (2008), derivatives trading stabilises prices and improves liquidity in the underlying markets, even though, in certain instances, the use of derivatives can induce greater volatility, price reversals, and abnormal trading volumes in underlying markets.

Other studies, however, have proven that the introduction of derivatives can actually increase spot market volatility. A number of studies were conducted on the impact of derivatives trading on the volatility of, for instance, equity markets. These produced mixed evidence on the impact of derivatives trading on the volatility of these markets (Gahlot, Datta & Kapil 2010). Actually, Gahlot, et al. (2010:140–142) argue that while the reducing effects of futures trading on underlying equity markets' volatility have been revealed, increased volatility of the underlying equity markets after the introduction of derivatives trading has also been reported in certain cases. However, Gahlot, et al. (2010) conclude that the introduction of derivatives markets has no detrimental effect on underlying spot markets, because empirical findings indicated no significant change in the volatility of the underlying equity markets after the introduction of a derivatives trading system. Subsequently, Gahlot et al. (2010) suggest that any increasing volatility resulting from derivatives trading may simply be suggestive of a need for more regulations.

Tiberiu (2007) acknowledges that many factors may contribute towards a desired reduction of macroeconomic volatility as a result of derivatives instruments' usage, including the following:

(1) A reduction of the shocks on the demand and supply of underlying assets

(2) Technological progress made in the area of information technology, which provides easy access to relevant information and enables investors to establish medium- and long-term strategies, thereby contributing to the reduction of fluctuations

(3) The ensuing financial reforms and fiscal policy

(4) A modification of the structure of economies

(5) A progressively developing services sector, which is less volatile than the industrial or agricultural sectors

(6) International financial integration, with its extended impact on commercial integration by freeing commercial exchanges between countries

(7) Increased labour market flexibility and a reduction in the volatility of capital markets

(8) Financial innovations that create the development of the financial markets and, accordingly, reduce the volatility of the production activity

However, quoting Rincon (2007) and Buch (2005), Tiberiu (2007) highlights that a positive relationship between the globalisation of financial activities and a reduction of volatility may not always exist, because GDP volatility often appears more significant for open economies.

Consequently, derivatives trading may impact not only on the volatility of the underlying spot markets, but also on the volatility of the general economy. Rodrigues et al. (2012) write that derivatives-related financial shocks may occur that might entail risks of a severe and vicious circle of market instabilities that are able to destroy wealth and growth. Similarly, Stiglitz et al. (2006) argue that the instable attributes of derivatives markets can adversely impact economic growth through different channels. Uncertainty about the economic environment could, for example, significantly reduce participants' willingness to take on risks and banks' ability to provide the funds required for firms to invest. Volatility might also cause underemployment to increase, as it might discourage adequate investments to be made in human capital, and underemployment is prejudicial to growth and welfare.

Rodrigues et al. (2012) assert that, in the realistic case of imperfect capital markets, the introduction of derivatives markets can either have a positive (reducing) or negative (increasing) effect on economic volatility. Figure 2.1 under section 2.3.2 depicts a fairly well-developed South African derivatives market relative to the country's economy in the more recent years (from 2005). Şendeniz-Yüncü et al. (2007) clearly stipulate that the size of the derivatives market is a key determinant of how it impacts a particular country's growth, claiming that medium-sized derivatives markets have more positive effects on economic growth than large and small derivatives markets. The direction of the impact of local derivatives markets on South Africa's GDP growth volatility will be empirically tested in Chapter 5.

Concerns remain that the welfare effects of derivatives markets are indeed absorbed by banks but not the whole economy (Haiss & Sammer 2010). With regard to the 2008 crisis, Laeven and Valencia (2010) provide that, owing to inadequate capital regulation, banks were allowed to increasingly use derivatives and move the created assets off-balance sheet into special-purpose investment vehicles with weak capital requirements. Such use of derivatives permitted investments to be made in risky and illiquid assets such as mortgages and mortgage derivatives, which significantly contributed to the crisis. Kohler (2012) adds that the proportion of derivatives trading that involves a genuine business person such as a farmer or a commodity buyer off-loading his or her risk is actually small. The majority of derivatives entails the creation of risk and gambling on it. For instance, credit default swaps are bets on whether a country or company will go bankrupt, interest rate swaps are bets on movements in interest rates, and contracts for difference are bets on movements in a share price or another asset. Kohler (2012) further explains that the 2008 global financial crisis is the result of banks' excessive usage of leveraged instruments.

Banks multiplied the leverage on their balance sheets by betting through derivatives markets and then lost control of their bets. Once again, banks' unrestrained involvement in the casino of derivatives created problems on their positions in the derivatives markets and resulted in large losses, putting the entire global financial system out of control and then blowing it up. Historically, Barings lost $1.2 billion in 1995 and LTCM $4.6 billion in 1998; in 2008, AIG and Societe Generale lost $18 billion and 7.2 billion, respectively; UBS lost $2 billion in 2011. These are only a few incidences. Derivatives-related losses may not always cause a general financial crisis, but the combination of the losses of AIG, Merrill Lynch, Lehman Brothers and a few others banks caused the global recession that still has repercussions today and continues to cause widespread misery.

Kohler (2012) and Wahl (2009) suggest that derivatives trading should be banned. Kohler (2012) indicates that when, for example, the US Dodd-Frank legislation, passed in 2010, requires non-US banks to register as swap dealers with US regulators, reports have been made that certain banks, particularly Asian banks, are cutting their relationships with US banks in some ultimate attempt to evade this regulation and continue to carry out their derivatives activities without registering. Moreover, US banks themselves are restructuring in order to keep up their uncontrolled derivatives activities. Kohler (2012) therefore argues that banks should be prohibited from trading derivatives instruments and putting their capital at risk. On the other hand, Wahl (2009) objected that the majority of derivatives instruments are the by-products of the casino economy, with its system of deregulated international markets, that generated the latest financial crisis. According to Wahl (2009), the casino system only promotes the principle of "profit/wealth maximisation at all times", and fails to enable adequate progress in the domain of development, thus creating more social inequalities. Wahl (2009) reports that only about 87 000 Africans, i.e. less than 0.01% of the total African population, benefit from the continent's growing integration into the global market.

In fact, the riskiness of derivatives markets merely places the utmost importance on the quality, soundness and timeliness of risk management and controls that must be in place with respect to users' participation in these markets (National Treasury

2009). Adelegan (2009) advises that the advantages of derivatives markets should not be disregarded or discounted because of the markets' current weaknesses.

2.5. CONCLUSION

This chapter has mainly dealt with the potential impact of the institutionalisation of derivatives markets on capital market development and economic growth to show how derivatives markets could affect Africa's development.

The contribution of derivatives markets to the economies of the developing countries that have afforded them, including South Africa, is quite substantial. The economic benefits of using derivatives entail the markets' risk management attributes, their ability to drive price formation, and their ability to support transactional efficiency.

Principally, the risk management (or hedging) attributes of derivatives are put forth to justify the instruments' suitability for achieving high-paced developing financial markets. Derivatives markets can thus be expected to stimulate financial development and growth in the economies, because they would facilitate risk transfer among economic agents, better price discovery processes, and the instantaneous dissemination of financial information that would effectively encourage growth in the underlying cash markets such as capital markets, and would subsequently instigate entrepreneurial activity towards more efficient economies.

Through their impact on capital markets, derivatives markets may enable the facilitation of superior and improved economic performance by capital markets through productivity growth, greater employment opportunities and greater macroeconomic stability. The benefits of the implied financial development can also be spread to a wider portion of populations, provided that, as capital markets develop, they would result in greater asset ownership by households. On top of everything, derivatives markets on their own may enhance countries' saving and investment potential, and as this happens, economies normally grow and become more stable.

Many factors may indeed assist in the desired reduction of macroeconomic volatility as a result of using derivatives instruments. For example, the technological progress made in the area of the information technology may provide easy access to information that will enable investors to better plan their medium- and long-term strategies, thereby contributing to the reduction of the fluctuations. Furthermore, the modification of the economy's structural composition, the development of services sectors, the integration into the international financial environment and the innovations created in these markets, as well as a reduction in the volatility of the capital markets, may all contribute to macroeconomic stability.

Derivatives markets would not only make a significant difference through the establishment and intensification of derivatives exchanges (which may well accelerate the processes of liberalisation and integration in financial markets), but they may also promote the emergence of new investment practices and the proliferation of institutional investors. The new techniques of risk taking and transferring may evenly transform the structures of financial markets for better economic growing prospects. As a matter of fact, there are three main channels through which derivatives markets can influence countries' growth.

The first channel is through their ability to emphasise the effects of the financial markets on growth by essentially augmenting financial trade and making the financial markets more efficient by helping them pulling national resources into the overall country's production. Derivatives trading can enable financial markets to attract some needed foreign capital funds, even though the use of the instruments can similarly cause a flight of capital in the event of crisis, due mostly to a loss of confidence by investors. A financial crisis can therefore deteriorate the positive contribution of derivatives on growth whenever it occurs. Correspondingly then, the risks associated with derivatives trading can amount to creating unwanted events for the financial system and the stability of the economy. The mounting systemic risk that is generally associated with the increasing use of derivative instruments, in particular, makes derivatives markets more prone to accelerating financial tumults and economic recessions.

The second channel of derivatives markets' influence on countries growth is through their ability to boost business activities, whereas the last channel entails the markets' stabilising effect on the country's GDP volatility.

Despite the stated financial and economic purposes behind the proposed introduction of derivatives trading, the use of the alleged tools of development can be perceived as too risky and too complex. As derivatives markets would offer more effective and wealth-enhancing methods to deal with financial markets' instability, sound regulations remain central to the constructive development of these markets. Nonetheless, derivatives markets and the resulting relatively bigger and well-developed capital markets may also bring some dimension of instability into financial markets. The OTC derivatives markets, in particular, are often the source of chaos in financial systems and the economy. The ability of derivatives markets to leverage and the obscure nature of some of the products can make them difficult to control, thereby enhancing their ability to lead to excessive risk taking. For instance, derivatives caused the 2008 global financial crisis because of their leveraging characteristics. As US banks vastly multiplied the leveraging on their balance sheets by betting through derivatives markets, they lost control of these derivatives positions in the end.

Even though all derivatives-related losses do not necessarily cause financial crises, the combination of successive and rather reproached losses by major market participants can generate widespread recessions and cause long periods of financial misery. In addition, the evasion of regulations by market participants often pose considerable concerns of financial and economy safety. The use of derivatives must be subject to sound and timely risk management in terms of users' participation per se. Countries that are willing to develop their own markets in derivatives need to anticipate the structure of the markets. The next chapter investigates the infrastructure of the South African derivatives market.

CHAPTER 3: THE INFRASTRUCTURES OF THE SOUTH AFRICAN DERIVATIVES MARKET

3.1. INTRODUCTION

The previous chapter explained that the use of derivatives should be subject to risk management and thus requires proper market infrastructures to be anticipated in order to ensure safe and well-functioning derivatives markets. Given South Africa's dynamic derivatives activity and the country's globally acknowledged well-functioning markets, it has been recommended that the fundamentals of prospective African derivatives markets need to be modelled on those of South Africa, so as to ensure proper infrastructures for these derivatives markets. In fact, past derivatives-related losses and other detrimental corporate events, including those that have cumulated during the 2008 crisis, have stressed the need for the use of derivatives to be subjected to such cautionary management of risks. Proper market infrastructures are thus required to guarantee the safeguarding and soundness of derivatives trading systems. Besides, it has clearly been stated that the success of any derivatives market depends not only on the products trades, but also on its formal structure (Adelegan 2009; Dudley & Hubbard 2004; Schwegler 2010; Tsetsekos & Varangis 1997; Van Wyk et al. 2012).

The goal of this chapter is to investigate South Africa's derivatives trading infrastructures. First, the global market for derivatives and latest trends related to markets' infrastructure development are duly visited. Next, the South African derivatives landscape is discussed with a look at the development of SAFEX and an overview of the derivatives products offered by the local exchange. Lastly, a discussion of South Africa's derivatives trading infrastructures concludes the chapter through the exploration of the institutional and regulatory infrastructures that are in place to ensure that the markets operate efficiently.

3.2. AN INTERNATIONAL PERSPECTIVE ON DERIVATIVES MARKETS AND THE LATEST DEVELOPMENTS IN TERMS OF DERIVATIVES MARKET INFRASTRUCTURES

The global derivatives market has been growing substantially, with a scope expanding beyond the boundaries of the industrialised world (De Rato 2007; Deutsche Bundesbank 2008; Mihaljek & Packer 2010). Before the financial crisis, between 1998 and 2008, the overall activity of the exchange was marked by increasing trading volumes in all groups of derivatives products. As depicted in Figure 3.1 below, the market segments for derivatives relating to equities in particular experienced very active trading. By 2008, the global derivatives market had expanded more than ten times from its 1998 levels in terms of equity index derivatives and individual equity derivatives volumes of trade (Davydoff & Naacke 2009).

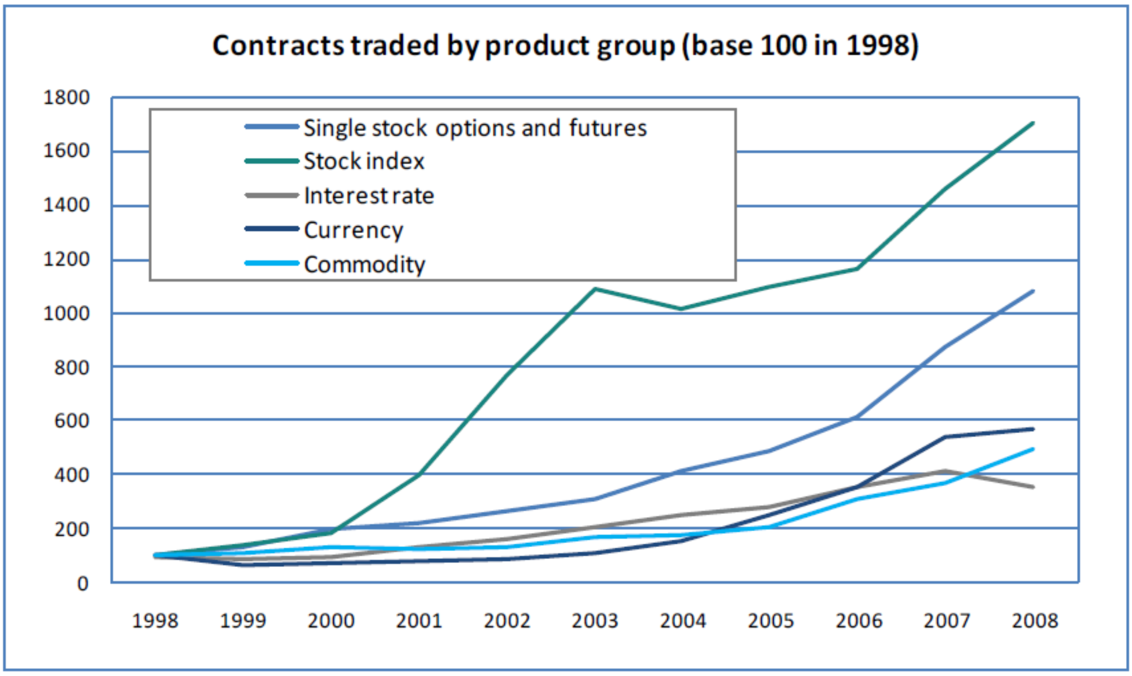


Figure 3.1: The pre-crisis trends in the global exchange derivatives trading for the different groups of products

Source: Davydoff and Naacke (2009:5)

Although the growth of the world's trade of derivatives instruments continued into the first half of 2008, the collapse of Lehman Brothers contracted the market, resulting in a contraction of the overall exchanges and OTC trade, as shown in Figure 3.2. The notional value of the overall on-exchange open positions declined by 31%, compared to end 2007. The 23% decrease in the outstanding value of OTC equity trades is only illustrative of the significance of the losses sustained by the OTC segment (Davydoff & Naacke 2009).

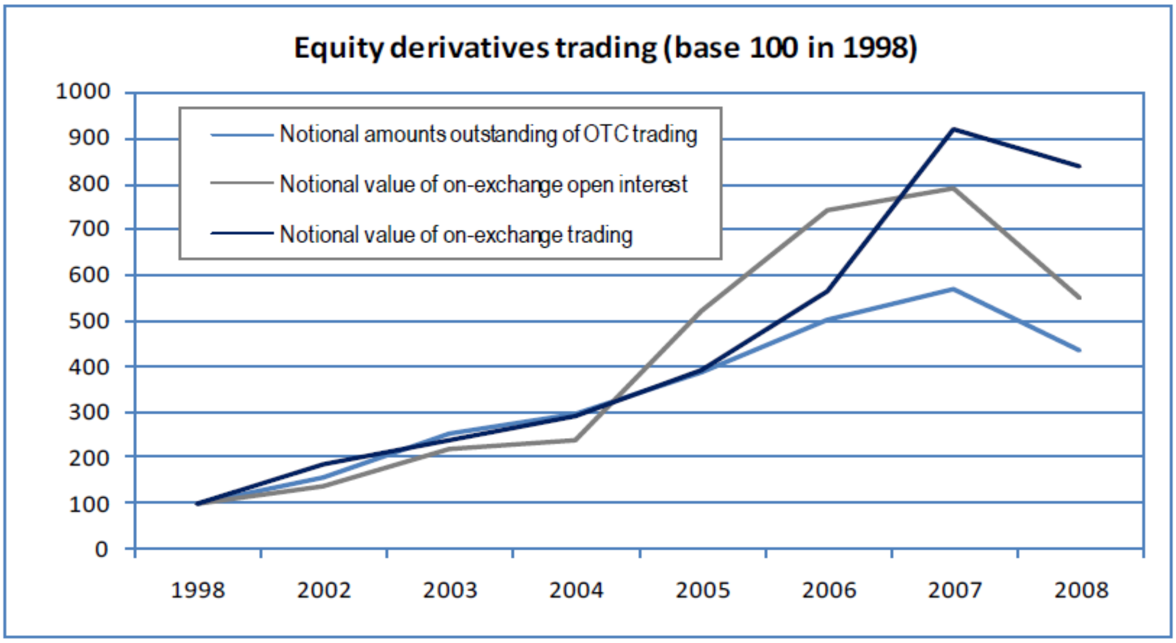


Figure 3.2: The pre-crisis OTC and exchange-traded equity derivatives trading
Source: Davydoff & Naacke (2009:6)

Despite the financial crisis, the use of derivatives instruments from a global perspective has remained significant in both exchange-traded and OTC markets (Van Wyk et al. 2012). The G-10 countries, with their preference for interest rate products, remain fond users of the instruments, especially in the OTC market. Instruments such as credit derivatives and other structured products are very popular in such advanced economies, mainly because they allow for the trade of illiquid assets and credit risks. This extensive use of OTC instruments by countries such as the USA and the UK has assisted in the broadening and completeness of these countries' financial markets. Hence, the performance of these economies has been nurtured by the provision of increasingly sophisticated instruments of risk management (De Rato 2007; Deutsche Bundesbank 2008; Dodd 2006).

In early 2008, the overall turnover of global derivatives exchanges peaked at almost $600 trillion (Baba et al. 2008). With the effect of the crisis, however, the end of 2008 was marked by a retreat in the activity of international derivatives exchanges, and the total turnover of exchanges fell to $408 trillion. Yet, this contraction of the global exchanges' activity was quickly followed by a rebound in activity by mid-2009, but trading volumes remained well below the pre-crisis level (Baba et al. 2008, 2009; Gadanecz, Gyntelberg & McGuire 2009). The global derivatives exchanges' activity then rose by 5% in the last quarter of 2009 (Avdjiev & Upper 2010). Eventually, in 2011, 25 billion exchange-based derivatives contracts were traded worldwide, representing a 12% increase from 2010's levels. In the OTC segment, the notional outstanding value finally stabilised, and levelled at around $601.1 trillion at the end of 2010 (Van Wyk et al. 2012).

Multiple market entries by exchanges in developing countries have characterised the global derivatives environment of recent years. These emerging derivatives exchanges have also made a fair contribution to the growth of the on-exchange and OTC global derivatives environment (Deutsche Bundesbank 2008; Mihaljek & Packer 2010).

3.2.1. The expansion of the business of derivatives trading into the developing world

Adelegan (2009) and Lien and Zhang (2008) emphasise that the 1990s saw a rapidly growing number of local derivatives trades in large developing countries such as Hong Kong, Japan, Brazil and South Africa that increasingly used local derivatives markets during that period. Figure 3.3 shows that developing countries' trade of derivatives is significant in both the OTC and on-exchange segments. About 62% of derivatives are traded on exchanges (right-hand panel) and 38% are OTC (centre panel). The markets for foreign exchange (FX) derivatives account for 50% of the overall turnover of derivatives exchanges, against 30% for equity-linked derivatives and 20% for interest rate derivatives (Mihaljek & Packer 2010). Mihaljek and Packer (2010) perceive the slacking of equity-linked and interest rate derivatives segments as the result of the relatively limited depth and liquidity of bond and equity markets in most of the developing countries, in comparison with more advanced countries, where derivatives are largely used against interest rate risk (77% of total turnover) while equity-linked derivatives and FX derivatives are less important.

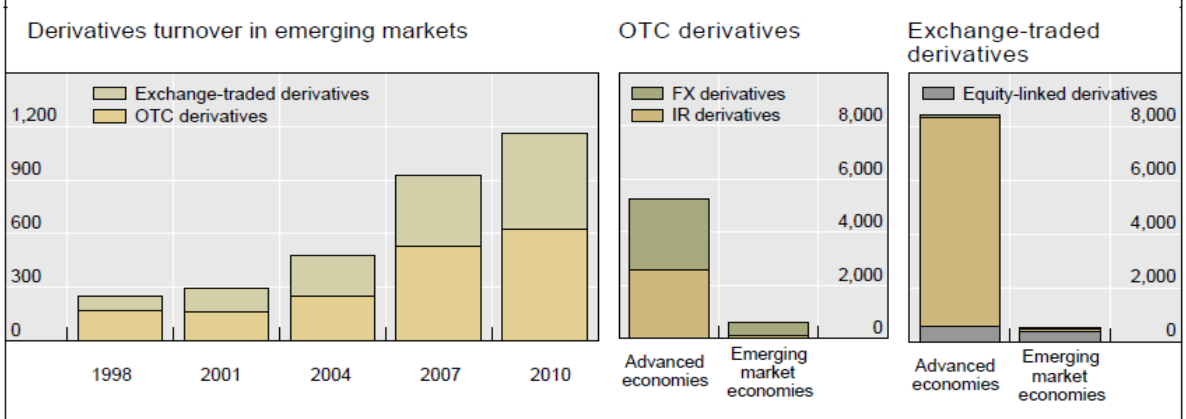


Figure 3.3: Derivatives turnover in advanced and emerging markets (daily average turnover in April, in billions of US dollars)

Source: Mihaljek & Packer (2010:45)

Whether traded on-exchange or OTC, derivatives are now recognised as some of cost-efficient tools for risk management in the developing world (Lien & Zhang 2008). Kaur (2004), for instance, presumes that countries not providing the globally accepted risk management facilities are disadvantaged in the prevailing rapidly integrating global economy. Hence, initiatives are underway to introduce domestic derivatives trading in a number of these countries (Lien & Zhang 2008).

3.2.2. The factors influencing the expansion of derivatives markets

Derivatives markets represent an arena for financial innovation, and thus increasingly provide new technologies and products for several exchanges worldwide (Davydoff & Naacke 2009). The globally growing derivatives market, and hence the large variety of derivatives listings at some ever-growing exchanges worldwide, is driven by a number of factors, including the following (Capitalmarket.webtutorials4u.com 2010; Jain 2008; NSE 2009):

(1) The increasing volatility in asset prices in financial markets

(2) The increasing integration of national financial markets with international markets

(3) The improvements in communication facilities and the sharp decline in their costs

(4) The development of more sophisticated risk management tools that provide economic agents with a wider choice of risk management strategies

(5) The innovations in the derivatives markets, which optimally combine the risks and returns over a large number of financial assets, leading to higher returns, and reduced risk and transaction costs when compared to individual financial assets

Notwithstanding the importance of derivatives markets in achieving the above mentioned factors, fears remain that the instruments are too risky, too complex, and potentially dangerous for countries' financial stability (Schwegler 2010; Van Wyk et al. 2012). OTC derivatives, for example, were blamed for increasing systemic risk and causing the latest financial crisis. The complexity and lack of transparency characterising these markets allegedly reinforced excessive risk taking in the markets. The markets did not provide regulators with clear insights into the problems that occurred in them, especially in terms of the markets' counterparty credit risk. The systemic collapse that resulted from users' high interconnection and inadequately collateralised transactions led to the Group of Twenty (G-20)[5]'s attempt to strengthen regulatory measures with respect to the OTC market to reduce counterparty credit risk and also to improve, altogether, market liquidity, efficiency and transparency (Duffie, Li & Lubke 2010; Mazars 2012).

[5] G-20 consists of a group of finance ministers and central bank governors from 19 of the world's largest economies, and the European Union. It was formed in 1999 as a forum for member nations to discuss key issues related to the global economy. The mandate of the G-20 is to promote growth and economic development across the globe. The G-20 consists of the members of the G-7 (*Canada, France, Germany, Italy, Japan, United Kingdom, United States*), 12 other nations (*Argentina, Australia, Brazil, China, India, Indonesia, Republic of Korea, Mexico, Russia, Saudi Arabia, South Africa, Turkey, China, India, Brazil and Saudi Arabia*), and rotating council presidency from the *European Union* (Investopedia.com).

CHAPTER 3: THE INFRASTRUCTURES OF THE SOUTH AFRICAN DERIVATIVES MARKET

It was shown that OTC derivatives markets can provide an extra avenue for risk management and liquidity in the financial system if used responsibly in a more appropriate infrastructural environment (Duffie, Li & Lubke 2010). In 2009, the G-20's recommendations for counteracting the problems associated with the OTC markets stipulate that (Mazars 2012; Financial Stability Board 2012):

(1) OTC derivatives had to be standardised, exchange-traded, and subjected to central counterparties' (CCPs) clearing by the end of 2012 at the latest.

(2) OTC derivatives contracts must be reported to trade repositories.

(3) Non-centrally cleared contracts should be subjected to higher capital requirements.

The standardisation of OTC products, their central clearing, and reporting to trade repositories aim to accomplish the following (Van Wyk et al. 2012):

(1) Improving pre- and post-trade transparency

(2) Increasing market competition

(3) Reducing systemic risk

(4) Ensuring more resilient liquidity

(5) Improving market surveillance for early problem detection

The implementation of the newly agreed upon international standards for OTC instruments has already been given motion. Largest derivatives centres, such as the European Union (EU), Japan and the US, have indeed embarked on structural efforts to align their OTC regulations with the G-20's recommendations. In July 2012, the EU published the European Markets Infrastructure Regulation (EMIR) to encourage stronger regulations through the promulgation of CCPs and trade repositories in the trade of OTC derivatives. EMIR focuses on the post-trading handling of OTC contracts and must be considered in conjunction with other OTC regulatory texts, such as the revised Market in Financial Instruments Directive

(MiFID)[6], the Market Abuse Directive, the Security Law Directive, the Central Securities Depositories Regulation, and the European version of Basel III, known as the Capital Requirements Directive IV (CRD IV) (Financial Stability Board 2012; Luxembourg Banker's Association 2013; Mazars 2012).

In the US, the Dodd-Frank Wall Street Reform (Dodd-Frank Act) and a Consumer Protection Act defines the OTC derivatives market regulation. The Dodd-Frank Act aims at preventing the repeat of a collapse of a major financial institution like Lehman Brothers, and also at protecting market participants with stricter rules. With respect to derivatives, the Dodd-Frank Act requires certain of these instruments, such as CDSs, to now be regulated under both the Security and Exchange Commission (SEC) and Commodity Futures Trading Commission (CFTC). Subsequently, the Dodd-Frank Act duly transfers the trade of such derivatives to an exchange-like setting and their clearance to a clearinghouse, in conformity with the G-20 recommendations (Luxembourg Banker's Association 2013; Koba 2012). Jointly, the SEC and CFTC have accommodated the provision of the Dodd-Frank Act with regard to OTC derivatives markets, and clearly indentify the OTC products that are subjected to the new regulations (Financial Stability Board 2012). The Financial Stability Oversight Council (FSOC) was also created to look out for events that could affect the financial system (Luxembourg Banker's Association 2013; Koba 2012).

With regard to the Japanese undertakings to meet the G-20 commitment in terms of OTC derivatives markets, new legislation in the 2010-revised Financial Instruments and Exchange Act (FIEA) include provisions aiming at improving the stability and clearing and settlement of OTC transactions through the use of clearinghouses, as well as strengthened regulatory oversight of the domestic OTC derivatives trading and clearing (International Monetary Fund 2012). In July 2012, the Japanese Financial Services Agency was enacted to put some OTC transactions under mandatory central clearing. Subsequently, reporting requirements for trade repositories (TRs) are to be introduced for certain interest rate, foreign exchange, equity, and credit derivatives transactions (Financial Stability Board 2012).

[6]MiFID2 addresses the trading and negotiation aspects of contracts.

Similarly, regulations have been proposed or adopted in a number of developing countries with respect to OTC derivatives markets. CCPs and exchanges are being made available to assist with the settlement and clearing of products in all OTC derivatives asset classes. Furthermore, TRs are provided for reporting transactions. By the end of 2012, Brazil had already established CCPs and TRs for OTC derivatives on commodities, equity, foreign exchange and interest rates. In India, a CCP and TR were established for OTC foreign exchange derivatives and only TRs were available for credit and interest rate derivatives trading. In Singapore, CCPs and TRs existed for OTC commodities and interest rate derivatives, as well as CCPs for OTC foreign exchange derivatives and TRs reporting applied to credit derivatives. The Korean TRs, on the other hand, served all classes of OTC derivatives, including commodities, equity, credit, foreign exchange and interest rates (Financial Stability Board 2012).

The Financial Stability Board (2012) divulges that the infrastructures for OTC derivatives trading platforms remain generally less developed than the infrastructures for central clearing and trade reporting, but these are expected to expand quickly worldwide. As a member of the G-20, South Africa has also committed to the restructuring of its derivatives market infrastructures. The remainder of the chapter deals with South Africa's derivatives trading scene.

3.3. THE SOUTH AFRICAN DERIVATIVES LANDSCAPE

3.3.1. The development of South Africa's derivatives exchange

A derivatives exchange encompasses all the formal structures, including the organisations in charge of trading and clearing, as well as the regulatory structures that govern the relationship among the users of the derivatives exchange. It is the trading system that links a central market, where the buyers and sellers of the risk-shifting products can meet, with the system of mechanisms for validating transactions and enhancing the credit of these transactions. As such, an exchange exists mainly to facilitate trade and reduce credit risk in the transactions between market participants. Properly structured market infrastructures must be maintained at all times to ensure a derivatives exchange that remains efficient in facilitating risk transfer, and the orderly trading and execution of transactions (Tsetsekos & Varangis 1997, 2000).

The derivatives exchange in South Africa emerged as an initiative of the Rand Merchant Bank (RMB) to enhance liquidity in the local financial markets and as a tool of risk management against volatile capital flows in order to meet the country's challenges of financial globalisation. The market commenced as an informal trading facility of futures contracts on bonds and equity. At that time, the RMB acted as the exchange, clearinghouse, and market maker for the futures market. Subsequently, SAFEX and the SAFEX Clearing Company (SAFCOM) took over the operation of financial futures trading from RMB in early 1990, acting as the new exchange and clearinghouse, respectively. The derivatives exchange was officially opened on 10August 1990. The monthly volumes in the first year of operation were approximately 60 000 contracts, but the exchange rapidly developed and by the end of 1993, about one million contracts were traded on a monthly basis. The product range was progressively broadened, introducing other types of instruments such as single equity options, single stock futures and options on futures. In 2001, the JSE acquired SAFEX and became the sole owner of the exchange in an attempt to increase the market's efficiency and new product development (Adelegan 2009; Banks 2003; Johannesburg Stock Exchange n.d.; Schwegler 2010).

The creation of the SAFEX agricultural division in 1995 introduced agricultural commodity futures trade on commodities such as maize and wheat. The agricultural derivatives market has developed to such an extent that the cash market now largely relies on its price transparency and discovery process to function properly. Prices that are generated on the derivatives market are considered as the industry standard and a reference point throughout southern Africa (Johannesburg Stock Exchange n.d.). On the other hand, the financial division of SAFEX has contributed towards the country's deeper financial markets with its many additions to the exchange's product offering (Adelegan 2009).

The South African derivatives market has gradually grown into its current state. The market has become a very dynamic one and now attracts a very diverse participation in the South African financial markets. Institutional investors are more prominent users of the derivatives market. Institutional users include trade funds, hedge funds and large corporate domestic and international companies (Adelegan 2009; Schwegler 2010).

As the host of SAFEX, the JSE now lists among the largest derivatives exchanges in the world. In 2008, the JSE simultaneously ranked as the world's largest exchange in terms of the number of single stock futures contracts traded, sixth in terms of the value of trades, and tenth in terms of the number of contracts traded (Schwegler 2010; Futures Industry Association 2009). Schwegler (2010) suggests that South Africa's fairly long and dynamic history of derivatives usage has been an important factor that helped turn the national financial industry into a fairly well-functioning and well-regulated environment.

3.3.2. The derivatives products offered by SAFEX

There are five classes of underlying assets that could be used when constructing derivatives instruments, namely commodities, equities, fixed-income instruments, foreign currencies and credit events (Chui n.d.). Currently, SAFEX lists and trades derivatives products on South Africa's primary markets for commodities, equities, fixed income and foreign exchange, as well as on some internationally referenced products (Adelegan 2009; Schwegler 2010). The following sections review the types of products that are currently offered by SAFEX in each class of derivatives contract.

3.3.2.1. Commodity derivatives

SAFEX's Agricultural Markets Division mainly trades local grains and oilseed, as well as some foreign referenced contracts on agricultural products, oil, precious metals and copper (Van Wyk et al. 2012). The exchange's commodity derivatives offering include the following (Johannesburg Stock Exchange n.d):

Grain futures and options: These derivatives give investors the opportunity to hedge or speculate on the price risk of local agricultural commodities such as white maize, yellow maize, wheat, sunflower seeds, soya beans and sweet sorghum.

Options on commodity futures provide farmers with the ability to have a floor price for their products through the use of put options, while millers can set a ceiling price for milling requirements by using a call option. This can be done at a non-refundable premium.

International commodity derivatives ease access to international commodity markets for local investors, as they provide them with exposure to international markets for commodities such as corn, soy, wheat and copper, oil, gold, platinum and silver.

The South African Volatility Index (SAVI) white maize is a three-month forward-looking index that makes it possible to know what the market volatility will be three months ahead.

3.3.2.2. Equity derivatives

The equity derivatives traded on SAFEX's Financial Derivatives Division consist of the following (Johannesburg Stock Exchange n.d.):

Warrants: These are long-dated put or call options issued on an individual or baskets of listed companies' securities trading with a maturity of ten years or more (Adelegan 2009; National Stock Exchange of India 2009). Warrants are generally listed as conventional securities, rather than as derivatives, and can also be issued along with debt instruments (National Treasury 2009; Schwegler 2010).

Can-do futures and options: These are essentially exotic derivatives that offer investors the advantage to trade some listed derivatives that have the flexibility of OTC contracts. With Can-dos, the exchange allows investors to negotiate the terms of contracts by deciding themselves on an underlying asset and the expiry date of contracts (Schwegler 2010).

eCFDs (Exchange-traded contracts for difference (CFDs)): As for any CFD, the two parties in an eCFD agree to exchange the difference in value of a particular asset between the time of the contract's inception and the time at which the contract is closed. Because eCFDs are listed on the exchange and cleared by SAFCOM, the contracts offer participants full exposure to the country's deep and liquid underlying equity spot market without any exposure to counterparty default risk whatsoever.

Single stock futures (SSFs) give investors exposure to the price movements of shares. SSFs are futures contracts based on the JSE's individually listed shares (Adelegan 2009).

Equity index futures provide exposure to the price movements of an entire index listing of the JSE. Market participants can take a futures position to invest in a basket of equities without actually trading in the individual constituent equities (Schwegler 2010).

Equity options are based on equity futures contracts such as SSFs (single stock options), index futures (index options) and Can-do futures (Can-do options). The purchaser of such equity options buys the right to buy or sell the underlying equity future, but not the share. Ultimately, though, the purchaser will be able to buy or sell the physical share (Johannesburg Stock Exchange n.d.).

South African Volatility Index (SAVI) Squared: SAVI is an indicator that measures the country's equity market's (FTSE/JSE Top 40 index) expected three-month volatility that gauges investors' fear and market sentiment about the local equity market. On the other hand, SAVI Squared is futures on variance/volatility offering investors the opportunity to buy or sell variance or volatility at predetermined strike prices and at a date in the future (Schwegler 2010; Johannesburg Stock Exchange n.d.).

Dividend futures can be applied against the dividend risk of single stock futures (SSFs). In the simplest form, these futures are referred to as F-contracts and can be booked in conjunction with a SSF to avoid differences between dividend predictions and actual dividend declarations. In a more complex form, these futures trade as Dividend Neutral Stock Futures (DNSF), that is, a basket of two SSF contracts constructed from the so-called F-contract and another SSF called a Q-contract. A party involved in an SSF may enter both dividend futures simultaneously to eliminate the risk associated with the SSF's dividends (Johannesburg Stock Exchange n.d.).

International (equity) derivatives can be used to hedge against currency risks associated with rand weaknesses. These are cash-settled futures on equities listed abroad. Futures contracts are offered on the stock of international companies, such as British Petroleum, Rio Tinto, Vodafone, Nokia and GlaxoSmithKline. The trade of international derivatives is likely to become an important aspect of SAFEX's business (Schwegler 2010).

3.3.2.3. Interest rate derivatives

Investors can protect themselves against unfavourable interest rate developments with interest rate derivatives. The products offered in this class of derivatives are as described below (Johannesburg Stock Exchange n.d.; Schwegler 2010):

Bond futures offer their holders the opportunity to gain exposure to interest rates as spot bonds, but at much lower costs. These futures are offered on government and corporate bonds.

Options on bond futures are fully margined options that underlie all bond futures contracts listed on the JSE. These options are available as European put and call options. The premium does not change hands on purchase or sale, but is realised through the mark-to-market process over the life of the option.

JIBAR (Johannesburg Interbank Agreed Rate) futures: The JIBAR futures contract is an efficient way to obtain exposure to the South African interest rate markets.

Index futures have bond indexes as underlying instruments. The underlying instruments in the index futures are listed on Yield-X, to which the terms and conditions in these contracts apply.

Interest rate derivatives are listed on the Bond Exchange of South Africa (BESA) and Yield-X, which serve as the bond exchange and JSE's interest rate exchanges, respectively. South Africa's interest rate derivative market is growing fast, with an impressive 41% growth in the number of contracts traded between January in 2012 and January 2013 (Johannesburg Stock Exchange n.d.).

3.3.2.4. Currency derivatives

The JSE started its currency derivatives market by offering currency futures on the US$/Rand, GBP/Rand and EUR/Rand exchange rates (Adelegan 2009). The currency derivatives enable investors to hedge against unfavourable exchange rate fluctuations (Schwegler 2010). At present, the JSE offers many currency derivatives products (Johannesburg Stock Exchange n.d.):

Currency futures allow participants to trade the rate of exchange between one unit of foreign currency and the rand for a period of time in the future. The JSE’s Yield-X platform offers the following currency futures contracts (Johannesburg Stock Exchange n.d.):

(1) Dollar/Rand ($1 000): This is the minimum contract size for qualifying individuals with no limitations (Adelegan 2009).

(2) Dollar/Rand Maxi ($100 000): The Dollar/Rand Maxi Currency Futures contract has a larger nominal size of $100 000 per contract instead of the normal size of $1 000 per contract. This contract was introduced to encourage larger contracts to be traded on-exchange and to spur on market participants to trade on the JSE instead of trading on foreign platforms.

(3) Other futures contracts include the Euro/Rand, Sterling/Rand, Swiss Franc/Rand, Australian Dollar/Rand, Japanese Yen/Rand, Canadian Dollar/Rand, Chinese Yuan/Rand, Any-day Expiry (futures with flexible expiry date), and also Can-do (exotic structures).

Currency options are based on currency futures contracts. With these options, premiums fluctuate with movements in the underlying spot and futures exchange rates.

Schwegler (2010) indicates that the broadening of the product range offered on SAFEX provides South African investors with many alternatives for their investment positions. The various instruments that trade on South Africa’s derivatives exchange and other institutional arrangements made on OTC markets have influenced the financial efficiency and helped spur economic development (Adelegan 2009). The country's exchange has grown into a well-functioning and efficient one. In general, the success of such an exchange often parallels a great extent of development in terms of market infrastructures. On the other hand, it is advised that poor financial infrastructures in many developing countries somehow deteriorate the expansion of financial services and, accordingly, constitute a significant blockage to countries' economic success. The presence of derivatives exchanges may perhaps facilitate access to financial instruments by providing the infrastructures needed to ensure some greater extent of transparency and governance in the financial markets (International Bank for Reconstruction and Development 2009; Tsetsekos & Varangis 1997). The next section deals with the infrastructures of well-functioning derivatives exchanges, with, yet again, an emphasis on South Africa's exchange.

3.3.3. The infrastructures of the South African derivatives exchange

As discussed by the Deutsche Börse Group (2009:17), the financial crisis has shown that the safety and integrity of derivatives trading and clearing need to be ensured, especially because the systemic risk borne by derivatives trading can trigger a domino effect whereby the failure of one market participant can adversely affect other market participants, with a possibility of destabilising an entire financial system. The Deutsche Börse Group (2009) suggests that strongly structured markets must be provided to mitigate and contain the negative effects of derivatives trading. Such well-structured derivatives trading systems can guarantee well-functioning markets that deliver maximum benefits to their participants and the economy as a whole through safe, efficient and innovative markets.

Some very important institutions that need to be considered when structuring a formal derivatives market are the following (Deutsche Börse group 2009; Rodríguez 2009; Thomas 2000):

(1) **Exchanges** facilitating the trade of most derivatives instruments, including standardised OTC instruments, which basically provide the infrastructure that brings together the buyers and sellers of the securities, and match the bids and offers of buyers and sellers (Deutsche Börse group 2009;

Rodríguez 2009; Thomas 2000). The on-exchange trade of standardised OTC derivatives with clearing through a CCP is advised and should be addressed when defining a structure for a derivatives market. The transfer of OTC trades to an on-exchange facility aims at ensuring greater stability in the financial system through the prevention of systemic crises (Deutsche Börse group 2009).

(2) **Clearinghouses and/or CCPs** are responsible for making margin calls and charging collaterals to on-exchange trades in order to ensure the prompt clearing and settlement of transactions. Clearing through such central counterparts guarantees the completion of all transactions, because the credit risk that arises from the parties' obligations is completely transferred to the clearinghouse (Rodríguez 2009). Moreover, the trade of standardised OTC instruments via CCPs and the collateralisation of these instruments have become the new norm. The use of CCP clearing is also recommended whenever on-exchange trading is not feasible in order to move such derivatives from bilateral clearing to clearing via a CCP, and thus to minimise the systemic risk associated with the OTC segment (Deutsche Börse Group 2009).

The main advantages of CCPs include the following (Deutsche Börse Group 2009:22):

(a) Mitigation and management of counterparty risk

(b) Reduction of information asymmetries

(c) Reduction of complexity and increase in efficiency

The collateralisation of bilateral exposure arising from derivatives contracts that may not be eligible for clearing by a CCP (e.g. if the product is not sufficiently standardised) or from market participants deliberately choosing not to use a CCP should enable these products to remain in the OTC segment for bilateral trading and clearing. Collateralisation should ideally be performed by third-party collateral managers. Fully collateralising these derivative contracts within the life cycle of bilateral transactions should minimise the counterparty risk (Deutsche Börse Group 2009).

(3) **A centralised TR** is needed to ensure that all derivatives contracts are duly reported and recorded. Relevant authorities need to have unrestrained access to the TR for the purpose of monitoring trades and open interest in the market (Deutsche Börse Group 2009).

According to Thomas (2000), an exchange and a clearinghouse are essential to the structuring of a formal derivatives market. Furthermore, the financial crisis has revealed the necessity of implementing exchange-based OTC trading, which requires extra developments in the way pre-crisis clearinghouses/CCPs function, and also the promulgation of the use of TRs. As one of the ways to ensure the trade guarantor status of an exchange as a whole, exchanges and clearinghouses often grant separate memberships to market participants. Clearing membership is normally available to those who meet the higher minimum financial requirements set by the clearinghouse, in addition to meeting the exchange's requirements (McBride & Hazen 2004). SAFEX and SAFCOM are South Africa's derivatives exchange and clearinghouse, respectively (Johannesburg Stock Exchange n.d.). The following discussion focuses on these institutions.

3.3.3.1. SAFEX, South Africa's derivatives exchange

The activity of SAFEX started in 1987, as five futures contracts began to trade on local equity and bond markets (Johannesburg Stock Exchange n.d.). As of May 1996, SAFEX has conducted its derivatives trading electronically through the exchange's Advanced Trading System (ATS), a deal booking and price publication system. Exchange members can book and execute deals through the ATS by publishing prices where they will bid or offer, or even request pricing information from other members (Banks 2003).

The role of the exchange when it comes to derivatives trading entails the following (Minister of Finance 2012:19):

(1) Provide an infrastructure for the trade of the listed securities.

(2) Supervise compliance with the exchange rules and exchange directives by its authorised users.

(3) Supervise compliance with regulatory measures by authorised users and issuers of listed securities, report any non-compliance to the registrar, and assist the registrar in enforcing regulations.

(4) Enforce the exchange rules, listing requirements and exchange directives.

(5) Be alert and inform the regulatory authorities of any matter that may pose systemic risk to the financial markets, thus providing them with any information requested to monitor and mitigate systemic risk.

(6) Issue exchange directives.

(7) Make the necessary amendments to the exchange rules and listing requirements if and when required.

(8) Make provision for the clearing and settlement of transactions effected through the exchange by appointing an associated or independent clearinghouse licensed to clear or settle the transactions on behalf of the exchange.

(9) Supervise compliance by issuers of listed securities with the exchange's listing requirements.

(10) Perform all the tasks necessary for, or conducive to, the proper operation of an exchange and that are not inconsistent with regulations.

SAFEX and BESA formalised South Africa's trade of derivatives (Adelegan 2009). In the opinion of Scalcione (2011), bringing derivatives trading onto such a transparent market-like trading venue is important to ensure more efficient, transparent and secure trading. Moreover, the automation of the exchange guarantees increasing market transparency and enhanced price discovery, and also facilitates the supervision of the market.

3.3.3.2. SAFCOM, the clearinghouse of SAFEX

Trades executed through SAFEX directly flow to SAFCOM, the 100% JSE-owned clearinghouse, for clearing and settlement (Banks 2003; Xulu 2012; Adelegan 2009). The role of SAFCOM is therefore explained below.

i. The functions of SAFCOM

The functions of the clearinghouse, as provided by the South African Minister of Finance (2012:39), include the following:

(1) Provide an infrastructure for the clearing of securities through the clearing house. McBride and Hazen (2004) state that the clearance of securities' trades by the clearinghouse entails the following:

(a) Daily reconciliation of all trade effected during a trading session. This requires clearing members to deliver detailed reports on all derivatives contracts to the clearinghouse to enable it to check for discrepancies in the information supplied by all clearing members. If such a discrepancy occurs, the clearinghouse notifies the affected clearing members so that the discovered differences are reconciled.

(b) Requesting daily settlement of amounts owed on futures and option contracts by clearing members. This entails the clearinghouse computing the net gain or loss on each of the clearing members' open positions and collecting the amount from the party with the net losses to pay it over to the clearing members with a net gain for the day. In the case of options, only the seller participates in the daily mark-to-market settlement process, because the buyer only pays a one-time premium at the inception of the contract.

(c) Guaranteeing the financial integrity of all futures and options that are accepted, which creates the margin calling and settlement enforcement duty of the clearinghouse. The clearinghouse can require of clearing members to satisfy their customers' obligations if the original party to a contract defaults. In cases where the defaulted amount is too large for the clearing member to settle, the obligation becomes incumbent on the clearinghouse, which then has to pay any remaining part of it.

(2) Inform the relevant regulatory authority of any matter that is reasonably believed to potentially pose systemic risk to the financial markets, as soon as it becomes aware of it.

(3) On request of the regulatory authority, disclose information on the exposure that a clearing member underwrites with the clearing house.

(4) Take the necessary action for the proper operation of the clearinghouse in conformity with regulatory measures.

ii. Clearing and settlement through SAFCOM and SAFCOM's management of credit risk

The clearing and settlement of trades is an important responsibility of the clearinghouse whereby it charges collateral to both sides involved in derivatives transactions with the view to ensure against credit losses (Tsetsekos & Varangis 1997). When SAFCOM clears SAFEX's derivatives, the clearinghouse establishes itself as the central counterparty in clearing members' transactions that have been matched and confirmed by the exchange. SAFCOM reviews the financial trustworthiness of the clearing members and requires collateralised contributions on the trading transactions (Banks 2003). In practice, the process of novation allows the multilateral netting of the members' obligations to one another, and SAFCOM is the place where this process is performed. Accordingly, both legs of every trade face the clearing corporation as legal counterparty in order to be freed from the credit risk of their respective counterparts (National Treasury 2009; Thomas 2000). Moreover, the margining process helps SAFCOM to protect against non-performance by members and ensures that settlement takes place on each trade, thereby minimising the possibility of credit losses (Johannesburg Stock Exchange n.d.; Loader 2005; National Treasury 2009).

Turning to SAFCOM's risk management philosophy, the clearinghouse management of credit risk is such that any registered clearing member stands to carry its client's losses if the client defaults, just as each clearing member carries its member's (the member for whom it clears) losses if the member defaults, and so on up to the top of the pyramid diagram depicted by Figure 3.4. SAFCOM therefore bears the risk that one of the clearing members would possibly default, whether as result of a member causing the default or as a risk of its own default, and thereby attempts to eliminate such risk (Johannesburg Stock Exchange n.d.; Matlala, Lowenthal, Siyaka, Stratten & Van Rooyen 2010).

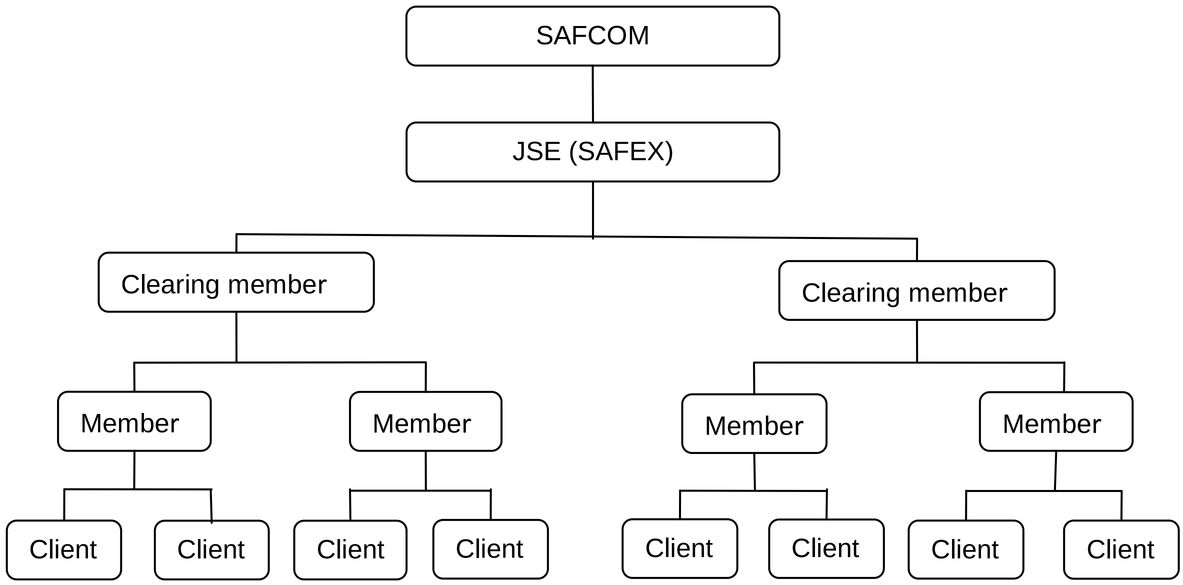


Figure 3.4: Pyramid of SAFEX's risk management structure

Source: Johannesburg Stock Exchange (n.d.)

Clearly, a clearinghouse is vital, because of the role it plays in the elimination of counterparty/credit risk (Thomas 2000). The risk management techniques of clearinghouses normally facilitate regulators' direct intervention in the markets for prudential risk appraisal and management (Scalcione 2011). The value of these institutions was particularly evident in 2007–2008 after the collapse of Lehman Brothers, as centrally cleared markets remained open and continued to drive price in the almost dried-up credit markets, thereby proving the then-required liquidity in these markets. Clearinghouses were able to guarantee the stability and solvability of counterparties in the credit markets. Fundamentally, the use of clearinghouses can guarantee the stability of financial systems by allowing risk trading even at times of extreme market disturbance (Scalcione 2011). Scalcione (2011) ultimately emphasises that exchanges should continuously strive to open infrastructures by facilitating the expansion of their product offering baseline and maintaining a proper level of investment on the development and sophisticated market infrastructures, especially on regulatory infrastructures.

3.3.3.3. The South African TR

A TR is a centralised database that maintains a secure and reliable electronic recording of open OTC derivatives transactions. South Africa has established the local TR to ensure enhanced markets' regulatory oversight and transparency. To assist in the development of a local TR in accordance with the country's regulatory requirements, Share Transaction Totally Electronic (Strate), South Africa's securities depository, recently entered into an agreement with REGIS-TR, the European TR that supported the inception of the new reporting obligation derived from EMIR in Europe. The collaboration with REGIS-TR aims at ensuring that the local TR benefits from world-renowned technology, meets international standards and also benefits the South African market (Strate 2013).

The South African Minister of Finance (2012:43) listed the duties to be performed by the local TR as follows:

(1) Employ timely and efficient record-keeping procedures.

(2) Make the information available to the relevant supervisory authorities.

(3) Ensure the confidentiality, integrity and protection of the information received.

(4) Permit the monitoring and mitigation of systemic risk.

Regulators globally have recognised the need to use a TR to reduce systemic risk, improve transparency and protect both investors and financial institutions. A local TR will protect South Africa's financial markets even in time of crisis (Strate 2013).

3.3.3.4. The Regulatory infrastructures of the South African derivatives market

A sound regulatory environment is yet another requirement for successful derivatives exchanges. Evolving regulatory infrastructures that support market innovations and provide up-to-date and effective regulations for the markets are of the utmost importance (Alberta Market Solutions 2003; Pickel 2006; Tsetsekos & Varangis 1997). The regulation and supervision of the markets entail the enforcement of trading rules through prudential oversights and inspections (Kane 2008; National Treasury 2009). These prudential measures have the following three common objectives (National Treasury 2009):

(1) Reducing systemic risk

(2) Ensuring that markets are fair, efficient and transparent

(3) Protecting investors

South Africa's non-banking financial institutions are subjected to the independent regulation of the Financial Service Board (FSB). The Capital Markets Department of the FSB is responsible for regulating and overseeing the activities of derivatives market organisations such as the exchange and clearinghouse. This department mainly aims to provide the efficiency and fairness needed for the clearing and settlement of transactions. The derivatives institutions are commonly self-regulating, which means that they regulate their own activity and the activities of authorised members, as well as the activities of the clients of members (Adelegan 2009; Banks 2003; Van Wyk et al. 2012).

Recently, the Financial Markets Bill of 2012 (FMB) has been adopted to replace the Securities Services Act (2004) in order to fulfil the G-20's commitment to the standardisation of OTC derivatives, the clearing of these instruments through CCPs, and the reporting of all derivatives contracts to trade repositories (Van Wyk et al. 2012).

The FMB was promulgated to realign the country's regulatory framework with international best practice in terms of the post-crisis newly recognised standards for financial market regulation. As such, the FMB emphasises the regulation of derivatives market institutions, including exchanges, clearinghouses and trade repositories, as well as the relationship of these institutions with their respective members. The bill also makes provision for the requirements applicable to the licensing of the exchange, clearinghouse and TR, the manner in which securities may be listed on, or removed from the exchange, the requirements that should be met by the rules of the exchange and clearinghouse, the manner in which these rules may be amended or suspended, and the standards of conduct that must be met by authorised users, participants and clearing members (Davids & Modise 2005; Minister of Finance 2012; National Treasury 2009; Van Wyk et al. 2012).

In terms of the FMB, participation in the country's derivatives markets, including that by the exchanges and clearinghouses, is conditional upon adequate authorisation obtainable through licensing and thus restricted to authorised users only. Nevertheless, unauthorised users can still participate through the use of the services of authorised users (Davids & Modise 2005; Minister of Finance 2012). Moreover, the rules that govern the exchange and clearinghouse, respectively, stipulate how financial services are rendered in terms of the contractual relationship that may exist between these institutions and their registered members. The derivatives rules are binding on SAFEX members and regulate the trade of listed derivatives. These rules reinforce restrictions on participation in the local derivatives markets by prescribing mandatory registration by the exchange members for the financial derivatives market or the agricultural derivatives products market, or both, in order to provide securities services (Davids & Modise 2005). The purpose of these derivatives rules is to effectively provide procedures to ensure the desired fairness and efficiency of the derivatives markets, and by the same token, to make sure that the exchange's business of derivatives trading is carried out in an orderly manner (Johannesburg Stock Exchange n.d.).

As elsewhere, in the wake of the financial crisis, new derivatives rules have been adopted to govern South Africa's derivatives trading. These are consistent with the guidelines of the International Organisation of Securities Commission (IOSCO), which require derivatives markets to have prefunded resources that would provide capital in addition to the collateral posted by participants. The new SAFCOM rules have thus promulgated the establishment of a default fund that add to investors' protection in the exchange-traded derivatives market. These rules serve as the way for better counterparty risk management in South Africa's markets for derivatives. Under these new rules, SAFCOM's clearing members, together with the JSE on behalf of SAFCOM, will pay collateral into the default fund, with each member's contribution to the fund being proportional to the risk it brings to the clearinghouse. SAFCOM's contribution to the default fund will add to the defence against potential defaults by clearing members. The protection the new rules offer clearing members, investors and SAFCOM itself is such that, in addition to the use of margins posted by the defaulting clearing members, the contribution to the default fund by defaulting members, the contribution of SAFCOM, as well as the contribution by non-defaulting members, will help offset the counterparty credit risk and the systemic risk that may form as clearing members interact in the market (Johannesburg Stock Exchange n.d.).

At last, the possible establishment of an independent clearinghouse is considered in view of reinforcing regulatory oversight of the OTC derivatives markets (Xulu 2012). Additional structural improvements in terms of the local OTC market regulation entail the anticipation of the institutionalisation of the domestic trade repository. Up to now, Strate has served as a centralised securities depository for all listed and certain OTC financial instruments trading in the local financial markets, except for derivatives, which have, until now, been maintained under SAFCOM's clearing for listed instruments. As already emphasised in section 3.3.3.3, the local TR is likely to help safeguard the local financial markets by reducing systemic risk, and ensure improved transparency and investors' protection in terms of OTC derivatives. The use of the TR will help maintain financial stability in both local and global financial markets (Strate 2012, 2013). South Africa's new system for regulating OTC derivatives is in compliance with the new trading, clearing and reporting standards regarding the OTC markets (Ensor 2013; Strate 2013).

CHAPTER 3: THE INFRASTRUCTURES OF THE SOUTH AFRICAN DERIVATIVES MARKET

Infante and Smirnova (2010) acknowledge that proper market infrastructures are essential for ensuring derivatives markets that will spur countries' economic performance and systemic stability. The presence of strong market infrastructures is thus regarded as an important stimulator of growth. The International Bank for Reconstruction and Development (2009) explains that better levels of financial infrastructures as a result of derivatives trading can allow the emergence of new technologies for trading and, accordingly, create new opportunities for better economic outcomes. Well-functioning institutional market infrastructures, as the International Monetary Fund (2012) further acknowledges, can reinforce the efficiency, transparency and safety of financial systems. Adequate regulatory and supervisory frameworks for both the markets and their infrastructures can help protect investors, promote public confidence, guarantee market discipline, and ensure that the markets do not develop systemic risk (International Monetary Fund 2012; United Nations 1999).

However, divergent opinions exist about the modernisation of financial infrastructures and its effect on economic welfare. In effect, better financial infrastructures have sometimes been blamed for supporting excessive risk taking, despite the fact that they enhance financial intermediation. It is believed that such modern financial infrastructures can effectively contribute towards increasingly complex behaviour from consumers in the markets, causing financial bubbling and possibly adding to the creation of crises (International Bank for Reconstruction and Development 2009).

In spite of everything, the International Bank for Reconstruction and Development (2009) maintains that access to finance and financial services in developing countries remain dependent on the development of these infrastructures. The quasi-absence of institutional and regulatory capacity is holding back the efficient operation of countries' financial markets.

The South African financial sector did not experience much of the financial side effects of the latest crisis, as strong regulations of financial markets and institutions permitted proactive actions to mitigate risks and avoid a financial and sovereign crisis. In the aftermath of the crisis, additional actions have prompted further strengthening of the country's regulatory structure in terms of derivatives. The new regulations that aim at keeping the country's derivatives environment in line with new global standards could open up the local markets to even more international players (National Treasury 2011; Van Wyk, et al. 2012; Xulu 2012). The other SSA countries can therefore draw from the South African experience to deepen local financial markets and ensure structurally sound infrastructures for the emergence of derivatives markets (Adelegan 2009; Pickel 2006).

3.4. CONCLUSION

This chapter has focused on the infrastructures of South African derivatives markets. The international derivatives markets were discussed, with a particular emphasis on the expansion of derivatives trading in the developing world, and the latest trends in terms of the development of these markets' infrastructures were also highlighted. Then, the South African derivatives trading settings were examined with the main intention of exposing the infrastructures that need to be in place to ensure well-functioning derivatives exchanges.

The number of derivatives exchanges in developing countries is expanding and contributing their fair share to the noticeable growing global derivatives activity, both in the OTC and exchange-traded markets. This expansion of derivatives trading to the developing world is encouraged by a number of factors, such as the volatility of the global financial markets, the rapid integration of national financial markets with international markets, the need for alternative risk management tools, and the innovations of derivatives markets.

The South African derivatives landscape has evolved substantially since the establishment of the local derivatives exchange in 1987. The local markets for derivatives trade an array of instruments on the regulated exchanges. The country's OTC markets also attract a broadening investor base. The vibrant markets offer derivatives on the five known classes of underlying instruments, thereby substantiating the composition of the country's financial markets. Furthermore, the introduction of instruments such as Can-do futures and options has introduced more flexible trade of exotic derivatives on the exchange. Such broadening of the product range offered on the local exchange provides South African investors with many alternatives to meet their investments needs.

The evolution of the local derivatives markets have undeniably complemented developments in financial infrastructures, which in turn has also led to further financial and economic development. South Africa's derivatives exchange has promoted local financial infrastructures' efficiency, transparency and their ability to maintain a safe financial system. The well-functioning derivatives infrastructures are therefore essential for promoting and maintaining the country's stability as a whole. Nonetheless, because such infrastructures may also concentrate systemic risk, they require appropriate regulation and oversight on their own. With an adequate regulatory and supervisory framework, the market infrastructures can enhance investors' protection, promote public confidence and guarantee discipline in the market. The presence of such strong market infrastructures is an important inducer of growth.

SAFEX and SAFCOM currently act as the exchange and clearinghouse of the formally instituted markets. Both institutions have critical roles in the operation and regulation of the derivatives markets. The clearinghouse is the most important because of its role in the management of the counterparty risk created by certain derivatives activities. The clearinghouse establishes itself as a central counterpart in the trades that occur through the exchange, charging collateral and margins to both parties of the transactions in order to shield against possible defaults. The process of novation allows SAFCOM's smooth settlement and clearing of transactions through the elimination of each party's credit risk. As a way to strengthen market infrastructures, initiatives were launched after the financial crisis to transfer the local OTC trading to an exchange-like venue with central counterparties (CCP) clearing trades and reporting to a trade repository.

The country's regulatory environment for derivatives markets has kept on providing safeguarding measures for the markets and financial system through systemic risk reduction, and fair, efficient, and transparent markets, as well as strongly enhanced investors' protection. South African derivatives trading is now placed under the jurisdiction of the Financial Markets Bill of 2012 and new derivatives rules, which followed on the financial crisis. These have emerged to achieve even better efficiency, fairness and transparency in the market, as well as enhanced systemic risk assessment. SAFCOM has adopted new rules that enable the establishment of a default fund, and thereby adds to investors' protection in the exchange-trading environment. The new regulations serve to create a better risk management process for South African derivatives markets, in line with new international standards.

4.1. INTRODUCTION

Having reviewed the literature on the influence of derivatives on capital market development on economic growth, and also having reported on structural requirements for safe and well-functioning derivatives markets, the study's attention now shifts to the empirical aspects of the investigation of the actual impact of the domestic derivatives exchange on South Africa's economic growth and growth volatility.

This chapter is dedicated to the methodological aspects of the study. It describes and explains the design of the empirical investigation. The data collection, sampling, and other relevant aspects pertaining to subsequent empirical analysis processes are duly covered. The chapter concludes on some methodological aspects about the interpretation of the empirical research results.

4.2. ASSUMPTIONS, FORMULATION AND STATISTICAL TEST FOR RESEARCH RATIONALE

As with any scientific research, the research at hand needs to be built up from some clearly stated and testable assumptions for which it attempts to provide an explanation. Confidence in the explanation that rests on the formulated assumptions would only increase as tests confirm them. Otherwise, the tests that would disapprove these assumptions could help to provide better explanations to the objective of the research (Zweerink 2010). The research seeks to establish the impact of an existing derivatives exchange on economic growth and growth volatility using the case of South Africa. Expectations, as informed by the theory of the study, are that the existence of such an exchange should positively impact economic growth, but that growth volatility is likely to increase as a result of derivatives trading.

According to Berenson, Levine and Krehbiel (2012), the process of statistical inference or hypothesis testing is usually used to prove the truthfulness of the assumptions made about an entire population of elements, based on findings yielded by the investigation of a representative sample. In addition, hypothesis testing can also be used as a confirmatory approach to the data analysis methods and to provide for the raison d'être of the study. In this respect, the data probability distribution considered in the study characterises the types of unknown parameters to be estimated and on which statistical inference should be based. As such, the normal distribution that is assumed throughout the current study assumes these unknown parameters to be the statistical averages or means (μ) and variances (σ^2) of samples and populations (Arsham 2013).

By assuming a positive impact of derivatives trading on economic growth, it is implicitly suggested that the average rate of output growth increased in the post-derivatives era, compared to when the trade of these financial instruments was inexistent in the country. According to Ahmed and Suliman (2011) and Seddighi (2012), volatility can be measured in terms of a sample variance (σ^2); hence, the assumed increase in growth volatility as result of the presence of the derivatives exchange would translate into an increase in growth variance due to the existence of the derivatives exchange.

4.2.1. The student's *t*-test and variance ratio test (*F*-test) for differences between sample means and variances

The independent *t*-test, also called the two-sample *t*-test or student's *t*-test, can be used to determine whether there is a statistically significant difference between the means in two distinct samples, while the variance ratio test (or *F*-test) can serve to evaluate the likelihood that the variances in all subgroups are equal (Eviews 2013a; Berenson et al. 2012; Statistics.laerd.com n.d.). Provided that normality of sample distribution is assumed, both tests can be performed to check the correctness of research assumptions (Arsham 2013; Eviews 2013a; Statistics.laerd.com n.d.).

In order to run the tests of differences between samples, one must pre-specify the following (statistics.laerd.com n.d.):

(1) One independent, categorical (dummy) variable that has two levels
(2) One dependent variable (in this case, it will be output growth)

Instead of the commonly used pooled-variance *t*-test, Satterthwaite's separate-variance *t*-test should be implemented where variance inequality is assumed between the samples investigated. The purported violation of the variance equality assumption of the pooled test must then be corrected by not using pooled estimates and by making adjustments to the degrees of freedom using the Welch-Satterthwaite method (Berenson et al. 2012; Statistics.laerd.com n.d.). A paired version of the *t*-test is normally applicable to statistical tests of difference between two related samples (i.e. samples taken from the same population under two different conditions), which is a more powerful alternative to the usual two-sample testing procedures in this context. However, the paired sample *t*-test can only be used when both samples have been matched, i.e. if they are the same size (Berenson et al. 2012; stats.gla.ac.uk n.d).

On the other hand, differences in the variability of two samples can be estimated by testing the difference in both samples' variances using the *F*-test. This test can essentially be useful for answering questions such as whether the two samples have equal variances or whether a new process or event has increased or reduced the variability/volatility of a series (Berenson et al. 2012; NIST/SEMATECH 2013). One important use of the *F*-test could be to verify whether the research assumption of unequal output growth variances (volatility) before and after the implementation of derivatives trading holds. In addition, this test can help to decide which one of the two *t*-tests, either the pooled-variance *t*-test (which assumes equal variances) or the separate-variance *t*-test (which does not assume equal variances), is actually appropriate for comparing the means of two samples (Berenson et al. 2012; NIST/SEMATECH 2013; Statistics.laerd.com n.d.). Essentially, the *F*-test is based on the ratio of the two samples variances. An *F*-distribution is assumed for this variance ratio test under the normality assumption of the sample distribution, hence its name (Berenson et al. 2012).

Section 4.8 is devoted to the methodological matters of the study's results interpretation. The methods for interpreting both the *t*- and *F*-tests' results are dealt with under Section 4.8.1.

4.3. DATA COLLECTION

Appendix A presents a table that describes the data set that is emphasised in this study. Rodrigues et al. (2012) investigate the impact of derivatives trading on per-capita GDP growth and growth volatility. They contextualise this investigation in terms of a panel of 45 countries observed over 39 years in order to uncover the relationship between derivatives trading and economic growth. The cross-country regression estimation was performed using a GMM model. In addition, the effect of the institutionalised derivatives trading on growth volatility was assessed by means of an Exponential GARCH (EGARCH) estimation.

The study at hand narrows the scope of Rodrigues et al.'s (2012) study to the case of a single country, South Africa, which eventually formed part of the sample investigated by Rodrigues et al. (2012). However, slight adjustments are made in terms of the research strategy and selection of variables, due to the study's special focus on the concurring impact of derivatives trading and capital market development on South Africa's output growth. Deviations from the methodology of Rodrigues et al. (2012) entail some proxy changes, as well as some adjustments regarding certain model specifications and estimation methods used.

Data were sourced from the online databases of the South Africa Reserve Bank (SARB), the World Bank and the WFE. While the data such as that pertaining to the country's GDP, the so-called Solow factors and the capital market development factors were sourced and ascertained from both the databases of the World Bank and SARB, the information relative to SAFEX's trading history was provided by the WFE.

4.4. SAMPLING

According to Schwegler (2010), the South African derivatives activity commenced in 1987, but the derivatives exchange was officially opened on 10 August 1990. This study's focus is on both the pre- and post-establishment of the exchange and, accordingly, yearly time series of relevant variables were selected that comprise data covering a period running from 1971 to 2012. A dummy regression will be conducted first on the data over the period 1971–2012, but the post-1990 establishment of the derivatives exchange will be especially emphasised when investigating the relationship between growth of GDP and historical derivatives trading volumes.

This subsequent use of the series pertaining to the actual domestic derivatives activity restricts the period under review to 1994–2012 due to the lack of data pertaining to the exchange's activity before 1994. Unfortunately, the use of a dummy variable in the context of the planned Granger causality test is only appropriate in a panel setting where there can be multiple observations in the period emphasised (Min n.d.). Ultimately, the assessment of the impact of derivatives trading on growth volatility/stability will entail an appraisal of GDP growth from 1971 to 2012, which aims at determining whether the operation of the derivatives exchange has reduced or increased the volatility/stability of the local economy.

4.5. PRELIMINARY DATA TRANSFORMATIONS

Raw data rarely meets the needs of a particular research project and must often be transformed into some new variables that are better suited to achieving the research objectives (Zikmund 2003). Therefore, certain variables in the data set, as portrayed in Appendix A, underwent transformation to guarantee their suitability for analysis purposes.

Total derivatives trading volumes were obtained by adding up the number of contracts for each derivatives class reported by the WFE. In addition, economic growth is usually portrayed by the first difference of the logarithmic (log) levels of the GDP series (Lee n.d.). A new variable describing the growth of GDP (GDP_GW) was then created by taking the first difference of log levels of the GDP. In order to achieve data completeness on the series referring to domestic credit to private sector in percentage of GDP (PRIVCREDIT), an average value of PRIVCREDIT was calculated so as to fill the information gap on that series in 1991. The exhibited 1991 value of PRIVCREDIT is an average estimate based on values of PRIVCREDIT over the period from 1988 to 1994.

4.6. DIAGNOSTIC CHECKS AND REMEDY

Diagnostic tests are often carried out at the earlier stage of any time-series analysis to detect the defects in the data that may possibly impair the quality of the study's conclusions. Stationarity tests are thus essential to ensure that the anticipated regression analyses do not generate spurious results with reference to some erroneous coefficient estimates and unreliable statistics tests (e.g. t, F and R^2), as the modelling of any non-stationary variable would tend to produce regression estimates that might be misleading (Djoumessi 2009; Gujarati 2004; Verbeek 2012; Stockhammar & Öller 2010).

Time-series data are generally plagued with autocorrelation or unit roots and heteroscedasticity (Zeileis & Hothorn n.d.; Gujarati 2004). Autocorrelation, as evidenced by the presence of unit roots in a time series, is an indication of the underlying series' non-stationarity property (Hendry & Juselius 1999). Stationarity requirements for regressors employed in the model also make it compulsory for variables not to be heteroscedastic (Stockhammar & Öller 2010). The stationarity assumption attached to regressors prohibits the presence of any kind of autoregressive unit roots, and heteroscedasticity in the data, even for superior estimators such as the GMM (Ogaki 1999).

The first step taken to test the stationarity of variables generally entails examining the series using correlograms in order to gauge the likelihood of each series having a unit root. Afterwards, the Augmented Dicky-Fuller (ADF) is often applied as a formal test to establish whether the individual series are actually stationary (i.e. unit roots-free) or whether they have unit roots (Djoumessi 2009; Gujarati 2004; Rossini & Kupke 2012). The series that are detected with non-stationarity defects can then be transformed into stationary, and subsequently be used in the regression estimation. The data transformations may entail the creation of new variables through "first" or "second" differencing of consecutive values in the series, depending on the number of unit roots present in that series (Asteriou & Hall 2011; Harris 1995; Ssekuma 2011). For the variables that cannot achieve stationarity after such a differencing transformation, a logarithmic transformation can be applied and then differencing can be executed. The logarithmic and subsequent differencing transformations may help making the series both homoscedastic and stationary (Asteriou & Hall 2011; Gourieroux & Monfort 1997; Stockhammar & Öller 2010). Such differencing and/or logarithmic transformations can at the same time help eliminate trends and seasonality in the data (Otexts.org n.d.). Unfortunately, some series often cannot achieve stationarity even after having undergone such transformations. In the event of this happening, the co-integration of variables in their original levels becomes an overriding requirement for any econometric model to use non-stationary time series with relaxed concerns about the occurrence of a spurious regression (Asteriou & Hall 2011; Djoumessi 2009; Koop 2005; Verbeek 2012).

4.7. THE METHODS OF ESTIMATION

The methodology implemented in the study is directed towards a regression analysis, a causality study and a volatility analysis. The empirical methods used are thus discussed in terms of the arguments that led to the choice of model estimators implemented by the study over alternative estimation techniques. By the same token, the limitations pertaining to the use of each estimator are highlighted. In terms of the study's practical analysis, three main econometric estimation techniques are employed, namely a GMM regression analysis, a Granger causality test and a GARCH estimation.

4.7.1. The GMM estimation

The intention of this analysis is to isolate the effect of the existence of a derivatives exchange on economic growth using the GMM model.

A common assumption used in regression analysis is that of the exogeneity of the explanatory variables, which implies uncorrelated relationships between the explanatory variables and the error term of the regression model (Verbeek 2012). If one or more of the independent variables are endogenous (in the sense that they are correlated with the error term), then the OLS estimator can yield biased, inconsistent and misleading regression results. Therefore, the application of the OLS will be conflicting in a dynamic setting, because the presence of a lagged dependent variable, for example, may raise the problem of regressors' endogeneity due to the high likelihood of existing correlation between the modelled lagged dependent variable(s) and error terms (Chaussé 2010; Gujarati 2004; Verbeek 2012; Zivot & Wang 2006). Alternative methods to remedy the OLS inefficiency in the presence of endogenous regressors include the two-stage least squares (2SLS) and the methods of instrumental variables (IV) (Gujarati 2004). While the 2SLS is asymptotically efficient in the presence of such homoscedastic error terms, the IV method can effectively address the endogeneity problem, and thus provides consistent estimates of the structural parameters under such an endogenous setting (Söderbom 2009). The standard IV techniques can yield consistent coefficient estimates in the presence of heteroscedasticity, but inference will generally be invalid and inconsistent (Baum, Schaffer & Stillman 2003).

The GMM estimation techniques were introduced by Hansen (1982), which, to some extent, are considered an extension of many standard estimators, including IV and OLS methods. Under endogeneity conditions, the GMM estimator coincides with the IV estimator when the model is exactly identified. However, the GMM will be an improvement over 2SLS and the conventional IV estimator in the presence of heteroscedasticity in the modelled error. The use of the GMM, rather than 2SLS, under such homoscedastic circumstances can simply come up to a 2SLS estimation, but the GMM is usually used when facing heteroscedasticity, as it allows for the efficient estimation in the presence of heteroscedasticity of unknown form (Baum et al. 2003; Söderbom 2009). Consequently, there is no clear need to specify how the error terms depend on the set of regressors when using the GMM, as the GMM allows the error components of the model to be both heteroscedastic and serially correlated, and statistical inference can accurately be conducted without explicitly characterising the nature of such dependence (Hansen & Singleton 1982; Zivot & Wang 2006).

Therefore, the GMM is a very good alternative estimator to the OLS model in the present context of an empirical growth regression (Bond, Hoeffler & Temple 2001). For instance, this estimator does not require a complete representation of the variables influencing the targeted economy, as valid estimation and inference can be achieved with only a subset of these economic factors. Moreover, the GMM model can produce consistent coefficient estimates in the presence of endogenous right-hand-side variables or even if some or all the elements in the set of the remaining independent variables are correlated with the error term (Atreriou & Hall 2011; Bond et al. 2001; EViews 2013b; Sorensen 2007; Verbeek 2012; Zivot & Wang 2006).

Hansen and Singleton (1982) highlight some key specification considerations that can ensure sufficiently strong conditions for consistent estimation using the GMM, which include the following:

(1) **The choice of weighting matrix**: The choice of the weighting matrix is indeed an important aspect in the specification of the GMM model (Eviews 2013b). A well-defined weighting matrix guarantees the GMM’s efficiency in identifying the uniqueness and valid parametric estimates (Hansen & Singleton 1982; Zivot & Wang 2006). The definition of the weighting matrix is

an intuitive and arbitrary process. Among others, the GMM estimation in this study uses the 2SLS weighting matrix (Eviews 2013b; Söderbom 2009).

(2) **The choice of moments or instruments**: What matters much more for the estimation efficiency than the choice of weighting matrix is the selection of the moment conditions or instrumental variables of the model (Sorensen 2007). The GMM effectively assumes that a group of instrumental variables exists that contain some or all the elements of the regressors included in the model and which should satisfy some crucial orthogonality conditions in order to guarantee superior parametric estimates (Zivot & Wang 2006). A detailed discussion on the selection of instrumental variables follows under section 4.7.1.3 below.

4.7.1.1. The variables

South African economic growth is profiled by a series portraying real gross domestic product (GDP) growth (calculated as the difference between the natural logarithms of real GDP for two consecutive years). This selection of "pure" GDP growth instead of the real GDP per-capita growth of Rodrigues et al. (2012) makes more sense in terms of the theory of the study, which suggests that the existence of the derivatives exchange should positively impact on economic activity through the various channels as referred to earlier, and more particularly by enabling the development of capital markets. Therefore, the focus on real GDP growth is more appropriate, as growth in economic activity does include a human population component that is present in real GDP per capita. The presence of a population element will prejudice the estimation towards factors that are simply not influenced by the existence of a derivatives market.

A dummy variable (DERIV_DUM) substitutes the development of the organised derivatives exchange, which is the factor of the study's prime interest. The use of a dummy variable is handy, because the variable pertaining to the exchange's trading history is parsimoniously observed and the very few observations on this variable may afflict the adequacy of the regression with too few degrees of freedom (Garavaglia & Sharma n.d.). The derivatives dummy is a substituting series for SAFEX's number of derivatives contracts traded. The use of the dummy variable in the regression can help to discover whether the existence of the derivatives exchange in South Africa makes a difference, as opposed to when the country did not operate such an exchange (Baker 2006). The dummy variable will be created such that it takes the value of 1 (one) for years in which the derivatives exchange has existed and 0 (zero) for years during which the exchange did not exist.

As is a common practice in empirical growth modelling, two categories of control variables are included in the regression model, along with the variables of the primary interest of the study. These include macroeconomic variables resembling the Solow model, and variables capturing the development of the financial system. These two groups of control variables must be retained in order to prevent model misspecification (Rodrigues et al. 2012).

Djoumessi (2009) and Kubík (2010) explain that the Solow model factors must underpin any growth accounting framework in an attempt to account for the various factors that are inclined to contribute to a country's growth. In terms of the Solow model, the determinants of economic growth are generally classified under three main categories that include capital, labour and residual factors. The residual can translate into a factor for technology development or other factors such as human capital, knowledge or total factor of productivity etc. It follows from the Solow model that GDP is produced by an aggregate contribution of the stated factors. Therefore, control variables closely resembling those used by Rodrigues et al. (2012) are included. Here, the Solow factors included are gross national savings as a percentage of GDP, gross national expenditure as a percentage of GDP, as well as inflation, which is measured as the growth in the Consumer Price Index (CPI). The growing rates of capital accumulation, general consumption expenditure by households and government, and inflation have surely influenced productivity and the growth of GDP in a number of countries in different kind of ways (Bobinaite, Juozapaviciene & Konstantinaviciute 2011; Holtz-Eakin 1993; Umaru & Zubairu 2012).

A form of a human capital component is often incorporated in growth models to suggest that human capital is a driver for economic growth in the long run, especially out of the credence that human capital can generate non-diminishing returns to scale from capital in a similar manner as innovations (Kubík 2010). Unfortunately, an unavoidable shortcoming of empirical growth modelling in the South African context is the exclusion of some form of human capital, such as secondary school enrolment or literacy rates. Sufficiently accurate and long enough time series of these variables are simply not available for the South African economy and it is therefore impossible to account for a human capital component. Similarly, due to the decision not to use real GDP per-capita growth as a dependent variable, the population growth factor is not included as a control variable.

In addition to the unavailability of a human capital variable, trade openness is another notable omitted control variable. The view that trade openness unequivocally leads to improved economic performance has been challenged by Yanikkaya (2003), who argue that barriers to trade (i.e. "less open" trade) are positively associated with growth, especially in developing countries. The exclusion of the trade openness variable is further motivated by the trade sanctions imposed against South Africa during the 1980s, which significantly distorted the theorised impact of trade liberalisation and openness on economic growth.

The variables controlling for the development of the financial sector include the following:

(1) The net inflow of FDI as a percentage of GDP, in replacement of the proxies of Rodrigues et al. (2012) for developments in the stock market, for which variables with sufficiently long time series could also not be found. Such inclusion of FDI follows the suggestion of Applegarth (2004) and Ly's (2011) that the development of African capital markets can be captured by modelling their levels of FDI net inflows as the volumes of funds flowing into these markets. While Ly (2011) claims that the funds invested in these markets are predominantly from foreign investors (including companies and individuals), Applegarth (2004), on the other hand, attests that a substantial part of FDI is invested in African securities such as shares. FDI, as reported by the World Bank, consists of the funds from foreign investors acquiring lasting interests in local enterprises, including equity capital, reinvestment of earnings and other short- and long-term capital.

(2) Domestic credit extended to the private sector as a percentage of GDP (PRIVCREDIT) remains the measuring indicator for the sophistication of the debt market, as in the study of Rodrigues et al. (2012). This series accounts for financial resources provided to the private sector domestically, including loans, purchases of non-equity securities, trade credits and other accounts receivable that establish a claim for repayment (Rodrigues et al. 2012; World Bank n.d.).

(3) The ratio of broad money stock (M2) to GDP serves as an indicator for the depth of the banking system (Odhiambo 2009a). This indicator is referred to as monetisation and it is commonly used to show the real size of a financial sector such as the banking system of a growing economy (Baluch & Ariff 2007). M2 (also referred to as money and quasi-money) comprises the sum of currency held outside the banks, demand bank deposits, as well as the time, savings and foreign currency deposits of resident sectors other than the central government (World Bank n.d.).

Tridico (2007) underlines the fact that a single mixture of variables cannot totally explain economic growth and that many other factors can contribute a very significant part to countries' economic growth. The study's focus on the African evolving capital markets and investment conditions supports its special emphasis and retention of these relevant financial development indicators.

4.7.1.2. Model specification

The GMM model is estimated with economic growth as dependent variable. Economic growth is calculated as the difference in the logarithm of real GDP. The main variable of interest, the institutionalisation of a derivatives exchange, is proxied by a dummy variable that takes a value of one (1) if a derivatives exchange existed in that year and zero (0) if a derivatives exchange did not exist in that year. In addition, the Solow factors are modelled by including gross national savings (SAVINGS) as a percentage of GDP, gross national expenditure (EXPENDITURE) as a percentage of GDP, and inflation (INFLCPI) among the set of independent variables, alongside the selected financial development indicators that include the net inflow of FDI as a percentage of GDP, Domestic credit to the private sector

(PRIVCREDIT) as a percentage of GDP, as well as the ratio of broad money stock (M2) to GDP.

The model, as specified by Rodrigues et al. (2012), includes the level of output in time *t*-1 as lagged dependent variable that makes it “endogenous by construction”. This is contrary to Barro (1999) and Keele & Kelly (2004), who argue that a more appropriate modelling approach in an empirical growth context entails using lagged growth, instead of the lagged level of output. While the modelling of lagged output by Rodrigues et al. (2012) instead of lagged growth indicates that current levels of output growth depends on past levels of economic activities, the modelling of lagged growth by Barro (1999) and Keele and Kelly (2004) dictates that the state of a country’s economy in previous periods is, in fact, what matters to the economic conditions today.

Although the approach of Rodrigues et al. (2012) is followed, their country-specific fixed effect and time trend are ignored in this case, as these are appropriate and only applicable to a panel study. Accordingly, the model under consideration reads as follows:

$$\Delta y_t = (\alpha - 1)y_{t-1} + \delta d_t + \boldsymbol{\beta}\boldsymbol{x}_t + u_t$$

Eq. (4.1)

Where y_t is the natural logarithm of output, and d_t denotes the dummy variable for the existence of an organised derivatives exchange, as explained earlier. $\boldsymbol{x}_t$ represents the vector of control variables, including the representative series for gross national savings as a percentage of GDP (SAVINGS), gross national expenditure as a percentage of GDP (EXPENDITURE), inflation (INFLCIP), net inflow of FDI as a percentage of GDP (FDI), domestic credit to the private sector as a percentage of GDP (PRIVCREDIT), and broad money stock in percentage of GDP (M2). The parametric estimates to be generated include an autoregression coefficient, α; the coefficient to “DERIV_DUM”, δ; and the (vector) set of $\boldsymbol{\beta}$ coefficients that are individually assigned to each control variable.

4.7.1.3. The selection of instruments

In earlier discussions it was mentioned that the GMM's utilisation of instrumental variables can guarantee reliable estimation under endogenous conditions. As such, an instrumental variable is a proxy variable to a modelled regressor (Gujarati 2004). For the GMM model to be defined, its overidentifying restrictions require that there must be least as many instruments selected as there are parameters in the model. (EViews 2013b). Another important requirement for estimating efficiency is the relevance and validity of the selected instrumental variables with respect to the previously mentioned orthogonality of instruments (Baum et al. 2003; EViews 2013b; Gujarati 2004). Baum et al. (2003) and Wooldridge (2001, 2013) eventually instruct that a good instrument should be uncorrelated (or orthogonal) with the error and, at the same time, it must be correlated with the endogenous explanatory variables in the model. In the context of a time-series analysis, as Wooldridge (2001) further contends, instrumental variables can be modelled by employing lagged terms of the dependent and independent variables that do not appear in the structural model investigated, as long as the latter variables are assumed to be uncorrelated with the error terms. According to Hansen and Singleton (1982), both current and lagged instruments can be used.

Baum (2013) explains that the instrumentalisation of the dependent lag models the second lag of regressand, in either its differenced or differenced-lagged forms or even a combination of both as instruments. These lagged terms are in fact believed to be highly correlated with the lagged dependent variable, but uncorrelated with the error process if the error is i.i.d.[7] The same strategy would apply when there are reasons to believe that the error might be following an autoregressive process, but instruments would to be selected by moving one period back and starting from the third lag of dependent variable.

An ever-present problem in regression analysis remains that of the misspecification of the model. Specifically, the problem of omitted variables is recurring because a model may contain some explanatory components that do not actually belong to the specification (Asteriou & Hall 2011). Even though the use of the GMM can help

[7] i.i.d. means independent and identically distributed, used in this context to indicate that the ongoing errors are not correlated to one another.

circumvent the problem of variable omission, as it does not require a full representation of the targeted economic environment, omitted variable bias remains a relevant concern with such an IV regression technique. To the detriment of the OLS, bias often occurs with IV estimators when an omitted relevant variable happens to be correlated with either the included non-endogenous explanatory variables or the instrumental variables that have been modelled (Hansen & Singleton 1982; Söderbom 2009). In addition, the use of GMM can suffer from finite-sample bias, as this estimator sometimes perform poorly, especially as the required selection of additional instrumental variables to be used in the regression may lead to strongly biased estimates for certain bad choices of weak instruments, lowering the model's efficiency. In effect, the GMM bias often results from some bad choices of instrumental variables that lower the model's efficiency (Chaussé 2010). Furthermore, one drawback of the selection of moment conditions by adopting the lagged values of the modelled variables is that this may restrict the dynamics in the model (Wooldridge 2001). Moreover, the use of lag variables as instruments has been criticised for not taking all the potential orthogonality conditions into account. This method of instrument selection assumes that the required instruments are purely internal (i.e. based on the lagged values of the modelled variables), while the GMM estimator also allows for the inclusion of external instruments (Baum 2013). Yet another misspecification problem entails the possibility of an incorrectly assumed linear relationship among the variables (Asteriou & Hall 2011).

4.7.2. Causality test

This study also investigates the causal link between SAFEX's derivatives trading volumes and South Africa's real GDP growth. The causality test will be carried out for the period 1994–2012 using the Granger causality testing approach. An important requirement of Granger's test is that the co-integration between the variables must first be established before the test for causation is proceeded with. Such a co-integration test aims to ensure that the adequate relationship links the variables together, as a way of guaranteeing the predictive accuracy of the test (Granger 2003; Stern 2011).

4.7.2.1. Co-integration test

Engle and Granger's approach to co-integration is a proposed method for determining if two *I*(1) variables are co-integrated. On the other hand, the Johansen approach is usually applied to multiple co-integration analyses (Asteriou & Hall 2011). Adom (2011) and Odhiambo (2009c, 2011) consider yet another approach, which is referred to as the Autoregressive Distributed Lag (ARDL)-bounds approach. The ARDL process for co-integration between variables presents many advantages over the other co-integration methods. A mixture of *I*(0) and *I*(1) variables is possible with the ARDL procedure of long-run relationship analysis (Atif, Jadoon, Zaman, Ismail & Seemab 2010). This approach removes the restriction of the Engle and Granger and also Johansen approaches that all the variables must be *I*(1). The ARDL is in effect valid, irrespective of whether the variables studied are all integrated of order one *I*(1) or zero *I*(0) or even a mixture of both. Stationarity tests are only performed in order to check that variables are not integrated of order two *I*(2) or more for better estimation accuracy. In addition, the ARDL is effective for small sample testing, and is reliable irrespective of whether the regressors are endogenous or exogenous (Adom 2011; Odhiambo 2009c, 2011).

i. Model specification and procedural approach to an ARDL-bounds co-integration analysis

The ARDL-bounds model in the bivariate setting can be formulated as follows (Odhiambo 2009c:619):

$$\Delta lny_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} \Delta lny_{t-i} + \sum_{i=0}^{n} \alpha_{2i} \Delta lnDervol_{t-i} + \alpha_3 y_{t-1} + \alpha_4 lnDervol_{t-1} + u_t$$

Eq. (4.2)

$$\Delta lnDervol_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} \Delta lnDervol_{t-i} + \sum_{i=0}^{n} \beta_{2i} \Delta y_{t-i} + \beta_3 lnDeri\_vol_{t-1} + \beta_4 lny_{t-1} + u_t$$

Eq. (4.3)

Where lny is the log of real GDP; $lnDervol$, the log of total derivatives contracts traded; u, the white noise error term; and Δ the first difference operator.

Chao, Corradi and Swanson (2000) state that original level data rather than transformed variables must be used for the co-integration analysis, as transformed data may lead to wrong and falsified predictions.

There are two main steps that need to be followed when implementing this testing procedure. As the ARDL test requires prior knowledge about the maximum lag length to be modelled. As a first step to an ARDL test, a lag selection technique like the Akaike Information Criterion (AIC) can be employed to select of the optimal lag to be included in the model. The implied structural analysis will involve obtaining the order of lags that govern the dynamic between the variables by running unrestricted Vector Autoregression (VAR) models on the data in their level forms (Adom 2011; Odhiambo 2011).

In the second step, the bounds *F*-test must be applied to equations (4.2) and (4.3) in order to determine whether or not a long-run relationship exists between them (Odhiambo 2011). The bounds test normalises each variable as a dependent variable, so that each of these co-integration equations can be estimated by OLS once the lag order of the model has been identified. Subsequenly, the Wald *F*-test must be applied to the output of each ARDL equation to test the likelihood of an existing long-run relationship among the variables by analysing the joint significance of the coefficients of the ARDL-OLS regressions (Odhiambo 2009c; Oteng-Abayie & Frimpong 2006). The tests of significance are conducted by comparing the *F*-statistic of the Wald test with the asymptotic critical bounds published by Pesaran, Shin and Smith (2001), which is provided in appendix B4 (Adom 2011).

The variables' co-integration would imply the existence of long-run relationship(s) between them, which generally points at the possibility of Granger causality flowing in one or more directions between them (Asteriou & Hall 2011; Ghafoor, Mustafa, Mushtaq & Abedullah 2009; Harris 1995; Stern 2011). This long-run relationship between the variables does not, however, indicate the direction of such causality; hence the utility of the causality test (Tang & Tan 2013).

4.7.2.2. Granger causality test

A causality test will be justified if the pair of the targeted variables is co-integrated. For two stationary variables, a Granger causality test entails examining if lagged (past) values of one variable help to predict the other (Verbeek 2012). A variable x_t would Granger-cause y_t if the current level of y_t can be better predicted by using the history (past/lagged values) of x_t. Similarly, y_t would cause x_t if, given the history of y_t, y_t can help predict x_t (Stern 2011; Liu & Bahadori 2012). Granger's approach to the question of causality between y_t and x_t therefore aims to determine how much of the current y_t can be explained by past values of x_t, and vice versa (EViews 2013a:428–429). In the conventional way Granger causality testing between the two variables will entail the following two regressions (Asteriou & Hall 2011; Odhiambo 2009c; Stern 2011):

$$y_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i}\, y_{t-i} + \sum_{i=1}^{n} \alpha_{2i}\, Dervol_{t-i} + u_t \qquad \text{Eq. (4.4)}$$

$$Dervol_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i}\, Dervol_{t-i} + \sum_{i=1}^{n} \beta_{2i}\, y_{t-i} + \varepsilon_t \qquad \text{Eq. (4.5)}$$

Where, in the preceding equations:

(1) n denotes the number of lagged variables
(2) α_1,α_2, β_1 and β_2 are the parameters to be estimated
(3) α_0 and β_0 are constant terms that represent the intercepts of the equations
(4) $u_t$and ε_t are mutually uncorrelated white noise residuals

A general rule to empirical causality investigations, as Rossini and Kupke (2012) advise, is that a Granger causality test in a standard VAR framework is appropriate for stationary data. When the data investigated presents unit roots, the Granger causality test is rather used on the original data in a restricted VAR, known as the Vector Error Correction (VEC) Model or VECM, after co-integration between them has been proven.

i. The VECM (restricted VAR) and Granger short- and long-run causality

A causality test using VECM is particularly justified in co-integrating settings. Under these circumstances, the co-integration of the variables may imply the existence of a common trend that may link them together over both the short- and long-run (Asteriou & Hall 2011; Ghafoor et al. 2009; Harris 1995; Odhiambo 2011; Stern 2011). The VECM is popular for its modelling of variables that are individually non-stationary, but linked together by long-run relationships (Obayelu & Salau 2010). In situations where the variables are co-integrated, there would indeed likely be short- and long-run causalities between them, which cannot be captured by the standard VAR (i.e. the unrestricted VAR) model. The VECM provides a remedy for the shortfalls of traditional VAR in such co-integrated relations by extending it with additional lagged error correction terms (ECT_{t-1}). Essentially, this modelling of ECT_{t-1} in the VECM co-integration equations serve to clarify the nature of hinted long-run relationships between the variables, if any (Ageli 2013; Odhiambo 2011; Tang & Tan 2013).

The Granger causality test can be implemented in a VECM framework by running the following regressions (Ageli 2013; Odhiambo 2009c):

$$y_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} y_{t-i} + \sum_{i=1}^{n} \alpha_{2i} Dervol_{t-i} + ECT_{t-1} + \mu_t$$

Eq. (4.5)

$$Dervol_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} Dervol_{t-i} + \sum_{i=1}^{n} \beta_{2i} y_{t-i} + ECT_{t-1} + \varepsilon_t$$

Eq. (4.6)

Where, ECT_{t-1} is the error correction term lagged one period.

Limitations on Granger's method of causality testing exist in that the problems of endogenous and omitted variables equally remain a major issue. Endogeneity in variables, if any, can lead to reverse causality from the dependent to one or more explanatory variables, causing the regression to be biased. In addition, a trivariate causality test could allow the assessment of causation between the development of formal derivatives trading, capital market development and economic growth altogether. Apart from this, such inclusion of a jointly influencing third variable can lead to even more effective causality estimates (Odhiambo 2009b). The omission of variables with influencing power on either the dependent or the independent or both variables may result in the direction of causality not being clearly defined (Stern 2011).

4.7.3. GARCH volatility estimation

Volatility is often measured as the standard deviation ($\hat{\sigma}$) of a series that is expressed as shown in equation (4.10) below. Another common way to measure volatility is in terms of a given series' variance (σ^2), as in cases involving analyses by GARCH estimators (Ahmed & Suliman 2011; Seddighi 2012).

$$\hat{\sigma} = \sqrt{\frac{1}{t-1}\sum_{i=1}^{t}(r_i - \mu)^2}$$

Eq. (4.10)

Where:

(1) r_i may be the growth rate in year i
(2) μ is the average rate of growth over the t–years period

Rodrigues et al. (2012) used Exponential GARCH (EGARCH) to highlight the impact of derivatives trading on economic growth volatility. In the context of this study, GARCH is retained for a similar investigation. An important distinction between GARCH and EGARCH lies in their respective symmetric and asymmetric assumptions about volatility (Ahmed & Suliman 2011; Bell, Holan & McElroy 2012; Guan 2004). GARCH's symmetry assumption implies that only the magnitude and not the (positive or negative) sign of news or information has an effect on the volatility in a given underlying variable. Conversely, asymmetric volatility models such as EGARCH adopt the view that bad news have larger impacts on volatility than good news (Ahmed & Suliman 2011; Seddighi 2012; Su 2010; Verbeek 2012).

In its general form, GARCH is known as GARCH (*p*, *q*), which is written as (Verbeek 2012):

$$\sigma_t^2 = \omega + \sum_{i=1}^{m} \alpha_j \varepsilon_{t-i}^2 + \sum_{i=1}^{n} \beta_j \sigma_{t-i}^2$$

Eq. (4.11)

Actually, there are two distinct equations that need to be specified in a GARCH model: one is the conditional mean (4.12) and the other is the conditional variance (4.13). The conditional mean equation often models an autoregressive component that explains the current level of a particular variable, along with an error term. As for the variance equation, it is destined to capture the essence of the GARCH models by explaining current volatility with the one lag(s) of presumably varying error terms and also some lagged variance (volatility) elements. The simplest form of GARCH is GARCH (1, 1), which is expressed as follows (De Beer 2008; Dixit, Yadav & Jain 2012):

$$y_t = \rho + \theta y_{t-1} + \varepsilon_t \qquad ;\ \varepsilon \sim N(0, \sigma^2)$$ [Mean equation]

Eq. (4.12)

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \qquad ; \omega > 0, \alpha > 0, \omega \geq 0$$ [Variance equation]

Eq. (4.13)

Where:

(1) y_t represents the dependent variable; in this case it will refer to levels of GDP growth
(2) θ and y_{t-1} correspond to the autoregressive coefficient and explanatory (lagged) variable, respectively
(3) ε_t is the normally distributed error term with zero mean and time-varying (heteroscedastic) variance
(4) ρ and ω denote some constants, where ω (also known as the unconditional variance) is a measure of the long-run variance (volatility) of the series
(5) α and ε_{t-1}^2 correspond, in that order, to the "news/information" coefficient and the ARCH(1) term

(6) β and σ_{t-1}^2 are the volatility persistence coefficient (old news) and GARCH(1) term, respectively

Essentially, σ_t^2 and σ_{t-1}^2 are the GARCH (1, 1) model's estimate for volatility at time *t* and *t-1*, respectively, and α and β are the ARCH and GARCH parameters, respectively (Dixit et al. 2012). In GARCH (1, 1), the current volatility (σ_t^2) depends on three elements only (EViews 2013b; Seddighi 2012; De Beer 2008):

(1) A constant term (the long-term average variance/volatility), ω

(2) The last period's variance (or news about shocks), which is measured as the lag of the squared residual from the mean equation, ε_{t-1}^2 (the ARCH term)

(3) Information (or news) about volatility from the last previous period σ_{t-1}^2 (also known as the GARCH term)

A non-negativity requirement attached to σ_t^2 conditions that $\omega > 0$, $\alpha > 0$, $\beta \geq 0$ and $(\alpha + \beta) < 1$. This non-negativity requirement for GARCH (1, 1) parameters is essential to ensure the existence of variance stationarity. Another requirement is that $\beta > \alpha$ (De Beer 2008; Verbeek 2012).

The implementation of GARCH (1, 1) to estimate the impact of South Africa's derivatives use on the volatility of economic growth can be performed by emphasising both the conditions before and after the 1990 opening of the local derivatives exchange. The separate univariate GARCH estimations could be based on the series of yearly real GDP growth rates from 1971 to 1990 and from 1991 to 2012, respectively, so as to determine any volatility increase or decrease in the period after the introduction of derivatives trading in comparison to the pre-exchange period. However, GARCH allows for the effect of additional factors to be directly studied in a multivariate setting, whereby changes in volatility can be estimated by adding additional terms to the equation (4.13). A viable approach to the investigation of derivatives' induced volatility in economic growth would be to use a dummy variable in such a multivariate framework to estimate the change in conditional volatility after the particular event (i.e. the institutionalisation of formal derivatives trading). As in the GMM context, the dummy variable will take the value 0 for the entire pre-event period and 1 afterwards. In this case, the variance equation of the GARCH (1, 1) model will be expressed as shown below (De Beer 2008):

$$\sigma_t^2 = \omega + \alpha\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \delta DERIV\_DUM$$

Eq. (4.14)

The steps to apply GARCH estimation of volatility include the following:

(1) Stationarity test: A volatility analysis requires that all variables involved are made unit root-free when these are detected with non-stationary defects (Sukati 2013).

(2) Estimation: GARCH estimation of volatility depends on the assumption formulated about the conditional distribution of the error term (Taylor 2005; EViews 2013b). The Gaussian normal distribution is commonly used in the context of GARCH estimation, but the student's *t*-distribution and Generalised Error Distribution (GED) provide alternative solutions in cases involving non-normality of the residuals (De Beer 2008; Taylor 2005; Zivot 2009).

(3) Post-estimation diagnostics: If a GARCH model is correctly specified, then its residuals' post-estimation should not display serial correlation and heteroscedaticity. In addition, the distribution of the conditional residuals (ε_t/σ_t^2) should match the error distribution used for the purpose of the estimation (Zivot 2009). Tests are available that can confirm the model's inclination to achieve these requirements. These involve testing for the fit of both the mean equation and the variance equation (Dixit et al. 2012):

- The test of the mean equation must be undertaken to check whether the error process is a white noise or not. This can be done using the Ljung-Box (*Q*) test (Dixit et al. 2012). This test gauges the remaining serial correlation in residuals by looking at the correlograms of the residuals and also reports a *Q*-statistic that should ideally be insignificant up to the number of lags included in the model for a correctly specified mean equation (De Beer 2008; Dixit et al. 2012).

- The remaining ARCH effect in the variance equation can be examined by the Lagrange multiplier (LM) test in order to ascertain the correctness of the variance equation, which should exhibit no ARCH in residuals if properly specified. In addition, the acceptability of the specification of the entire model can be captured by applying the *Q*-

test to the conditional residuals. Both the ARCH LM and *Q*-statistics test should turn out insignificant for correctly specified variance equation and the GARCH model, respectively (De Beer 2008; Dixit et al. 2012).

- Finally, the Jarque-Bera (JB) statistic test can be used to verify the exactitude of assumption of distributional normality made about the residuals (De Beer 2008). Jarque-Bera is a test that makes a hypothetical comparison between the skewness (i.e. symmetry in rapport with the mean value) and kurtosis (i.e. “peakedness” and “fat tails” of distribution, which are related to the frequency and size of deviations) of the series residuals and those of the normal distribution curve in order to evaluate the difference between them. The JB statistic must be insignificant for the normality distribution to hold (De Beer 2008).

The selection of GARCH (1, 1) is motivated by the widely accepted argument that the later model performs very well in empirical volatility applications. It is argued that low-order GARCH (*p*, *q*) models are preferred to high-order GARCH (*p*, *q*) processes that are commonly obtained by choosing either *p* or *q* greater than (1) one (EViews 2013b; Verbeek 2012; Zivot 2009). The non-negativity restrictions of GARCH (1, 1), however, remains a limitation in the sense that these can be violated, as the model can yield negative coefficients. Also, the symmetric (G)ARCH models ignore the leverage effects of volatility and the asymmetry assumption of volatility is generally preferred to better reflect the leverage in volatility because of the fact that bad news (negative shocks) has a larger impact on volatility than good news (positive shocks). This is in accordance with the general assumption that volatility tends to be higher in falling markets than in rising ones (Dixit et al. 2012; Seddighi 2012; Su 2010; Zivot 2009).

4.8. METHODOLOGICAL ASPECTS OF RESULTS INTERPRETATION

The endeavour of this section is to clarify the meaningful ways of interpreting the results and other estimates that will be produced by the methodology implemented in the study, including the statistical analyses that provide the rationale of the study and also cover the interpretational aspects of the planned econometric analysis.

The accuracy of the parameters of a particular model in predicting the true relationship that exists among variables is often verified using statistical techniques, either by providing confidence intervals for, or performing significance (hypothesis) tests on the estimated regression coefficients (Koop 2005). Hypothesis testing using the test-of-significance approach, in particular, often hypothesises some value for the parameter to determine whether the estimated parameter lies within reasonable (confident) limits around the hypothesised value (De Beer 2008). For instance, these tests can provide the statistical evidence in favour or against the inclusion of each regressor in the model. Likewise, evidence in favour of the inclusion of all the regressors in the model can be supported by jointly examining the overall significance of the regression (Koop 2005; Seddighi 2012). An example of a hypothesis that is commonly tested is that the value of a certain coefficient is zero in order to ascertain the explanatory power that the corresponding parametric variable has on the dependent variable (Koop 2005).

Generally, the stated hypothesis is known as the null hypothesis (H_0), which is always tested against an alternative hypothesis (H_1) (Gujarati 2004). The tests could be two-tailed or one-tailed tests. The two-tailed version tests against the alternative that the variances are not equal. The one-tailed version only tests in one direction, that is if the given parameter is either greater than or less than (but not both) of a targeted value. The choice is determined by the problem at hand (NIST/SEMATECH 2013). The general strategy for such hypothesis testing is that a test statistic must first be calculated and then compared to a critical value; if the test statistic is greater than the critical value, one can reject H_0, otherwise it is accepted (Koop n.d.). A commonly used approach to hypothesis testing employs the analysis of probability values or *p*-values (Berenson et al. 2012; Gujarati 2004; Koop 2005).

4.8.1. The statistical analyses for research rationale

4.8.1.1. Reporting the result of the independent t-test

When testing for difference in means, a null hypothesis of no difference between group means must be test with a calculated *t*-value (Arsham 2013). The result of the *t*-test must be reported by stating the *t*-statistic value, the degrees of freedom (df) and the level of significance (*p*-value) of the test (Statistics.laerd.com n.d.). The table below presents the general rules that apply to the analysis of the different *t*-tests of differences in samples means.

	Pooled-variance *t*-test	**Separate-variance *t*-test**	**Paired *t*-test**
Hypotheses	**Two- and one-tailed tests** $H_0: \mu_1 = \mu_2$ or $\mu_1 - \mu_2 = 0$ $H_1: \mu_1 \neq \mu_2$ or $\mu_1 - \mu_2 \neq 0$ $: \mu_1 < \mu_2$ $: \mu_1 > \mu_2$	**One-tailed tests** $H_0: \mu_1 = \mu_2$ or $\mu_1 - \mu_2 = 0$ $H_1: \mu_1 < \mu_2$ $: \mu_1 > \mu_2$	**Two- and one-tailed tests** $H_0: d = \mu_1 - \mu_2 = 0$ $H_1: d \neq 0$ $: d < 0$ $: d > 0$
***t*-Statistic calculation**	$$t_{STAT} = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sqrt{S_P^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$ Where: S_P^2 = pooled variance $\bar{X}_1$= mean of the sample 1 $\bar{X}_2$= mean of the sample 2 n_1= size of sample 1 n_2= size of sample 2 $(\mu_1 - \mu_2)$ = hypothesised mean difference	$$t_{STAT} = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sqrt{\left(\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}\right)}}$$ Where: S_1^2 and S_2^2= variances of sample 1 and sample 2, respectively $\bar{X}_1$= mean of the sample 1 $\bar{X}_2$= mean of the sample 2 n_1= size of sample 1 n_2= size of sample 2 $(\mu_1 - \mu_2)$ = hypothesised mean difference	$$t_{STAT} = \frac{\bar{D} - \mu_D}{\frac{S_D}{\sqrt{n}}}$$ Where: μ_D= hypothesised mean difference $\bar{D} = \sum_{i=1}^{n} D_i / n$ $S_D = \sqrt{\frac{\sum_{i=1}^{n}(D_i - \bar{D})}{n-1}}$
Degrees of freedom	The t_{STAT} test statistic follows a *t* distribution with $n_1 + n_2$ - 2 degrees of freedom	The t_{STAT} test statistic approximately follows a *t* distribution with *V* degrees of freedom equal to the integer portion of the following computation: $$V = \frac{\left(\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}\right)^2}{\frac{\left(\frac{S_1^2}{n_1}\right)^2}{n_1 - 1} + \frac{\left(\frac{S_2^2}{n_2}\right)^2}{n_2 - 1}}$$	As with the one-sample *t*- test, the paired t_{STAT} test statistic follows a *t* distribution with n-1 degrees of freedom.
t-decision rules for a α level of significance	• The general rule for *t*-tests' decision apply: Rejects H_0 if ◦ in a two-tail test (≠): $\lvert t_{STAT} \rvert > t_{\alpha/2,df.}$ ◦ in a lower- or left-tail test (<): $t_{STAT} > -t_{\alpha,df}$ ◦ in an upper- or right-tail test (>): $t_{STAT} > t_{\alpha,df.}$ (Gujarati 2004:133)	• For a given level of significance, H_0 is rejected if the computed t_{STAT} is greater than the upper-tail critical value $t_{\alpha/2}$ from the *t*-distribution with *V* degrees of freedom or if the computed *t*-test statistic is less than the lower-tail critical value $-t_{\alpha/2}$ with *V* degrees of freedom. Thus, the decision rule is Reject H_0 if $t_{STAT} > t_{\alpha/2}$ or if $t_{STAT} < -t_{\alpha/2}$; otherwise do not reject H_0; hence, H_0 is not rejected if $-t_{\alpha/2} < t_{STAT} < t_{\alpha/2}$	• For a two-tail test with a given level of significance, α, reject H_0 if the computed t_{STAT} is greater than the upper-tail critical value $t_{\alpha/2}$ from the *t*-distribution, or if t_{STAT} is less than the lower-tail critical value $-t_{\alpha/2}$. The decision rule is: Reject H_0 if $t_{STAT} > t_{\alpha/2}$ or if $t_{STAT} < -t_{\alpha/2}$; otherwise, do not reject H_0

Table 4.1: Methods of student's *t*-tests' analysis and interpretation

Source: Researcher's construct based on information provided by Berenson et al. (2012:366–373), Gujarati (2004:133) and The Statistics Glossary (The Statistics Glossary is available from: http://www.stats.gla.ac.uk/glossary/?q=node/355).

4.8.1.2. Variance ratio (F-) test

The first step in performing a variance ratio test is to compute the variance for each subgroup, and then calculate the value of the *F*-statistic as the ratio between the larger variance and the smaller variance obtained (Eviews 2013a). The critical values of the *F*-distribution depend on the degrees of freedom in the two samples, and the F_{STAT} test statistic should follow an *F*-distribution with $n_1 - 1$ and $n_2 - 1$ degrees of freedom. The degrees of freedom are mentioned such that the degree of freedom for the sample in the numerator of the ratio (the larger sample variance) is stated first, followed by the degree of freedom for the sample in the denominator for the second sample (the smaller sample variance). The F_{STAT} test statistic is given by the following expression (Berenson et al. 2012):

$$F_{STAT} = \frac{\sigma_1^2}{\sigma_2^2}$$

Where:

σ_1^2 = variance of sample 1 (the larger sample variance)

σ_2^2 = variance of sample 2 (the smaller sample variance)

$n_1 - 1$ = degrees of freedom from sample 1 (i.e. the numerator degrees of freedom)

$n_2 - 1$ = degrees of freedom from sample 2 (i.e. the denominator degrees of freedom)

n_1 = size of sample 1

n_2 = size of sample 2

The further F_{STAT} deviates from 1, the stronger the evidence for unequal variances. The H_0 that the two variances are equal is rejected if (NIST/SEMATECH 2013):

- $F_{STAT} > F_{\alpha,n_1-1,n_2-1}$; for an upper one-tailed test
- $F_{STAT} < F_{1-\alpha,n_1-1,n_2-1}$; for a lower one-tailed test
- $F_{STAT} < F_{1-\alpha/2,n_1-1,n_2-1}$; or $F_{STAT} > F_{\alpha/2,n_1-1,n_2-1}$; for a two-tailed test

Where, F_{α,n_1-1,n_2-1} is the critical value of the *F*-distribution with $n_1 - 1$ and $n_2 - 1$ degrees of freedom and a significance level of α.

4.8.2. Statistical considerations of a multivariate regression

A variety of hypotheses about regression parameters can be tested, based on statistical tests such as the *t*- and *F*-tests. In this regard, a statistic or a parameter is said to be statistically significant if the null hypothesis is rejected, and insignificant in the event of the none-rejection (acceptance) of the null hypothesis (Gujarati 2004). Relevant statistical parameters for interpretation may include regression estimates such as the regression coefficients estimates, together with *t*-statistics (or *p*-values), as well as the R^2s and *F*- and *J*-statistics for testing the significance of the whole regression (EViews 2013b; Koop 2005).

4.8.2.1. Regression coefficients

A regression coefficient measures the effect that the particular independent variable to which they are assigned has on the dependent variable. In the case of simple regression, such a coefficient is simply considered as the marginal effect of the independent variable on the dependent variable (i.e. as a measure of the effect that a change in X has on Y or as a measure of the influence of Y on X), whereas the interpretation of the coefficients slightly differs in the multiple regression context. Each regression coefficient is, in fact, seen as a measure of the marginal effect of the corresponding independent variable on the dependent, *ceteris paribus*. The term *ceteris paribus* is important for the correct interpretation of the regression results. It means “holding all other explanatory variables constant”, and implies that all other variables in the regression equation do not change (Koop 2005).

The coefficient used for the dummy variable must be interpreted as the percentage change in dependent variable as the dummy variable under consideration takes the value 1, keeping all other factors fixed. It will therefore indicate the percentage change in the growth rate that is caused by or attributed to the existence of the organised derivatives exchange (Wooldridge 2013). The test of significance for the coefficient of a dummy variable is performed exactly as with the ordinary variables (Koop 2005).

4.8.2.2. T-statistics

The *t*-statistic is used for significance tests where the stated hypothesis is that a particular coefficient is equal to zero (EViews 2013b). It is thus used to test hypotheses about individual regression coefficients. Setting the coefficient of a regressor to zero under the null hypothesis means that, all the other variables held constant, the variable of interest has no (linear) influence on the dependent variable (Gujarati 2004).

The probability values (*p*-values) reported along with the *t*-statistic are known as marginal significance levels. Given the value of this statistic, the hypothesis that the true coefficient is zero is therefore rejected or accepted against the alternative that it is different from zero using the reported *p*-values, which in fact measure the probabilities of observing the reported *t*-statistic, given that the values of the corresponding coefficients are zero. The interpretation of the *t*-statistics' *p*-values may be done analogously with the *p*-value methodology described later on, in conjunction with the *F*-statistic's testing of hypotheses about R^2. (Koop 2005; EViews 2013b). Generally speaking, the idea behind these significance tests is that the decision to accept or reject H_0 is made on the basis of the value of the test statistics obtained from the data at hand (Gujarati 2004).

4.8.2.3. The coefficient of determination, R-squared (R^2), and the adjusted R-squared ($\bar{R}^2$): Measures of goodness of fit

The coefficient of determination, also referred to as the *R*-squared (R^2) statistic, is a measure of goodness of fit of the estimated line to the studied sample (Seddighi 2012). The R^2-statistic is a summary measure that indicates how successful the estimated regression is in predicting the values of the dependent variable within the sample. This measure of the success of the regression is usually a non-negative number taking a value between 0 and 1. Higher values of R^2s support better fits of the estimated linear relationships to the samples of data, and R^2 will equal 1 if the regression fits perfectly (Gujarati 2004; EViews 2013b; Seddighi 2012). R^2 is thus interpreted as a measure of the explanatory power of all the explanatory variables together, rather than as just the one explanatory variable (Koop 2005).

Using R^2 as a measure of goodness of fit can be problematic, because the value of R^2 does not decrease as the number of explanatory variables present in a model increase. The adjusted R^2 ($\bar{R}^2$) remedies the weakness of R^2, as it only increases where the inclusion of a new term improves the model. $\bar{R}^2$ is never larger than R^2 and it can be negative. A negative $\bar{R}^2$ is taken as if its value is zero, meaning that there is no relationship between the regressand and the regressors whatsoever (Asteriou & Hall 2011; Benchimol n.d.; EViews 2013b; Gujarati 2004). $\bar{R}^2$ is considered a better measurement of fit than R^2, because R^2 tends to give an overly optimistic picture of the fit of the regression, especially when the number of explanatory variables is not very small (Gujarati 2004).

A negative R^2 can abnormally be generated in certain cases of model misspecification, but such negative R^2s are not a problem for estimators such as the Two-stage Least Squares and the GMM, because these estimators do not limit the R^2 statistics between 0 and 1 (EViews 2008, 2010). Such a negative R^2 only means that the equation fits the data very poorly (Startz 2013). Generally, instrumental variables-based estimators are rather tested for the validity of their instruments instead of goodness of fit (EViews 2010).

4.8.2.4. F-statistic and GMM's J-statistic

Generally in multiple regression analysis, the *F*-test is used to test hypotheses that all the slope coefficients (excluding the constant, or intercept) are zero. This involves testing the null hypothesis that R^2 = 0 against an alternative hypothesis that R^2 ≠ 0. The rejection of the null hypothesis means that all the explanatory variables jointly have an influence on the dependent variable, while accepting that R^2 = 0 is equivalent to stating that the explanatory variables are not significant, as they do not provide any explanatory power for the dependent variable (Koop 2005).

The *p*-value assigned to the *F*-statistic is known as the marginal significance level of the *F*-test (EViews 2013b). This statistic gives a measure of the plausibility of the null hypothesis R^2= 0 against the alternative hypothesis, R^2 ≠ 0. At a 5% significance level, for instance, the test of significance based on the *p*-value method rejects or accepts the null hypothesis in conformity with the following strategy (Koop 2005):

(1) If *p*-value ≤ 5% (i.e. 0.05), the null hypothesis is rejected, and one can deduce that $R^2 \neq 0$ (is significant)

(2) If *p*-value > 5% (i.e. 0.05), the null hypothesis is accepted and it can be concluded that $R^2 = 0$ (is not significant)

Significance tests can be performed at other levels of significance (e.g. 10% and 1%) following the same strategy (Koop 2005; EViews 2013b).

To yield superior and efficient estimates in the GMM estimation, one must have over-identifying restrictions (Wooldridge 2001). This requirement for over-identifying restrictions of the GMM simply implies the necessary condition that the number of instrumental variables (K) modelled must be greater than or equal to the number of explanatory variables (L) for the GMM's identification of valid coefficient estimates. If K = L, then the model is said to be *just* identified; on the other hand, the model is said to be *over*-identified if K > L; whereas the model is not identified for any value of K < L (Zivot & Wang 2006). In the context of the GMM estimation, the *J*-statistic acts as a test statistic for model misspecification and therefore helps to evaluate the suitability of the model. The *J*−statistic can be employed to determine the validity of the model's over-identifying restrictions (Baum et al. 2003; Benchimol n.d.; Zivot & Wang 2006). The null hypothesis in this instance entails that the over-identifying and orthogonality restrictions are satisfied. Thus, the rejection of this hypothesis will mean that some selected instruments do not satisfy the orthogonality conditions required for their employment in the model, perhaps because they are not truly exogenous, or because they are being incorrectly excluded from the regression model. Hence, if the equation excluding the instruments is exactly identified (that is if K = L, i.e. there is the same number of instruments as parameters), the value of the *J*-statistic will be zero, indicating that the model's moment conditions suit the data well. If, on the other hand, K > L, then the *J*-statistic will be greater than zero, and in this case the model would be said to be over-identified (Baum et al. 2003; Benchimol n.d.; EViews 2013b). However, in cases where the GMM model is rejected, a large *J*−statistic generally indicates a misspecified model (Zivot & Wang 2006).

4.8.3. Interpretation of ARDL co-integration results

According to Ageli (2013) and Odhiambo (2009c, 2011), significance tests for an ARDL-bound co-integration analysis may be based on the joint *F*-statistic (or Wald statistic). In all the equations, the null hypothesis of no co-integration among the variables needs to be tested against the alternative hypothesis that there is a co-integrating relationship between the variables of the study's concern, as stated below:

In Eq. (4.2): $\mathbf{H_0}: \alpha_3 = \alpha_4 = 0$; $\mathbf{H_1}: \alpha_3 \neq \alpha_4 \neq 0$

In Eq. (4.3): $\mathbf{H_0}: \beta_3 = \beta_4 = 0$; $\mathbf{H_1}: \beta_3 \neq \beta_4 \neq 0$

Adom (2011) and Odhiambo (2009c, 2011) stipulate that the significance tests in this context are based on the asymptotic critical bounds of Pesaran et al. (2001). Using the computed *F*-statistic, the test is conducted by comparing the latter statistic with the critical values reported for this purpose by Pesaran et al. (2001). In this regard, there are two sets of critical values for a given significance level. One set of critical values assumes that all variables included in the ARDL model are I(0), while the other is calculated on the assumption that the variables are I(1). If the computed *F*-statistic exceeds the upper critical bounds value, then the (H_0) hypothesis is rejected. The co-integration test becomes inconclusive if the *F*-statistic falls within the two bounds. If the *F*-statistic is lower than the lower bound value, then the null hypothesis (H_0) of no co-integration cannot be rejected.

4.8.4. Interpreting the findings of the Granger causality test

The Granger causality test examines whether the lagged values of one variable help predict another variable (Verbeek 2012). A significance test in conventional Granger causality tests involves the testing of the null hypothesis that X does not cause Y and vice versa (Odhiambo 2009c), in which case all the coefficients for the lagged values of X are zero in the equation for Y, and all the coefficients for past values of Y in the equation for X will also be zero (Pîrlogea & Cicea 2011; EViews 2013a). The error correction-based causality test introduces some long-run information into the model through its modelling of the lagged error correction term (Odhiambo 2009c). With this approach to causality testing, the short-run causal impact is determined by an *F*-

statistics analysis on the joint significance of the independent variables, while the long-run causal impact is established through the significance of the error correction term by means of a simple *t*-test based on coefficients of the lagged error correction terms (Odhiambo 2009a, 2009b, 2009c, 2011).

4.8.5. The interpretation of GARCH parameters

GARCH estimates can capture the tendency of an event to cause volatility clustering by defining the connection between, for instance, information (news) and volatility. The size of the ARCH and GARCH effects determine the current and long-lasting influence of a particular event on volatility, whereas the sum of these two effects measures the persistence of volatility in the respective periods under consideration. A significant ARCH or GARCH parameter translates into a clustered volatility process in the sample investigated over several subsequent periods, whereas an insignificant ARCH or GARCH indicate that the impact does not last (De Beer 2008).

De Beer (2008) suggests that a significant positive (negative) coefficient points towards an increase (decrease) in the volatility as a result of a particular event. So, in the dummy-based estimation, a significant positive (negative) coefficient will then hint at an increase (decrease) in the volatility as a result of derivatives trading. In addition, a large ARCH or GARCH term in the variance equation would indicate that shocks to the economy persist for several subsequent periods, whereas a small ARCH or GARCH term implies a short-lived impact of shocks to the underlying economic volatility.

In the separated univariate GARCH estimations, an increase/decrease in the ARCH(1) coefficient suggests a faster/slower dissemination of news and apparent impact on the economy. In particular, an increase in the ARCH(1) coefficient from one period to another suggests that financial information had become more rapidly assimilated by volatility driving forces such as the price of financial assets, whereas a decrease in the coefficient translates into a slower dissemination of the financial news. On the other hand, an increase in the GARCH(1) coefficient is indicative of an increase in volatility, and a decrease in this coefficient implies that there is no volatility transmission effects. An increased GARCH(1) coefficient simply implies a prolonged effect of past volatility on the underlying economy (De Beer 2008).

The persistence of volatility is measured as the sum of the two coefficients assigned to the ARCH and GARCH terms (i.e. $\alpha+\beta$), which is referred to as the autoregressive root. A root (ARCH plus GARCH) that is close enough to 1 (unity) causes the volatility to decline and dissipate slowly. If ($\alpha+\beta$) = 1, this means that the shock effect of volatility never dissipates, and with ($\alpha+\beta$) = 0, the shock diminishes immediately (i.e., no ARCH effects). GARCH coefficients are evaluated only when ($\alpha+\beta$) < 1 because if ($\alpha+\beta$) $\geq$ 1, the conditional variance is not defined. Hence, if α and β sum up to a value less than 1 (unity), it indicates a stationary and predictable volatility (De Beer 2008).

In turn, the unconditional variance (ω) represents a measure of the long-term average volatility. The change observed in this coefficient after the event, as compared to the change in the autoregressive root ($\alpha+\beta$), may confirm an increase or decrease in the conditional (long-term average) variance or volatility. Therefore, volatility changes can also be captured by comparing the values of pre- and post-event unconditional variances (i.e. ω) for separated univariate GARCH estimations (Siopis & Lyroudi 2008).

4.9. CONCLUSION

The empirical methodology of the study was the subject of this chapter. The procedure that was followed to generate empirical results was then covered, and the methodological aspects of the research results' interpretation were also emphasised. Mainly, the econometrics methodology employed in this study is directed towards a multivariate regression analysis, a causality study and volatility analysis.

First, a GMM regression is set to explore the existence of correlating relationships among the variables under investigation as a way to characterise the dependence between, mainly, the existence of the local derivatives exchange and South Africa's economic growth. However, as for any regression analysis, the variables of interest must be analysed for non-stationarity defects, and then undergo remedial (differencing and/or logarithmic) transformations if detected with such defects in an attempt to achieve their stationarity. The stationary data so obtained can be used for the purpose of regression estimation in order to circumvent spuriousness of estimation results. In cases where all the variables do not achieve stationarity after the suggested transformations, the co-integration of the data becomes an overriding requirement for the model to use the data series in levels.

Subsequently, a Granger causality test is to be undertaken to determine the causal link between SAFEX's derivatives trading volumes and South Africa's real GDP growth. Causation will flow from one series to another, depending on the ability of past/lagged values of one variable to help predict the current state of the other variable. The co-integration of the variables is, however, a prerequisite that ensures that an adequate long-run relationship exists between them, which in turn guarantees the causality test's predictive accuracy. An ARDL-bound testing approach will then be employed to find out if the required long-run relationships exist between the variables, as the existence of such relationships would normally hint at the possibility of Granger causality in at least one direction between the variables. Basically, a standard VAR-based causality model can be used for the proposed causality test in the event of the purported co-integration of the variables, but the Granger causality test can be implemented in VECM so as to capture the possible short- and long-run causality between the variables. The VECM can remedy the shortfalls of traditional VAR in such co-integrated relations by extending them with additional lagged error correction terms (ECT_{t-1}). While a Granger causality test in a standard VAR framework requires stationary data, the VECM-based Granger causality is applicable to the original variables after co-integration between them has been proven, even though the data investigated presents unit roots.

Ultimately, the univariate GARCH (1, 1) assessment of the volatility in the GDP growth variable can be applied to two distinct subsamples in the derivatives exchange implementation before and after 1990. Both subsamples can be then tested separately for the ARCH(1) and GARCH(1) effects. However, an alternative approach would involve the use of a dummy variable in a multivariate framework that can help to detect the change in the conditional variance after the opening of the derivatives exchange. In the latter case, a significant positive (negative) coefficient estimate for the dummy's parameter will typically point at an increase (decrease) in the volatility as a result of derivatives trading.

5.1. INTRODUCTION

The empirical methodology of the study was explained in the previous chapter. The discussion of this chapter is focused on the implementation of selected empirical techniques and the evaluation of research results, such as to divulge the impact of the South African derivatives exchange on the local economy's growth and growth volatility.

5.2. STATISTICAL ASSUMPTION TEST AND RATIONALE

5.2.1. Hypothesis testing for differences between the two samples

The theory of the study suggests that average economic growth would be higher in the period where an organised derivatives exchange exists, but that the existence of such an exchange could promote economic volatility. Let period 0 be those years during which such an exchange did not exist in South Africa, and period 1 those years that such an exchange has existed. Therefore period 0 = 1971–1990, and period 1 = 1991–2012. The student's *t*-test is then implemented to verify whether or not the means for these two periods are statistically different. A variance ratio test follows, which assesses the significance of the presumed inequality between the samples. Descriptive statistics of both pre- and post-samples of the relevant GDP series are provided in Appendix B.

The hypothesis statement of the *t*-test is as follows:

$$H_0: \mu_0 = \mu_1$$
$$H_1: \mu_0 < \mu_1$$

The null hypothesis states that there is no significant difference between the two means, while the alternative hypothesis states that – as expected according to theory – the mean in period 1 would be significantly higher than in period 0. The hypothesis was tested using the student's *t*-distribution and is a one-tailed test. The t_{STAT} value was calculated using the following formula:

$$t = \frac{(\bar{X}_1 - \bar{X}_0)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_0^2}{n_0}}}$$

The results of the *t*-test are as shown in the table below:

Real GDP Growth	**Mean**	**Standard deviation**	**Number of Observations**
Pre-exchange (period 0)	2.407	2.460736	20
Post-exchange (period 1)	2.672273	2.109154	22
Difference of means	0.265273		
t_{stat} value 0.3733		Critical values at 1% significance level $t_{.10,21}$ = 1.7207; $-t_{.10,21}$ = -1.7207	
Degree of freedom 20.9872			

Table 5.1: Results of the student's *t*-test of equal means between pre- and post-derivatives samples

Considering a critical value, $t_{.10;21}$ = 1.7207, the null hypothesis of equal means cannot be rejected at a 10% significance level. The computed *t*-statistic (t_{STAT} = 0.3733 > $t_{.10;21}$ =-1.6860) does not support the alternative hypothesis that $\mu_0 < \mu_1$. This test unfortunately fails to provide evidence for the claim of increasing growth in the post-derivatives exchange period. To the contrary, it indicates that a significant statistical difference cannot be asserted between the mean GDP growth rates of both the periods: before and after the existence of the derivatives exchange. This preliminary analysis may be indicative of possible problems to arise the subsequent GMM estimation.

While this preliminary analysis formally shows that the average level of real GDP growth in period 1 is not statistically different from that in period 0, it does not tell anything about the impact of derivatives on economic activity.

5.2.2. Variance ratio tests

In terms of the variability of GDP growth, the theory suggests that the introduction of derivatives trading is likely to increase volatility in economic growth. Therefore, the hypothesis statement of the *F*-test is as follows:

$$H_0: \sigma_1^2 = \sigma_0^2$$

$$H_1: \sigma_1^2 < \sigma_0^2 \text{ (upper-tailed test)}$$

The following table indicates that the variance (or volatility) has decreased after the institutionalisation of a derivatives exchange in South Africa in 1991 for growth in real GDP, but has increased for the level of real GDP.

Variance	GDP_GW	LogGDP
Pre-exchange	2.460736	0.010332
Post-exchange	2.109154	0.014785
Difference	-0.351582	0.004453
F_{STAT} *value*	1.36117343	2.0477355
Degree of freedom	19.21	21.19
Critical values at α significance level	1% $F_{.01;19,21}$ = 2.904 $F_{.01;21,19}$ = 2.981 10% $F_{.10;19,21}$ = 1.784 $F_{.10;21,19}$ = 1.807	5% $F_{.05;19,21}$ = 2.109 $F_{.05;21,19}$ = 2.144

Table 5.2: Results of the variance ratio test

The two-sample variance *F*-testing, however, indicates rejection of H_0 for the growth rate series at the 10% level ($F = 1.136 < F_{.10;19,21} = 1.784$), but acceptance of H_0 for the level of real GDP at the 5% confidence level ($F = 2.048 > F_{.05;21,19} = 2.144$). Interestingly, the analysis points to the fact that volatility in economic growth has not been significantly different between the two periods. However, the level of output itself has seen a significant decrease in volatility (i.e. increased stability) since 1991. Although causality as a result of the existence of a derivatives exchange cannot be inferred on the basis of this evidence, one can at least acknowledge a definite correlation between derivatives trading and economic stability in South Africa. However, this analysis is not sufficient to prove that derivatives trading contributed to the hinted economic growth stability.

5.3. THE GMM ESTIMATION

5.3.1. Stationary tests and remedial actions

All variables were tested for unit roots using the ADF test. The results of these tests are reported in the following table:

Variable	Order of integration	Significance level
GDP_GW	I(0)	1%
SAVINGS	I(1)	1%
D_SAVINGS	I(0)	1%
EXPENDITURE	I(1)	10%
D_EXPENDITURE	I(0)	1%
INFLCPI	I(0)*	5%
TRADE	I(1)	1%
D_TRADE	I(0)	1%
FDI	I(0)	1%
PRIVCREDIT	I(1)	1%
D_PRIVCREDIT	I(0)	1%
M2	I(1)	1%
D_M2	I(0)	1%

*trend and intercept

Table 5.3: Results of ADF stationarity tests for the GMM estimation

The ADF stationarity tests revealed that not the all variables were stationary in level. While the series pertaining to GDP_GW, real GDP, INFLCPI (stationary in levels at 5% with trend and intercept) and FDI are stationary in their raw forms, the series referring to SAVINGS, EXPENDITURE, PRIVCREDIT and M2 was detected with first-differenced stationarity defect. This led to the creation of new series referring to D_SAVINGS, D_EXPENDITURE, D_PRIVCREDIT, D_M2, through the differencing of the respective individual data series. As all the variables achieved stationarity after first differencing, no logarithmic transformations or premature co-integration tests of data were required. The generated series were then used in substitution of their corresponding variables in the subsequent regression estimation.

5.3.2. Estimation and results

According to Gujarati and Porter (2009), “if an explanatory variable in a regression model is correlated with the stochastic disturbance term, the OLS estimators are not only biased but also not even consistent”. An endogenous explanatory variable will cause correlation between this explanatory variable and the error term to be detected. An endogenous explanatory variable can be an explanatory variable that is "caused" by the dependent variable. In such a case, an instrumental variable estimation is appropriate, where a variable that is highly correlated with the endogenous explanatory variable but uncorrelated with the stochastic error term is used to proxy the original endogenous explanatory variable. An instrument variable does not in itself belong to the original equation (*instruments are therefore exogenous*). GMM is a very good option, given the presence of the lagged dependent variable in the model to be estimated, as it is able to correct for bias caused by this lagged GDP term and other potentially endogenous explanatory variables.

The model with all the control variables, as described in Chapter 4, was estimated. The summarised output of the GMM regression analysis is presented below.

Dependent Variable: GDP_GW		
Variable	**Coefficient**	***p*-value.**
GDP(-1)	0.690665	0.0097
DERIV_DUM	-2.654282	0.2101
D_SAVINGS	0.631906	0.0777
D_EXPENDITURE	0.898135	0.0470
INFLCPI	-0.490028	0.0405
FDI	-0.487906	0.8032
D_PRIVCREDIT	-0.165083	0.3590
D_M2	0.057110	0.8899
R-squared	0.530457	
Adjusted R-squared	0.427745	
J-statistic	0.789788	
Prob(*J*-statistic)	0.374164	

Table 5.4: Results of the GMM estimation

A number of instrumental variables were used, with lagged output introduced as instrumental variable for the lagged dependent variable. Weak exogeneity is assumed for the time-varying regressors, and accordingly lagged values of gross savings, expenditure, inflation, FDI net inflows, private sector credit extension and broad money were also included as instruments. In addition, the dummy variable serves as its own instrument lagged one period. This is indeed in accordance with the requirement of Wooldridge (2001:95–96) that instrumental variables can be modelled in the context of a time-series analysis by employing lagged terms of the dependent and independent variables that do not appear in the regression equation, as long as the latter variables are assumed to be uncorrelated with the error term. The choice of these instrumental variables should be acceptable, given Hansen and Singleton's (1982:1276) argument that "[f]rom the standpoint of obtaining a consistent estimator, a researcher is given considerable latitude in selecting x_t".

The GMM output (Eviews full output reported under Appendix C) indicates a negative (δ = -2.654282) but highly insignificant (*p*-value = 0.2101) relationship between the existence of the derivatives exchange (the derivatives dummy) and economic growth. A statistically significant *J*-statistic (*J* = 0.789788) is satisfactory (*p*-value = 0.374164 > 0.10) and indicates that one can reject the hypothesis of model misspecification. Baum (2006) precisely instructs that the *J*-statistic tests the null hypothesis that the overidentifying restrictions are valid. Specifically, the *J*-statistic test examines whether the instruments are independent of the error term. According to Baum (2006:201), "rejection of the null hypothesis implies that the instruments do not satisfy the required orthogonality conditions – either because they are not truly exogenous or because they are being incorrectly excluded from the regression." A high *p*-value, as in the present case, implies the non-rejection of the null, in other words the conclusion that the choice of instrumental variables is appropriate.

While all the control variables are not statistically significant, they do perform the invaluable function of isolating the impact of the derivatives dummy on economic growth. Even though the results seem to indicate that derivatives do not influence growth in South Africa, this analysis still shows the relevance of Solow factors as influential factors of growth in South Africa, with D_SAVINGS, D_EXPENDITURE and INFLCPI being statistically significant. Yet, all capital market development factors also remain insignificant.

The main drivers of economic growth appear to be the savings rate and expenditure rate. SAVINGS captures the investment rate and therefore the rate of capital accumulation, which is expected to positively impact growth. However, the savings rate is significant only at the 10% confidence level, which might indicate that savings or the level of capital accumulation does not play such an important role for South Africa's growth. On the other hand, EXPENDITURE approximates consumption spending and is positively related to economic growth at the 5% confidence level. The ratio of final consumption spending by households to GDP was very close to and mostly above 60% since 1990 (South African Reserve Bank n.d.), and the results seem to confirm that the South African economy is mainly driven by consumer spending. Inflation is shown to negatively impact economic growth at the 5% confidence level. Finally, the fact that none of the controlling financial development variables is statistically significant, coupled with the insignificance of the derivatives dummy, indicates that developments in financial markets are not strong drivers of economic growth in South Africa. Financial markets in developing economies might not always be as sophisticated as financial markets in some advanced economies to fully support the theoretical benefits of increased access to information, improved risk and hedging strategies, etc. Therefore some of the theorised benefits of an institutionalised derivatives exchange might not be present in such a developing economy, simply due to the fact that its financial markets might not be sufficiently developed to take full advantage of these opportunities.

Overall, the GMM estimation fails to prove that the derivatives exchange contributes to economic growth. The results discussed above are rather consistent with the result of the statistical analysis performed in 5.2.1, as it could not be proven that a statistical difference existed between the average output growth of the periods before and after the derivatives exchange was established, which hinted at the eventuality that the GMM regression could be irrelevant in capturing statistics confirming the theory and assumptions the study. Correspondingly, the results of the GMM regression are pointing at the absence of deterministic responses between the existence of a local derivatives exchange and growth in South Africa; in other words, this indicates a lack of a contemporaneous correlation between the two main variables of the study’s primary interest.

Wooldridge (2013), however, contemplates that the use of transformed data in the model could impose limits on the scope of the relationships that might exist between the variables, and thus suggests that additional information may be produced through certain spurious regressions involving level variables. For instance, evidence of co-integrating dynamics between the variables normally can expose the possibility of long-run relationships between them. For this reason, the study may go on to investigate the existence of such co-integrating relationships among the variables of interest.

5.3.3. Multicollinearity

A violation of the classical linear regression model that often occurs in time-series analysis is a high correlation or close linear relationship among some of the explanatory variables, known as multicollinearity (Gujarati and Porter 2009). While this can be problematic in an OLS estimation, multicollinearity is much less of an issue in instrumental variable estimations such as GMM. Regardless, table 5.5 below reports the correlations between the explanatory variables.

	RGDP	DERIV_DUM	SAVINGS	EXPENDITURES	INFLCPI	M2	PRIVCREDIT	FDI
RGDP	1.000000	0.779878	-0.751756	0.356182	-0.525482	0.930872	0.911341	0.401931
DERIV_DUM	0.779878	1.000000	-0.871881	0.364924	-0.656124	0.780844	0.905879	0.406125
SAVINGS	-0.751756	-0.871881	1.000000	-0.467340	0.604312	-0.792680	-0.871289	-0.406278
EXPENDITURES	0.356182	0.364924	-0.467340	1.000000	-0.545147	0.483698	0.461986	0.403922
INFLCPI	-0.525482	-0.656124	0.604312	-0.545147	1.000000	-0.635629	-0.720391	-0.411393
M2P	0.930872	0.780844	-0.792680	0.483698	-0.635629	1.000000	0.937046	0.509275
PRIVCREDIT	0.911341	0.905879	-0.871289	0.461986	-0.720391	0.937046	1.000000	0.444303
FDI	0.401931	0.406125	-0.406278	0.403922	-0.411393	0.509275	0.444303	1.000000

Table 5.5: Correlations between explanatory variables

The relatively low correlations among the variables illustrates that the dataset does not suffer from severe multicollinearity problems. The degree of multicollinearity that does exist (primarily between real GDP and the two measures of growth in domestic credit) is largely remedied by the GMM estimation technique.

5.4. GRANGER CAUSALITY

A Granger causality test was performed on real GDP growth and the volume of derivatives traded in South Africa. The derivatives volume series is only available from 1994. So, as anticipated, the replacement of the dummy variable by the series pertaining to SAFEX's actual volume trading history restricts the scope of the investigation to 1994–2012.

The methodical requirements in terms of the ARDL co-integration force the modelling of original level data rather than transformed ones. The real GDP growth levels (GDP_GW) were considered in this analysis, in conjunction with the series pertaining to derivatives trading volumes (DERVOL). The ADF stationarity test was performed on GDP_GW and DERVOL prior to the co-integration test just to make sure that none of these variables was *I*(2) or beyond (Odhiambo 2009c). This testing yielded the results described in table 5.6 below:

Variable	**Order of integration**	**Significance level**
GDP_GW	I(0)	5%
DERVOL	I(1)	1%
D_DERVOL	I(0)	1%

Table 5.6: Results of ADF stationarity tests introducing the ARDL and Granger causality tests

According to the stationarity tests, real GDP growth is I(0) (with a 95% level of certainty), while the derivatives volume series is I(1). The variables are not *I*(1) as a bivariate co-integration analysis using the Engle and Granger approach would require them to be. This makes them suitable for an ARDL procedure, because the ARDL is valid regardless of the order of integration of the variables, as long as they are not *I*(2) or beyond. On top of that, the ARDL guarantees a more efficient estimation for same samples (Odhiambo 2009c).

5.4.1. ARDL-bound co-integration analysis

As the study involves the analysis of annual time series, the maximum lag length can be set to two (Adom 2011). The following table summarises the results of the bound co-integration test, of which full Eviews outputs are reported in Appendix D1.

<table>
<tr><th>Dependent variables</th><th colspan="3">Function</th><th colspan="4">F-test statistic</th></tr>
<tr><td>$\Delta lnGDP\_GW_t$</td><td colspan="3">GDP_GW (DERVOL)</td><td colspan="4">1.606931</td></tr>
<tr><td>$\Delta lnDERVOL_t$</td><td colspan="3">DERVOL (GDP_GW)</td><td colspan="4">2.167898</td></tr>
<tr><td colspan="8">Asymptotic critical values</td></tr>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">10%</td><td colspan="2">5%</td><td colspan="2">1%</td></tr>
<tr><td>I(0)</td><td>I(1)</td><td>I(0)</td><td>I(1)</td><td>I(0)</td><td>I(1)</td></tr>
<tr><td colspan="2">Pesaran et al. (2001), p. 300, Table CI(ii) Case II</td><td>2.37</td><td>3.20</td><td>2.79</td><td>3.67</td><td>3.65</td><td>4.66</td></tr>
</table>

Table 5.7: Result of the ARDL-bound test for co-integration

The co-integration test indicates that no clear co-integration vector is apparent between the variables in the both equations. For the GDP_GW equation, the calculated *F*-statistics for the GDP_GW equation are insignificant (F = 1.61 < 2.37), as it is lower than the lower-bound critical value at the 10% significance level. In turn, the test is also insignificant for the DERVOL equation at the 5% significance level, with a computed *F* that also remains lower than the lower-bound at this level. Similarly, at a 10% level of significance, the test statistic remains insignificant for a computed *F*-statistic (F = 2.16), which is inferior to the lower-bound critical value of 2.37 for this testing level. Overall, the null hypotheses of no co-integration are rejected in both equations, and the implication of these non-rejections of H_0 is a lack of a long-run relationship between the variables of the study's interest.

5.4.2. Granger causality test

Given the total absence of a co-integrating relationship between derivatives volumes and GDP growth hinting at a lack of long-run relationship between the variables, the causality tests were performed for a better confirmation purpose of the ARDL estimation results.

The Granger causality test was first specified in a standard VAR framework, rather than in VECM. A requirement for such a VAR-based Granger causality test is that both variables must be stationary. Therefore, the first difference of the derivatives volume series was used in the analysis. The results described in Table 5.7 below indicate that one cannot reject the hypothesis that real GDP growth does not Granger-cause derivatives volumes (*p*-value = 0.12 > 0.10). On the account of a reported *p*-value = 0.1066, the hypothesis supporting that derivatives volumes do not cause real GDP growth is also not rejected. These finding lends further support to the findings in earlier sections that the South African data simply does not support the theory.

Null hypothesis tested	***F***	***p*-value**
D_DERVOL does not Granger-cause GDP_GW	2.76347	0.1066
GDP_GW does not Granger-cause D_DERVOL	2.58745	0.12

Table 5.8: Results of the pairwise Granger causality

Sørensen (2005) reiterates that a Granger causality test in VAR has a limited predicting power in a possible co-integrating relation. For better confirmation of the results of the implied causality in VAR, a VECM-based Granger causality test was undertaken to check if any long-run causal relationships prevail between both factors. As with other tests, the VECM-based Granger causality was estimated with two lags as the maximum lag length structure. In addition, the number of co-integration for the purpose of this test was set to one. The results obtained (see appendix D2) are summarised in the subsequent table:

Dependent variables	**Short-run causality**		**Long-run causality**
	Testing $\Sigma\Delta lnGDPpc_{t-i}$	Testing $\Sigma\Delta lnDervol_{t-i}$	Testing ECT_{t-1}
	F*-statistics *(p-value)		**Coefficient estimates *(p-value)***
$\Delta lnGDP\_GW_t$	-	0.158663*(0.8556)*	0.789296*(0.1688)*
$\Delta lnDERVOL_t$	1.294471*(0.3205)*	-	-2.761340*(0.0203)* (**)

Note: (**) denotes statistical significance at the 5% level.

Table 5.9: Results of the VECM-Based Granger causality test

The results of this causality test exhibit no evidence of short-run causation between GDP_GW and DERVOL, and are in conformity with the preceding findings in this regard. Short-run causality is denied by the *p*-values of associated *F*-statistics, which are all statistically insignificant as their values lie all above the restrictive critical values of 10%, 5% and 1%. This confirms the absence of correlation between derivatives trading and economic growth.

While a long-run Granger causality from derivatives volumes to GDP growth is also denied by an ECT_{t-1} coefficient that is both positive and insignificant (*p*-value = 0.1688), there is evidence of a long-run causality from growth in GDP to derivatives trading. The negative and statistically significant (*p*-value = 0.0203 < 0.05) lagged error correction terms sufficiently provide for the existence of a unidirectional causal relationship from GDP_GW to DERVOL at a 5% level of significance.

Consequently, the study finds a lack of short causation between derivatives markets and economic growth in the short run. Nonetheless, a unidirectional long-run Granger causality from economic growth to derivatives market development is explicit. However, causality from the existence of a derivatives exchange cannot be inferred on the basis of the study's evidence, even in the long run. Hence, causation generally runs from economic growth to the expansion of derivatives trading, which leads to the acknowledgement that developing derivatives markets adhere to the demand-following hypothesis. Such a prevalence of a demand-following response between economic development and the expansion of derivatives trading simply supports that it is the economic growth that leads to the development of a derivatives market (Adenuga 2010).

Isu and Okpara (2013) substantiate the finding that with the prevalence of the demand-following hypothesis of finance, the growth of the economy is necessary for financial development and not necessarily otherwise. Financial markets generally develop and progress when there is an increase in the growth of the real economy. In other words, it is the expansion of the real sector of the economy that generates increased new demands for financial services, and consequently new financial institutions usually emerge to diversify and satisfy the new financial services demand. Therefore, the economic stimulus of more sophisticated and efficient financial markets becomes noticeable as the economy matures.

Financial development has to be pursued in parallel with enhanced endeavours towards the diversification of the economy through tapping into alternative sources of growth, such as a potentially well-endowed natural resources sector and/or the expansion of the agricultural sector, which can help induce further economic growth and eventually lead to financial deepening. While growth-enhancing programmes and the related long-term investments are pursued, the provision of conductive and efficient capital markets remains a necessary endeavour for even better growth prospects for such a developing country.

Therefore, the described demand-following response between the development of derivatives markets and economic growth implies that the expansion of the economy is the factor that creates new demands for derivatives instruments in South Africa. Under these circumstances, some large and sophisticated market infrastructures need to precede the liberalisation of derivatives trading. Accordingly, strong financial institutions should first be established that are intended to prepare the path to fair and efficient trading in innovative financial instruments (Adenuga 2010).

The analysis of the relationship between South Africa’s derivatives use and economic growth has yielded results that are contrary to the advocacy of Rodrigues, et al. (2012) of the significantly positive contribution of the existence of derivatives markets upon countries’ economic growth. However, Baluch and Ariff (2007), Haiss and Sammer (2010) as well as Şendeniz-Yüncü et al. (2007) are all supportive of a positive influence of derivatives trading on economic growth, which implies that countries with fairly well-developed and well-functioning derivatives markets experience higher growth than countries without such markets.

A potential relenting factor of the contributing power of the local derivatives markets on the country's economy could be the size of the South African derivatives markets. In effect, the size of derivatives markets has been given as a key determinant of how they impacts a particular country's growth, and medium-sized derivatives markets have more positive effects on economic growth than large and small derivatives markets. While South Africa's derivatives markets are now described as fairly advanced, the study evidence of a lacking influential impact of derivatives trading on GDP growth could suggest that the markets have not been developed to their optimal extent yet and that a lot more could be drawn from the South African derivatives markets. The depiction of long-run causality, even though only flowing from growth to derivatives market development, is at least supportive of a more realistic view that developing financial markets is a rather long-run process, and, accordingly, efficient derivatives trading cannot not be achieved over the short run (Standley 2010).

5.5. GARCH (1, 1) ANALYSIS

Ultimately, the question relating to the impact of the local derivatives trading on growth volatility was raised. Figure 5.1 presents the development in the South African economic growth in terms of the growth rate of the country's yearly real GDP over the targeted period 1971–2012. The graph clearly shows a pronounced inclination to fluctuation in the series, suggesting in-built volatility.

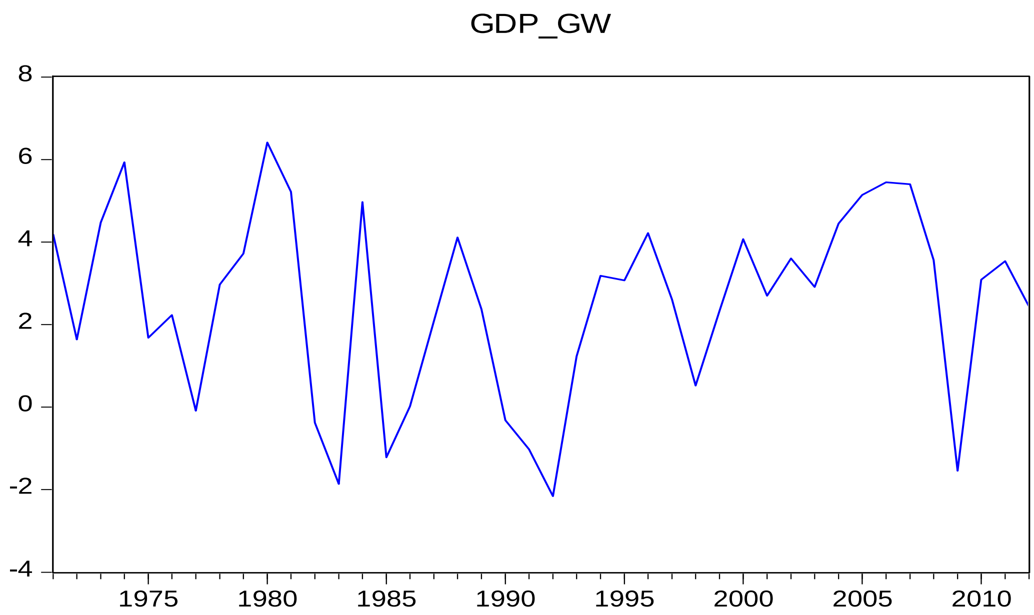


Figure 5.1: Real economic growth in South Africa over the period 1971–2012

Source: EViews8 Generated

5.5.1. GARCH (1, 1) parametric estimation and interpretation

With regard to GARCH (1, 1) volatility analysis, the study reintroduces two variables, GDP_GW and DERIV_DUM, to stand as a proxy for economic growth and the implementation of the derivatives exchange, respectively. The modelling of a dummy variable is viable for the identification of any statistically significant change in growth volatility as a result of derivatives trading over the full sample period under review. The GARCH analysis ignores the tests for GDP_GW stationarity, as the stationarity of this variable was been proven in an earlier investigation. The results reported in terms of the current GARCH (1, 1) estimation were obtained under the assumption of Gaussian normal distribution.

Table 5.9 summarises the main findings of the dummy-based GARCH estimation, of which a full Eviews output is reported in Appendix E1.

Variance equation estimates	
	Coefficients *(p-values)*
Constant – ω	1.569161 *(0.0171)* (**)
ARCH(1) – α	-0.185347 (*0.0000*) (***)
GARCH(1) – β	0.953165 *(0.0000)* (***)
DERIV_DUM – δ	-0.943978 *(0.0502)* (*)
Autoregressive root – ($\alpha + \beta$)	0.767818

Note: (***) denotes statistical significance at the 1% level; (**) denotes statistical significance at the 5% level; (*) denotes statistical significance at the 10% level.

Table 5.10: Results of GARCH (1, 1) estimation of GDP growth volatility over the period 1971-2012

The table shows that the value of α is -0.185347 and statistically significant; the value of the β coefficient is 0.953165 and also significant. The sum of these parameters is 0.767818, which is close to unity, indicating a very persistent conditional volatility. Such a large value of the GARCH lag coefficient (β = 0.953165) indicates that shocks to conditional variance take a long time to dissipate, which confirms the finding of volatility persistence. α violates the non-negative requirement for the ARCH and GARCH coefficients.

The GARCH assumption that positive and negative shocks have a symmetric effect on volatility is often violated in empirical practices, when volatility tend to increase more after bad news than after good news. Consequently, the realisation of the negative estimates serves as empirical evidence for the unsuspected leverage effect, which is indicative of the tendency of volatility to be higher after negative news than good news (Black 1976; Brooks 2008). In effect, Jobst (2006) explains that "even though the traditional two-factor GARCH (1, 1) does not recognise the asymmetric spread dynamics of volatility, the asymmetric effects of past shocks on conditional spread volatility can be observed through the significance of *negative* coefficients in a GARCH (1, 1) analysis". Accordingly, conditional volatility spread is mostly informed by such a portrayal of asymmetric ARCH effects for GARCH (1, 1), which contribute more economic significance to the usually positive GARCH effects. This eventually suggests that in the course of a persistently widening volatility spread, negative shocks that are associated with sudden declines of spread lead to a significant departure from the initial pattern, and induce higher spreads in volatility, which tend to be propagated over time by further negative past shocks. Therefore, the negative (α = -0.185347) and statistically significant (*p*-value = 0.0000) ARCH(1) coefficient simply implies that bad news (shocks) tend to affect volatility in such a way that if the spread of volatility declined in the previous period lag as a result of such a bad event, volatility becomes disproportionately increased for the current period (Jobst 2006; Subhani, Hasan, Moten & Osman 2011).

Both the ARCH and GARCH coefficients (-0.185347 and 0.953165) are statistically significant, and the sum of these coefficients ($\alpha + \beta$) is 0.767818, which indicates that shocks to volatility have a persistent effect on the conditional variance. Such a close to unity autoregressive root is in fact conversant with the fact that volatility shocks certainly persist for many subsequent future periods, thereby hinting at the "long memory" of the factors that govern growth in the economy. Any shock in conditional variance at a given time will therefore have a prolonged/permanent changing effect on all the future values of volatility; hence, the persistence of the volatility shocks (Goudarz & Ramanarayanani 2010). These shocks would have been associated with a permanent effect if the sum of the ARCH and GARCH coefficients equalled unity (Durnel 2012).

The presence of the derivatives exchange is attributed to a decreasing effect on economy volatility, as shown by the negativity and significance of the dummy variable coefficient (δ = -0.943978, and a *p*-value of 0.0502 < 0.10). Provided the capability of the derivatives dummy variable to explain growth volatility, the operation of a formal derivatives centre is found to have a significant impact on the volatility of the economy. This analysis therefore acknowledges a definite correlation between derivatives trading and economic stability in South Africa.

The post-estimation tests involve the testing of both the mean and variance equations, and indicate an overall well-specified GARCH model. The results of these post-estimation diagnostic checks are reported in Appendix E2. Typically, the ARCH LM test is insignificant (*F* = 2.011473 and the associated *p*-value = 0.1643) for one lag in the variance, revealing no remaining ARCH effects in the model, and hence the correctness of this equation. Similarly, the Ljung-Box (*Q*) statistic turned out insignificant for both the mean and variance equations. The acceptability of the modelled mean equation is then confirmed by the highly insignificant *Q*-statistic (*p*-value = 0.685) reported in terms of the Ljung-Box (*Q*) test. In addition, the null hypothesis of persisting serial correlation in squared conditional residuals is rejected on the basis of the insignificant one lag-based *Q*-statistic (*p*-value = 0.508) for the variance equation. Finally, the Jarque-Bera (JB) statistic test was used to verify the exactness of assumption of distributional normality made about the conditional residuals. The Jarque-Bera statistic is also insignificant (*p*-value = 0.377355), which indicates that the normality of distribution is respected. The null hypothesis of non-distributional normality can be rejected.

At least, a more detailed volatility analysis in the context of the present study supplements the suggestion of Rodrigues et al. (2012) of the stabilising effect of derivatives exchanges on countries' economic performance with strong empirical evidence. This analysis further provides evidence that derivatives markets can produce similar economic volatility reduction in the unique circumstances of a developing country. Tiberiu's (2007) investigation of the Euronext financial markets rather offers evidence of such a stabilising effect of derivatives trading for more advanced countries. In such developed countries, the use of derivatives has mostly had a significant positive impact on the reduction of economic performance volatility, thus leading to more stable economic conditions.

5.6. CONCLUSION

The empirical procedures and results of the study form the subject of the current chapter, which is aimed at divulging the impact of the formal derivatives trading on national economic growth and growth volatility. Considering the stated objectives of the research, the preceding chapter proposed three main econometric models to be used for uncovering the required empirical evidence for analysis. The implementation of this research strategy has often required the use of auxiliary procedures, both before and after implementation of the model so as to ensure the acceptability of the results. Having implemented the formulated research methods, this section marks the closing of the chapter by summarising the empirical ways of investigation followed in this study and the findings generated from these.

The GMM estimation turned out insignificant, pointing at the absence of deterministic responses between local derivatives trading and growth in the economy. The

Granger causality tests uniformly corroborate these findings. A pairwise Granger causality test described an absence of causation in any direction between the derivatives volumes and GDP growth. Although an ultimate investigation of causality in VECM also confirms the absence of short-run causality, a unidirectional long-run causality was revealed from economic growth to the development of derivatives trading. Still, causality from the existence of a derivatives exchange could not be inferred on the basis of this test's evidence either. The GARCH (1, 1) at least acknowledges a definite correlation between derivatives trading and economic stability in South Africa. Accordingly, the study concedes the stabilising effect of derivatives trading on the economy. However, this does not constitute sufficient evidence to prove that the derivatives exchange has contributed to economic growth in South Africa.

6.1. INTRODUCTION

This study has considered the economical impact that the introduction of a formal derivatives market could achieve for SSA countries. The use of derivatives for the management of financial risks is offered as a reason for the need to implement centres of derivatives trading in the region. Moreover, derivatives markets are allegedly able to insufflate development into the regional countries, as the lack of derivatives trading infrastructures in most SSA countries is perceived prejudicial to the continental investment environments and growth prospects.

Given the ongoing advocacy for the emergence of African derivatives markets for their alleged capacity to attract development in the region, this study has undertaken to investigate the impact that the locally operated derivatives exchanges could have on economic growth and growth volatility. Among all countries in SSA, South Africa has a well-functioning derivatives market and one of the most advanced. Therefore, the case of South Africa was selected to illustrate how the local derivatives exchange can influence GDP growth and growth volatility.

Currently, most SSA economies are characterised by high instability, which hinders their growth prospects. New risks will emerge as a result of these countries’ use of innovative financial instruments, which could eventually constitute new factors of instability in the economy. This mainly provides the essence of the present study and makes it noteworthy.

The study makes use of a review of relevant literature (theory) as well as an empirical investigation to reach a conclusion on the matter under investigation.

6.2. THEORETICAL CONSIDERATIONS

Following the introductory chapter, the literature pertaining to the impact (both direct and indirect) of derivatives markets on economic growth was emphasised.

Chapter 2 began by highlighting some characteristics inherent to the trade of derivatives instruments, including the benefits of derivatives trading to countries that can afford it. Among other benefits, the markets’ risk management attribute, their price discovery function and transactional efficiency function may lead to better processes of price formation and real-time dissemination of financial market information, and also to the creation of new business through enhanced entrepreneurial activity, which may all help prompt growth.

Derivatives markets can exert an indirect influence on growth through their attracting capital market development. In effect, derivatives trading are often integrated in capital markets. As derivatives markets develop, they often do so alongside some increasingly efficient and complete capital markets. This generally materialises in deep markets for equity and debt instruments, as well as some efficient banking sectors.

Derivatives trading can therefore contribute towards financial markets' completeness by assisting with the development of viable capital markets. This provision of fairly well-developed capital markets is often associated with better financial discipline and good economic policies, and can thus lead to the creation of a favourable environment for sustained growth and development. In addition, deeper capital markets can also be the source of efficient financial intermediation, and as such, they can help mobilising countries' resources towards longer-term project financing. Moreover, the implied provision of the efficient banking sectors, as well as well-developed equity and bond markets, is a key driver of productivity, greater employment opportunities and macroeconomic stability. Derivatives trading can lead capital markets' efficiency towards greater financial and economic development.

Conversely, efficient capital markets may not always be associated with stronger economies. These markets do not always achieve the expected higher levels of economic growth and may, to some extent, make it more difficult for countries to achieve macroeconomic stability. Developments in capital markets can produce instability rather than growth, because the markets generally expose countries to the changes in the economic circumstances outside the country.

With regard to the impact that derivatives markets themselves could have on countries' growth, the literature basically identifies three main channels through which local derivatives trading commonly exert positive influence on economic growth. Firstly, as part of the financial markets, derivatives trading can improve the ability of the local financial markets in channelling the resources of the countries into growth through better accumulation of capital, enhanced market efficiency, and improved informational transparency. The second channel of influence entails derivatives' role in attracting the development of more sophisticated and competitive business environments through enhanced risk management for organisations, which can help reduce the costs of running businesses and, in this manner, free up capital for investments in value-enhancing and growth-driving projects. Lastly, derivatives markets may reduce economic growth volatility.

Unfortunately, as is the case with capital markets, certain features of derivatives markets embody some risks to economic stability. The introduction of derivatives can increase financial uncertainty and thus add risks to the economy, which can adversely impact economic growth. Systemic risk represents the most significant danger posed by derivatives, which could lead to the rapid spreading of financial ruin, as was the case in 2008. In light of the highly risky transactions in derivatives markets, the operation of these markets must be subjected to risk management. The countries that are willing to operate these markets therefore need to implement adequate market infrastructures.

Chapter 3 was therefore centred on the structural aspect of a derivatives exchange, and focused on the infrastructures that have to be in place to ensure well-functioning derivatives markets. The chapter started with a discussion of the new internationally agreed requirements for derivatives market infrastructures. Afterwards, the South African derivatives landscape was emphasised in order to capture a model of a well-functioning derivatives market. The South African derivatives trading system complies with the newly internationally agreed standards in terms of the trading, clearing and reporting of derivatives. The investigation of the infrastructures of the South African derivatives markets clarified the international requirements for safe derivatives markets. Safe and well-functioning derivatives markets require some vital institutional and regulatory infrastructures, including the following:

(1) An exchange that trades on most derivatives instruments, including standardised OTC instruments, has to provide the infrastructure that brings together the buyers and sellers of the securities.

(2) A clearinghouse and/or CCP is essentially responsible for making margin calls and charging collaterals to on-exchange trades in order to ensure

prompt clearing and the settlement of transactions to guarantee the completion of all transactions occurring on the exchange.

(3) A centralised TR ensures that all information on derivatives trades are reported and registered to permit the monitoring of trades and open interest in the OTC market.

(4) A sound regulatory environment keeps up with the innovative trading environment by providing evolving regulatory infrastructures and up-to-date and effective regulations for the markets.

The South African derivatives landscape has progressively evolved from the time it was initiated. The local derivatives exchange now offers an array of instruments for investors to trade in. OTC markets also attract a broadening investor base. This expansion of the local derivatives markets has effectively complemented development in terms of financial infrastructures, which has also helped further financial and economic development. The expansion and sophistication of the derivatives trading infrastructures, and mostly those pertaining to the markets' regulatory environment, must be ensured at all times for the sake of financial safety. The widening, but also riskier, financial environment does not only offer many alternative investments for broadening pools of investors, but also some opportunities for enhanced efficiency, transparency and governance in the financial markets.

The South African derivatives exchange has led to the creation and development of some vital financial infrastructures, which provide an enhanced environment in terms of efficiency, transparency and safeguarding the local financial system. By allowing adequacy in the regulatory and supervisory framework, the sound derivatives market infrastructures enhance investors' protection, promote public confidence and guarantee discipline in the local financial markets. On their own, strong financial infrastructures are an important consideration for growth.

6.3. THE EMPIRICAL CONSIDERATIONS

Chapters 4 and 5 emphasised the empirical component of the study by respectively stating the study's empirical strategy and discussing the results of the empirical investigation. A regression analysis was performed to estimate the responsiveness of South Africa's growth in GDP to the existence of the local derivatives exchange, in which a dummy variable was employed to proxy the development of the exchange. In addition, an investigation of the causality between the South African exchange derivatives trading volumes and economic growth was to determine if the existence of the local derivatives exchange Granger-causes economic growth. A GARCH analysis was finally carried out to evaluate the impact of the local derivatives exchange on volatility in the economy.

Chapter 5 addressed the results of the empirical research, which included the results of auxiliary statistical analyses and tests for data stationarity and co-integration, as well as relevant post-estimation diagnostics checks. The aim of these auxiliary analyses and tests was mainly to guarantee the acceptability of the results yielded by the study.

6.4. RESULTS AND DISCUSSION

Prior to this study, Rodrigues et al. (2012) investigated the effect of the institutionalisation of derivatives trading on economic growth and economic growth volatility using a panel of 45 developed and developing countries, all at different levels of their economic development processes. The results of this investigation pointed at a statistically and economically significant positive effect of the establishment and existence of a domestic derivatives exchange on economic growth. Furthermore, the analysis of the effect of the local derivatives activities on growth volatility showed that domestically implanted derivatives exchanges had a stabilising effect on the economy. The current study contradicts the analysis of Rodrigues et al. (2012) that derivatives trading has an immediate contribution to economic growth. The GMM estimation turned out insignificant, indicating the absence of immediate deterministic responses between growth in the economy and derivatives trading in South Africa. These findings were uniformly confirmed by the Granger causality tests that were performed subsequently, which clearly described an absence of causation between the derivatives volumes and GDP growth over the short run. However, a one-way long-run causality was revealed that flows from economic growth to the expansion of derivatives trading. This means that it is growth in real GDP that causes South Africa's derivatives markets to develop. There was still no evidence of a possible causation from the expansion of formal derivatives trading to the levels of growth in GDP.

Although a causal relationship was not defined with regard to the dynamic that links local derivatives trading and GDP growth, the unidirectional Granger causality predicted from economic development to the expansion of derivatives trading supports the notion that it is economic growth that leads to the development of a derivatives market (demand-following response). This prevalence of a demand-driven hypothesis between economic growth and derivatives market development implies that the expansion of an economy is the factor that creates a new demand for derivatives instruments in South Africa. Accordingly, some large and sophisticated market infrastructures need to precede the liberalisation of derivatives trading. Strong financial institutions must thus first be established in order to satisfy the new demand for these financial instruments (Adenuga 2010). These findings at least sustain a more realistic view that developing financial markets is a rather long-run process, and therefore that efficient derivatives trading would not be achieve over the short-run (Standley 2010).

The size of the South African derivatives markets could be holding back the contributing power of the local market on the country's economy. The size of the derivatives markets is in fact a key determinant of how they impact a particular country's growth. Medium-sized derivatives markets' effect on economic growth is more positive than the effects of large or small derivatives markets. The described lack of influential impact of derivatives trading on GDP growth could thus be pointing to the fact that the South African derivatives markets might not be developed to an optimal extent yet and that a lot more could be drawn from these markets. Hence, given the small size of the majority of SSA economies, the ongoing efforts to develop regional capital markets are also relevant for derivatives markets in order to overcome scale constraints (Standley 2010). On a continent where most of the individual exchange initiatives since the 1980s have failed, the current wish to develop a pan-African derivatives exchange is likely to represent the best likelihood of success (Mbeng Mezui, Rutten, Sekioua, Zhang, Magor N'diaye, Kabanyane, Arvanitis, Duru & Nekati 2013).

The study at least acknowledges a definite positive relationship between derivatives trading and economic stability in South Africa. This is in accordance with the advocacy of Rodrigues et al. (2012) of the stabilising effect of derivatives trading on growth volatility. The existence of a derivatives exchange in South Africa has a negative and significant impact on the country's growth volatility, and therefore the local derivatives exchange tends to lower growth volatility. South Africa has indeed experienced lowering volatility in output growth since the early 1990s, and notwithstanding the latest financial crisis, the country has maintained positive and steady GDP growth (Bhoola & Kollamparambil 2011).

The study has therefore provided the evidence that derivatives markets can produce economic volatility reduction under the unique circumstances of a developing country. Tiberiu (2007) indeed exposes such a stabilising effect of derivatives in more advanced economies by investigating the Euronext financial markets. In these countries, the use of derivatives has mostly had a significant positive impact on the reduction of economic performance volatility, thus leading to more stable economic conditions.

Although many of the SSA economies have been among the world's fastest growing over the past decade, almost all of these countries remain highly unstable in terms of their macro-performances (Mbeng Mezui et al. 2013). Not all derivatives transactions actually entail the creation of risk and gambling with likelihoods of creating instabilities. Sound derivatives exchange(s) can help achieve growth sustainability in these countries (Mbeng Mezui et al. 2013). Many factors may actually assist in the desired reduction of macroeconomic volatility as a result of the use of derivatives instruments. For instance, the technological progress made in the area of information technology may provide easy access to information that would enable investors to better plan their medium- and long-term strategies, thereby contributing to the reduction of fluctuations in their investments' returns. Furthermore, the modification of the economy's structural composition, the development of services sectors, the integration into the international financial environment and the innovations created in these markets, as well as the reduction of the volatility of the capital markets, may all contribute to macroeconomic stability. In the same way, the opening of new derivatives markets should affect the availability of information about financial assets' future cash flows. Derivatives contracts can help complete an otherwise incomplete market and can have a significant impact on the price behaviour of the underlying securities (Curto & Marques 2013).

Better structured and more complete financial markets can help reduce countries' economic volatility through financial innovation, and promote market integration and liquidity (Curto & Marques 2013).

Financial innovation has the potential to be a determining factor for rapid, sustainable and inclusive growth over the medium term (Songwe 2013). The innovation of derivatives markets can thus add to the list of conventional contributors to economic stabilisation, and assist in achieving output growth sustainability for local economies (Dynan, Elmendorf & Sichel 2005). In South Africa, for example, the derivatives landscape has evolved substantially since the opening of the local derivatives exchange in 1990. South Africa's markets for derivatives trade an array of instruments on the regulated exchanges and OTC markets. The vibrant markets offer derivatives in the five known classes of underlying instruments, including various commodity- and financial-based instruments. The development of financial derivatives trading has helped substantiate the composition of the country's financial markets. The broadening of the product range offered on the local exchange provides South African investors with many alternatives to meet their investment needs. South Africa's markets for derivatives now attract a broadening investor base.

African derivatives markets will not only make a significant difference by way of the establishment and intensification of activity of the derivatives exchanges – which may well accelerate the processes of liberalisation and integration in the financial markets – but they may promote the emergence of new investment practices and the proliferation of institutional investors. The new techniques of risk taking and transferring may evenly transform the structures of financial markets for better and sustainable economic growth prospects.

Another factor for better stability as a result of derivatives liberalisation would be the growing size and depth of the financial systems. In spite of the ongoing financial liberalisation trends, regional financial markets remain underdeveloped and are far from being an effective tool for improving economic prospects. With the exception of South Africa, SSA countries have immature domestic capital markets and rely on relatively shallow banking sectors (Standley 2010). The markets for equity instruments lack size and are characterised by a high degree of illiquidity, as shares are rarely traded and activity is impeded by outdated trading, clearing and settlement systems (Masetti & Mihr 2013).

If SSA equity markets remain underdeveloped, domestic bond markets are even more so (Standley 2010). The shallow debt markets are dominated by government securities, as corporate bond markets outside South Africa and Nigeria are almost non-existent. Secondary market trading is currently not very active, because most investors adopt a buy-and-hold strategy. Dealing in debt instruments is mostly limited to OTC transactions. The only deep and liquid domestic debt market in the region is the BESA. Certain SSA countries have timidly started to tap the international debt markets in order to expand their investor base through the use of Eurobonds (Masetti & Mihr 2013). While the banking sectors dominate the financial systems of most of the countries, most banks tend to rely primarily on commercial banking for finance because of the prevailing lack of efficient capital markets. The banking sectors of most African countries do not yet have sufficient depth to play a catalytic role in promoting the development of a deep financial sector (Standley 2010).

Currently, Africa’s small and incomplete capital markets offer limited potential for any economic growth-promoting activities (Hearn & Piesse n.d). Derivatives markets could become some valuable factors of efficiency in the continent’s capital markets. These markets could be a suitable engine for achieving high-paced developing financial markets. Derivatives trading are usually associated with a high level of stock trading, and its application to equity markets could be a medium for generating a more stable source of local currency funding for both the public and corporate sectors. Potential increases in the liquidity of local equity markets may assist investors to hedge their equity investment positions easily, and as they would interact for their hedging, speculation and arbitrage, they would provide further opportunities for underlying equity market growth and stability.

In addition, the debt markets will also develop as a result of derivatives usage, given the possibility of favourable transformations within these markets as a result of derivatives trading. The increasing availability of derivatives instruments could indeed facilitate the broadening of debt markets as investors in the bond markets would increasingly seek to manage their exposure to risks such as those pertaining to changing interest rates. Fluctuating interest rates can affect investors' coupon receipts, the capital gains or losses on debt instruments, and reinvestment income. Debt derivatives may allow for the hedging of such risks and, correspondingly, may also add to the offering of debt instruments.

Therefore, the development of derivatives markets can reduce countries' dependency on bank credit as a source of funding and increase the influence of both the debt and equity components of the capital markets as financing methods for local governments and firms' long-term investments projects. However, the banking sectors could also gain efficiency as a result of derivatives usage. By promoting capital market development, the introduction of derivatives may enhance the financial intermediation function of banks, and hence contribute towards economic growth through more efficient banking sectors.

Deeper primary financial markets and the creation of some efficient secondary markets may constitute extra avenues for impelling further financial and economic development that relies on the expansion of trading in bonds and equities. The implied change of the financial landscapes, especially in terms of the development of extensive secondary markets and increasing securitisation, is likely to produce the necessary diversification for further growth and the mitigation of volatility (Dynan et al. 2005).

Achieving deep and efficient financial markets will, however, be difficult in the absence of corresponding regulations that can promote further economic stability and stimulate investor confidence (Standley 2010). As African countries become more closely linked to the world financial systems, issues of market misconduct, information asymmetry, and anti-competitive behaviour will emerge (Songwe 2013). Furthermore, an unfortunate paradoxical issue with the emergence of both derivatives and capital markets is that they are likely to add some volatile elements to financial systems and economies on their own. The use of the alleged tools of development can therefore be perceived as too complex and too risky. For instance, the OTC derivatives markets are often host to various kinds of malpractice and could become the source of chaos in the financial systems and the economy. The ability of derivatives markets to leverage and the obscure nature of some of the products can make them difficult to control, thereby enhancing their ability to lead to excessive risk taking. This particularity of the use of derivatives instruments has unfortunately won them the spreading appellation of “weapons of mass destruction”. Similar to derivatives markets, the targeted capital market development can also bring some dimension of instability to the financial markets. Consequently, sound regulations must remain central to the constructive development of these distinct, but yet highly interconnected financial markets.

Accordingly, the development of the appropriate institutional and regulatory infrastructures must complement the developments in derivatives markets. The well-functioning derivatives infrastructures are essential for promoting and maintaining the country’s financial and economic stability. As such, the derivatives infrastructures are some important tools of risk management in countries’ derivatives environments. These infrastructures should always be kept in line with international standards. Because derivatives market infrastructures can concentrate systemic risk, they themselves require appropriate regulation and oversight. With an adequate regulatory and supervisory framework, these market infrastructures can enhance investors’ protection, promote public confidence and guarantee discipline in the market. The presence of such strong market infrastructures is an important inducer of growth. Moreover, the new regulatory environment can improve financial institutions’ ability to offer new products and expand across geographic boundaries (Dynan et al. 2005). The derivatives market regulations could then open up the continental markets to an increasing base of international players.

6.5. RECOMMENDATION FOR FUTHER RESEARCH

This study has mainly been concerned with the influence of the South African derivatives markets on real output growth so as to foresee how the prospective introduction of derivatives trading in SSA countries is likely to impact on African economies. An important direction for future research in this field could refer to the viability of African derivatives markets, whereby the impact of derivatives trading on capital market liquidity would be tested. It has been alluded to throughout the study that the derivatives markets could be drivers of liquidity in their underlying markets. This issue of derivatives markets' induced liquidity is noteworthy, given the illiquid capital markets in SSA. It is even more so, since derivatives markets themselves must rely on liquid underlying markets to flourish (Alberta Market Solutions 2003). As Baluch and Ariff (2007) clearly indicate, the liquidity of the underlying markets is the most critical factor driving the successful operation of any derivatives market. It could be valuable to assess to what extent derivatives markets are able induce liquidity in the capital markets, and thus provide suitable conditions for their own expansion and survival. Without liquidity in the underlying capital markets there will be little hope of there being liquidity in any related derivatives (Alberta Market Solutions 2003).

Possible measurements for market liquidity include the value of shares traded as a percentage of GDP, or the turnover ratio (the value of shares traded as a percentage of market capitalisation) (World Bank n.d.). Mainly, the research could also seek to determine whether the conditions for a successful derivatives market are met on the continent, and eventually ascertain the likelihood of success of derivatives markets on the continent. A successful derivatives market requires an overall suitable environment and it is important to study each case to see whether the conditions are right with regard to the major environmental elements that determine derivatives markets' success (Alberta Market Solutions 2003).

In this respect, liquidity in the underlying market will imply that investors are interested in the particular underlying assets and therefore need derivatives to hedge their exposure to that asset. Hence, the greater the liquidity in the underlying capital markets, the more investors will hedge using derivatives. Without that liquidity, potential market makers and other suppliers of liquidity in the derivatives market will be unable to hedge effectively; the derivatives markets will then have to rely on speculators who are barely able to sustain the market on their own (Alberta Market Solutions 2003; George 2009).

A clearly favourable argument as to why derivatives markets should be introduced in SSA is that trading in derivatives instruments is likely to promote efficiency in the underlying capital markets. George (2009) reflects that one way in which the introduction of a derivatives market can enhance capital market efficiency is indeed by increasing liquidity in the underlying markets, mainly as a result of investors' interaction in hedging and arbitrage endeavours, but also through the provision of new trading strategies. Yet, some harmful effects on the liquidity of the underlying markets could be apparent.

In summary, the findings of the study did not sustain the advocacy of Rodrigues et al. (2012) of the significantly positive contribution of derivatives trading on economic growth. The negative but insignificant relationship portrayed between the derivatives dummy and real GDP growth does not allow a clear conclusion to be drawn, from the viewpoint of the GMM estimation, as to whether the institutionalisation of derivatives markets has positively or negatively influence economic growth in SSA. The South African data simply did not support any evidence of a statistically significant change in pre- and post-derivatives output growth study. In addition, the short nature of the data investigated in the context of the causality test between SAFEX's trading volumes and South Africa's real economy growth may provide additional extenuating circumstances as to why insignificant inference has continued to be reported in terms of the relationship between the local derivatives trading and economic growth. These results seem to indicate that derivatives trading do not influence growth in South Africa. Rather, the main drivers of the South African economy appear to be, predominantly government and household consumption expenditure rate, and subsequently the rate of investment as captured by the rate of savings (capital accumulation). Yet, the circumstances of a South African derivatives market might differ from those of a pan-African market. Other than Rodrigues et al. (2012), Baluch and Ariff (2007), Haiss and Sammer (2010) as well as Şendeniz-Yüncü, et al. (2007) have all supported that derivatives trading can positively influence economic development and that countries with fairly well-functioning derivatives markets experience a higher economic growth than those without one. The unidirectional long-run causation revealed from economic growth to the expansion of derivatives trading sustains the realistic view that efficient derivatives markets could not be achieved over the short-run. At least, the inference of a negative and statistically significant impact of the local derivatives exchange on South Africa's GDP growth volatility leads to conceding the stabilising effect of derivatives trading on the economy, and accordingly to concluding that the institutionalisation of derivatives markets in SSA can help stabilising regional countries' macroeconomic performances. However, this does not constitute enough evidence to establish that the derivatives exchange has contributed to economic growth in South Africa.

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Appendix A: The Data

YEAR	GDP	GDP_GW (Growth rate)	DERVOL (number of contracts)	SAVINGS (% of GDP)	EXPENDITURE (% of GDP)	INFLCPI (%)	FDI (% of GDP)	PRIVCREDIT (% of GDP)	M2 (% of GDP)
1971	13.4594	4.19	NA	22.5	104.2	6	1.86	68.8	39.11
1972	13.47581	1.64	NA	24.4	97.5	6.5	1.32	67.6	39.34
1973	13.52051	4.47	NA	24.5	97.4	9.5	0.55	67.8	38.25
1974	13.57983	5.93	NA	24.8	100.6	11.6	0.1	63.7	37.61
1975	13.59664	1.68	NA	23.8	102.5	13.5	1.95	65.8	39.53
1976	13.61889	2.23	NA	22.5	101.2	11.1	0.51	63.5	38.92
1977	13.61795	-0.09	NA	27	95	11.3	0.05	62	37.97
1978	13.64765	2.97	NA	27.1	93.3	10.9	-0.31	60.8	38.54
1979	13.68486	3.72	NA	31	90.6	13.2	-0.24	58.7	36.83
1980	13.74896	6.41	NA	33.6	92	13.8	-0.87	55.6	34.6
1981	13.80118	5.22	NA	26.4	102	15.2	-0.01	60.7	37.01
1982	13.79734	-0.38	NA	20.5	100.4	14.7	0.07	62.5	38.02
1983	13.7787	-1.86	NA	24.8	96.3	12.4	0.41	66.8	40.77
1984	13.82844	4.97	NA	21.7	98.2	11.6	0.08	69.9	43.25
1985	13.81625	-1.22	NA	24.2	91.2	16.1	0.49	73.4	42.77
1986	13.81643	0.02	NA	23.2	91.2	18.7	-0.67	72.8	38.1
1987	13.83722	2.08	NA	21.9	90.1	16.1	-0.06	73.4	39.77
1988	13.87836	4.11	NA	22.5	93.5	12.9	-0.18	75.3	44.82
1989	13.90202	2.37	NA	22.2	94.7	14.7	0.14	77.9	47.29
1990	13.89884	-0.32	NA	18.9	94.5	14.4	-0.16	81	46.32
1991	13.88861	-1.02	NA	18.3	95.7	15.3	-0.07	93.2	46.8
1992	13.867	-2.16	NA	16.4	96	13.9	0.21	102.4	46.27
1993	13.87926	1.23	NA	16.1	95.3	9.7	0	108.2	42
1994	13.91109	3.18	4990527	16.8	97.8	9	0.01	114.3	44.77
1995	13.94177	3.07	6275351	16.5	99.3	8	0.28	119.3	44.83
1996	13.98394	4.22	8110226	16	98.5	7.4	0.83	119.9	47.79
1997	14.01006	2.61	10791224	15.2	98.8	8.6	0.57	116.2	51.14
1998	14.01522	0.52	16111532	15.2	98.9	6.9	2.56	118.2	53.04
1999	14.03853	2.33	18618331	15.7	97.4	5.1	0.41	134.4	54.93
2000	14.07924	4.07	24677939	15.6	97	5.3	1.13	133.7	51.49
2001	14.10622	2.7	36316528	15.3	96	5.7	0.73	142.3	53.34
2002	14.14225	3.6	31314309	16.7	96.2	9.2	6.14	115.1	54.02
2003	14.17131	2.91	32981740	15.7	97.7	5.8	1.33	120.7	57.64
2004	14.21585	4.45	38373074	15	100.3	1.4	0.47	132.4	57.85
2005	14.26728	5.14	51359094	14.5	100.5	3.4	0.32	144.2	61.33
2006	14.3218	5.45	105000000	14.4	102.4	4.7	2.64	163.4	65.45
2007	14.37579	5.4	317000000	14.3	102.7	7.1	0.24	167.5	69.26
2008	14.41137	3.56	494000000	15.5	103.1	11.5	2.3	147.4	69.21
2009	14.39599	-1.54	152000000	15.5	100.9	7.1	3.62	152.1	65.96
2010	14.42691	3.09	160000000	17.1	100.2	4.3	2.68	153.9	62.73
2011	14.46227	3.54	103000000	16.8	100.6	5	1.02	144.7	61.3
2012	14.48664	2.44	81685604	14.2	103	5.6	1.03	151.1	59.5

Note: GDP = Gross Domestic Product; GDP_GW= Cumulative GDP growth rates; Dervol=Derivatives volumes; Savings=Gross national saving; Expenditure=Gross National Expenditure; INFLCPI=CPI growth rates, Inflation; FID=Foreign direct investment net inflows; Privcredit=Domestic credit to private sector; M2= Money and quasi money.

Source: Compiled based on information extracted from databases of the South Africa Reserve Bank (SARB), World Bank and World Federation of Exchanges (WFE)

Appendix B: Descriptive statistics (GDP_GW & LogGDP)

GDP_Gw			
	Mean	Std. Dev	Obs.
Pre	2.407	2.460736	20
Post	2.672273	2.109154	22
All	2.545952	2.258888	42

Real GDP			
	Mean	Std. Dev	Obs.
Pre	2.618459	0.010332	20
Post	2.649926	0.014785	22
All	2.634942	0.020358	42

Appendix C: Eviews Output of the GMM Estimation

Dependent Variable: GDP_GW
Method: Generalized Method of Moments
Date: 05/31/14 Time: 16:10
Sample (adjusted): 1973 2012
Included observations: 40 after adjustments
Estimation weighting matrix: Two-Stage Least Squares
Standard errors & covariance computed using estimation weighting matrix
Instrument specification: GDP(-2) DERIV_DUM(-1) SAVINGS(-1)
EXPENDITURE(-1) INFLCPI(-1) FDI(-1) PRIVCREDIT(-1) M2(-1)
Constant added to instrument list

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	0.690665	0.251103	2.750525	0.0097
DERIV_DUM	-2.654282	2.075509	-1.278858	0.2101
D_SAVINGS	0.631906	0.346654	1.822871	0.0777
D_EXPENDITURE	0.898135	0.434769	2.065773	0.0470
INFLCPI	-0.490028	0.229513	-2.135075	0.0405
FDI	-0.487906	1.941658	-0.251283	0.8032
D_PRIVCREDIT	-0.165083	0.177402	-0.930560	0.3590
D_M2	0.057110	0.409237	0.139553	0.8899

R-squared	0.530457	Mean dependent var	2.527500
Adjusted R-squared	0.427745	S.D. dependent var	2.296421
S.E. of regression	1.737186	Sum squared resid	96.57004
Durbin-Watson stat	2.122076	J-statistic	0.789788
Instrument rank	9	Prob(J-statistic)	0.374164

Appendix D: Causality Test & Procedure

(1) Appendix D1: Regression output of the ADRL-Bounds Co-integration equations, Wald Test and Pesaran, et al. (2001)'s critical values bonds

- GDP_GW Equation (4.2)

Dependent Variable: DLNGDP_GW
Method: Least Squares
Date: 05/01/14 Time: 22:11
Sample (adjusted): 1997 2008
Included observations: 12 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	370.3549	241.6772	1.532436	0.1860
DLNGDP_GW(-1)	-0.304555	0.313095	-0.972724	0.3754
DLNGDP_GW(-2)	-0.775465	0.340418	-2.277980	0.0717
DLNDERVOL(-1)	-0.120350	1.153046	-0.104375	0.9209
DLNDERVOL(-2)	-3.255122	1.790925	-1.817565	0.1288
LNGDP(-1)	-150.8619	97.33742	-1.549886	0.1819
LNDERVOL(-1)	1.745774	0.999246	1.747091	0.1411

R-squared	0.620525	Mean dependent var	-0.014173
Adjusted R-squared	0.165155	S.D. dependent var	0.742622
S.E. of regression	0.678533	Akaike info criterion	2.353430
Sum squared resid	2.302033	Schwarz criterion	2.636292
Log likelihood	-7.120579	Hannan-Quinn criter.	2.248704
F-statistic	1.362684	Durbin-Watson stat	2.535613
Prob(F-statistic)	0.375755		

- Wald Test

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	1.606931	(2, 5)	0.2891
Chi-square	3.213862	2	0.2005

Null Hypothesis: C(6)=C(7)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(6)	-150.8619	97.33742
C(7)	1.745774	0.999246

Restrictions are linear in coefficients.

- DERVOL Equation (4.3)

Dependent Variable: DLNDERVOL
Method: Least Squares
Date: 05/01/14 Time: 22:19
Sample (adjusted): 1997 2009
Included observations: 13 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-202.1227	103.1190	-1.960091	0.0977
DLNDERVOL(-1)	1.396332	0.356982	3.911494	0.0079
DLNDERVOL(-2)	-0.618974	0.572278	-1.081598	0.3210
DLNGDP_GW(-1)	0.185012	0.125887	1.469664	0.1920
DLNGDP_GW(-2)	-0.056555	0.137767	-0.410510	0.6957
LNDERVOL(-1)	-0.888276	0.427391	-2.078369	0.0829
LNGDP(-1)	82.10559	41.57081	1.975078	0.0957

R-squared	0.845035	Mean dependent var	0.225682
Adjusted R-squared	0.690071	S.D. dependent var	0.522395
S.E. of regression	0.290824	Akaike info criterion	0.671535
Sum squared resid	0.507471	Schwarz criterion	0.975739
Log likelihood	2.635020	Hannan-Quinn criter.	0.609008
F-statistic	5.453089	Durbin-Watson stat	2.000198
Prob(F-statistic)	0.029099		

  - Wald Test

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	2.167898	(2, 6)	0.1956
Chi-square	4.335796	2	0.1144

Null Hypothesis: C(6)=C(7)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(6)	-0.888276	0.427391
C(7)	82.10559	41.57081

Restrictions are linear in coefficients.

- Pesaran, et al. (2001)'s critical values bonds

Table CI. Asymptotic critical value bounds for the F-statistic. Testing for the existence of a levels relationship[a]

Table CI(i) Case I: No intercept and no trend

	0.100		0.050		0.025		0.010		Mean		Variance	
k	$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$
0	3.00	3.00	4.20	4.20	5.47	5.47	7.17	7.17	1.16	1.16	2.32	2.32
1	2.44	3.28	3.15	4.11	3.88	4.92	4.81	6.02	1.08	1.54	1.08	1.73
2	2.17	3.19	2.72	3.83	3.22	4.50	3.88	5.30	1.05	1.69	0.70	1.27
3	2.01	3.10	2.45	3.63	2.87	4.16	3.42	4.84	1.04	1.77	0.52	0.99
4	1.90	3.01	2.26	3.48	2.62	3.90	3.07	4.44	1.03	1.81	0.41	0.80
5	1.81	2.93	2.14	3.34	2.44	3.71	2.82	4.21	1.02	1.84	0.34	0.67
6	1.75	2.87	2.04	3.24	2.32	3.59	2.66	4.05	1.02	1.86	0.29	0.58
7	1.70	2.83	1.97	3.18	2.22	3.49	2.54	3.91	1.02	1.88	0.26	0.51
8	1.66	2.79	1.91	3.11	2.15	3.40	2.45	3.79	1.02	1.89	0.23	0.46
9	1.63	2.75	1.86	3.05	2.08	3.33	2.34	3.68	1.02	1.90	0.20	0.41
10	1.60	2.72	1.82	2.99	2.02	3.27	2.26	3.60	1.02	1.91	0.19	0.37

Table CI(ii) Case II: Restricted intercept and no trend

	0.100		0.050		0.025		0.010		Mean		Variance	
k	$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$
0	3.80	3.80	4.60	4.60	5.39	5.39	6.44	6.44	2.03	2.03	1.77	1.77
1	3.02	3.51	3.62	4.16	4.18	4.79	4.94	5.58	1.69	2.02	1.01	1.25
2	2.63	3.35	3.10	3.87	3.55	4.38	4.13	5.00	1.52	2.02	0.69	0.96
3	2.37	3.20	2.79	3.67	3.15	4.08	3.65	4.66	1.41	2.02	0.52	0.78
4	2.20	3.09	2.56	3.49	2.88	3.87	3.29	4.37	1.34	2.01	0.42	0.65
5	2.08	3.00	2.39	3.38	2.70	3.73	3.06	4.15	1.29	2.00	0.35	0.56
6	1.99	2.94	2.27	3.28	2.55	3.61	2.88	3.99	1.26	2.00	0.30	0.49
7	1.92	2.89	2.17	3.21	2.43	3.51	2.73	3.90	1.23	2.01	0.26	0.44
8	1.85	2.85	2.11	3.15	2.33	3.42	2.62	3.77	1.21	2.01	0.23	0.40
9	1.80	2.80	2.04	3.08	2.24	3.35	2.50	3.68	1.19	2.01	0.21	0.36
10	1.76	2.77	1.98	3.04	2.18	3.28	2.41	3.61	1.17	2.00	0.19	0.33

Table CI(iii) Case III: Unrestricted intercept and no trend

	0.100		0.050		0.025		0.010		Mean		Variance	
k	$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$
0	6.58	6.58	8.21	8.21	9.80	9.80	11.79	11.79	3.05	3.05	7.07	7.07
1	4.04	4.78	4.94	5.73	5.77	6.68	6.84	7.84	2.03	2.52	2.28	2.89
2	3.17	4.14	3.79	4.85	4.41	5.52	5.15	6.36	1.69	2.35	1.23	1.77
3	2.72	3.77	3.23	4.35	3.69	4.89	4.29	5.61	1.51	2.26	0.82	1.27
4	2.45	3.52	2.86	4.01	3.25	4.49	3.74	5.06	1.41	2.21	0.60	0.98
5	2.26	3.35	2.62	3.79	2.96	4.18	3.41	4.68	1.34	2.17	0.48	0.79
6	2.12	3.23	2.45	3.61	2.75	3.99	3.15	4.43	1.29	2.14	0.39	0.66
7	2.03	3.13	2.32	3.50	2.60	3.84	2.96	4.26	1.26	2.13	0.33	0.58
8	1.95	3.06	2.22	3.39	2.48	3.70	2.79	4.10	1.23	2.12	0.29	0.51
9	1.88	2.99	2.14	3.30	2.37	3.60	2.65	3.97	1.21	2.10	0.25	0.45
10	1.83	2.94	2.06	3.24	2.28	3.50	2.54	3.86	1.19	2.09	0.23	0.41

(Continued overleaf)

Table CI. (*Continued*)

Table CI(iv) Case IV: Unrestricted intercept and restricted trend

	0.100		0.050		0.025		0.010		Mean		Variance	
k	$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$
0	5.37	5.37	6.29	6.29	7.14	7.14	8.26	8.26	3.17	3.17	2.68	2.68
1	4.05	4.49	4.68	5.15	5.30	5.83	6.10	6.73	2.45	2.77	1.41	1.65
2	3.38	4.02	3.88	4.61	4.37	5.16	4.99	5.85	2.09	2.57	0.92	1.20
3	2.97	3.74	3.38	4.23	3.80	4.68	4.30	5.23	1.87	2.45	0.67	0.93
4	2.68	3.53	3.05	3.97	3.40	4.36	3.81	4.92	1.72	2.37	0.51	0.76
5	2.49	3.38	2.81	3.76	3.11	4.13	3.50	4.63	1.62	2.31	0.42	0.64
6	2.33	3.25	2.63	3.62	2.90	3.94	3.27	4.39	1.54	2.27	0.35	0.55
7	2.22	3.17	2.50	3.50	2.76	3.81	3.07	4.23	1.48	2.24	0.31	0.49
8	2.13	3.09	2.38	3.41	2.62	3.70	2.93	4.06	1.44	2.22	0.27	0.44
9	2.05	3.02	2.30	3.33	2.52	3.60	2.79	3.93	1.40	2.20	0.24	0.40
10	1.98	2.97	2.21	3.25	2.42	3.52	2.68	3.84	1.36	2.18	0.22	0.36

Table CI(v) Case V: Unrestricted intercept and unrestricted trend

	0.100		0.050		0.025		0.010		Mean		Variance	
k	$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$
0	9.81	9.81	11.64	11.64	13.36	13.36	15.73	15.73	5.33	5.33	11.35	11.35
1	5.59	6.26	6.56	7.30	7.46	8.27	8.74	9.63	3.17	3.64	3.33	3.91
2	4.19	5.06	4.87	5.85	5.49	6.59	6.34	7.52	2.44	3.09	1.70	2.23
3	3.47	4.45	4.01	5.07	4.52	5.62	5.17	6.36	2.08	2.81	1.08	1.51
4	3.03	4.06	3.47	4.57	3.89	5.07	4.40	5.72	1.86	2.64	0.77	1.14
5	2.75	3.79	3.12	4.25	3.47	4.67	3.93	5.23	1.72	2.53	0.59	0.91
6	2.53	3.59	2.87	4.00	3.19	4.38	3.60	4.90	1.62	2.45	0.48	0.75
7	2.38	3.45	2.69	3.83	2.98	4.16	3.34	4.63	1.54	2.39	0.40	0.64
8	2.26	3.34	2.55	3.68	2.82	4.02	3.15	4.43	1.48	2.35	0.34	0.56
9	2.16	3.24	2.43	3.56	2.67	3.87	2.97	4.24	1.43	2.31	0.30	0.49
10	2.07	3.16	2.33	3.46	2.56	3.76	2.84	4.10	1.40	2.28	0.26	0.44

Source: Pesaran, et al. (2001), pp. 300-301

(2) Appendix D2: Granger Causality tests

- Pairwise Granger Causality test

Pairwise Granger Causality Tests
Date: 05/02/14 Time: 08:32
Sample: 1994 2012
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
D_DERVOL does not Granger Cause GDP_GW	16	2.76347	0.1066
GDP_GW does not Granger Cause D_DERVOL		2.58745	0.1200

- Granger Causality in VECM

  - with GDP_GW as dependant Variable

Dependent Variable: D(GDP_GW)
Method: Least Squares
Date: 05/02/14 Time: 10:24
Sample (adjusted): 1998 2012
Included observations: 15 after adjustments
D(GDP_GW) = C(1)*(GDP_GW(-1) - 2.8282014524E-08*D_DERVOL(-1) - 3.00914885335) + C(2)*D(GDP_GW(-1)) + C(3)*D(GDP_GW(-2)) + C(4)*D(D_DERVOL(-1)) + C(5)*D(D_DERVOL(-2)) + C(6)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.789296	0.527509	1.496269	0.1688
C(2)	-0.525900	0.593637	-0.885894	0.3987
C(3)	-0.517293	0.520030	-0.994736	0.3459
C(4)	5.21E-09	1.16E-08	0.448092	0.6647
C(5)	1.07E-09	7.99E-09	0.133487	0.8967
C(6)	-0.014727	0.455436	-0.032337	0.9749

R-squared	0.595194	Mean dependent var	-0.011333
Adjusted R-squared	0.370301	S.D. dependent var	2.220427
S.E. of regression	1.761988	Akaike info criterion	4.259937
Sum squared resid	27.94143	Schwarz criterion	4.543157
Log likelihood	-25.94953	Hannan-Quinn criter.	4.256920
F-statistic	2.646570	Durbin-Watson stat	2.185924
Prob(F-statistic)	0.096992		

- Wald Tests

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	0.158663	(2, 9)	0.8556
Chi-square	0.317327	2	0.8533

Null Hypothesis: C(4)=C(5)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(4)	5.21E-09	1.16E-08
C(5)	1.07E-09	7.99E-09

Restrictions are linear in coefficients.

- with DERVOL as dependant Variable

Dependent Variable: D(D_DERVOL)
Method: Least Squares
Date: 05/02/14 Time: 10:40
Sample (adjusted): 1998 2012
Included observations: 15 after adjustments
D(D_DERVOL) = C(1)*(D_DERVOL(-1) - 35358160.1887*GDP_GW(-1) + 106397967.188) + C(2)*D(D_DERVOL(-1)) + C(3)*D(D_DERVOL(-2)) + C(4)*D(GDP_GW(-1)) + C(5)*D(GDP_GW(-2)) + C(6)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-2.761340	0.981740	-2.812700	0.0203
C(2)	1.002175	0.764488	1.310910	0.2223
C(3)	0.310864	0.525884	0.591126	0.5690
C(4)	-62527371	39064038	-1.600638	0.1439
C(5)	-28168063	34220340	-0.823138	0.4317
C(6)	-655852.4	29969765	-0.021884	0.9830

R-squared	0.714870	Mean dependent var	-1621128.
Adjusted R-squared	0.556464	S.D. dependent var	1.74E+08
S.E. of regression	1.16E+08	Akaike info criterion	40.26434
Sum squared resid	1.21E+17	Schwarz criterion	40.54756
Log likelihood	-295.9825	Hannan-Quinn criter.	40.26132
F-statistic	4.512908	Durbin-Watson stat	2.004977
Prob(F-statistic)	0.024547		

- Wald tests

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	1.294471	(2, 9)	0.3205
Chi-square	2.588942	2	0.2740

Null Hypothesis: C(4)=C(5)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(4)	-62527371	39064038
C(5)	-28168063	34220340

Restrictions are linear in coefficients.

Appendix E: GARCH Analysis

(1) Appendix E1: EViews output showing the result of the GARCH (1, 1) estimation

Dependent Variable: GDP_GW
Method: ML - ARCH (Marquardt) - Normal distribution
Date: 05/02/14 Time: 21:56
Sample (adjusted): 1972 2012
Included observations: 41 after adjustments
Convergence achieved after 16 iterations
Presample variance: backcast (parameter = 0.7)
GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1) + C(6)*DERIV_DUM

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	2.375406	0.414548	5.730104	0.0000
GDP_GW(-1)	0.254902	0.147003	1.733991	0.0829
Variance Equation				
C	1.569161	0.657825	2.385378	0.0171
RESID(-1)^2	-0.185347	0.002461	-75.32242	0.0000
GARCH(-1)	0.953165	0.103619	9.198745	0.0000
DERIV_DUM	-0.943978	0.482055	-1.958239	0.0502

R-squared	0.038696	Mean dependent var	2.505854
Adjusted R-squared	0.014048	S.D. dependent var	2.271766
S.E. of regression	2.255753	Akaike info criterion	4.455650
Sum squared resid	198.4484	Schwarz criterion	4.706416
Log likelihood	-85.34082	Hannan-Quinn criter.	4.546965
Durbin-Watson stat	1.682159		

(2) Appendix E2: Post-estimation Diagnostic checks

- Q-test of the Mean Equation

Date: 05/02/14 Time: 22:19
Sample: 1971 2012
Included observations: 41
Q-statistic probabilities adjusted for 1 dynamic regressor

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | . |	. | . |	1	0.061	0.061	0.1647	0.685

- Q-test of the Variance Equation

Date: 05/02/14 Time: 22:16
Sample: 1971 2012
Included observations: 41
Q-statistic probabilities adjusted for 1 dynamic regressor

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
. |*. |	. |*. |	1	0.100	0.100	0.4391	0.508

*Probabilities may not be valid for this equation specification.

- LM-test of the Variance Equation

Heteroskedasticity Test: ARCH

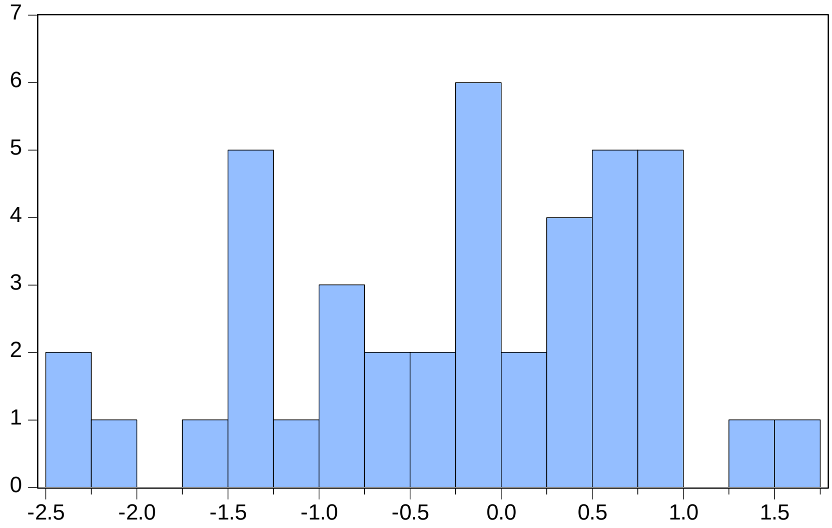
F-statistic	2.011473	Prob. F(1,38)	0.1643
Obs*R-squared	2.010896	Prob. Chi-Square(1)	0.1562

Test Equation:
Dependent Variable: WGT_RESID^2
Method: Least Squares
Date: 05/02/14 Time: 22:14
Sample (adjusted): 1973 2012
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.811973	0.269908	3.008336	0.0046
WGT_RESID^2(-1)	0.224512	0.158300	1.418264	0.1643

R-squared	0.050272	Mean dependent var	1.048563
Adjusted R-squared	0.025280	S.D. dependent var	1.359267
S.E. of regression	1.341976	Akaike info criterion	3.474871
Sum squared resid	68.43423	Schwarz criterion	3.559315
Log likelihood	-67.49741	Hannan-Quinn criter.	3.505403
F-statistic	2.011473	Durbin-Watson stat	1.956852
Prob(F-statistic)	0.164263		

- Residuals distributional normality: The Jarque-Bera (JB) statistic test



Series: Standardized Residuals
Sample 1972 2012
Observations 41

Mean	-0.222313
Median	-0.123514
Maximum	1.578035
Minimum	-2.336889
Std. Dev.	1.007695
Skewness	-0.381754
Kurtosis	2.252996
Jarque-Bera	1.949137
Probability	0.377355