The reaction of South African markets to the global financial crisis

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ABSTRACT

The aim of this research was to explore the impact of the global financial crisis on South African markets.

The results of the research indicate the existence of market linkages between United States and South African markets and that the global financial crisis did have an impact on South African markets. The impact on the financial stocks in S.A. was however, not as significant as that recorded in the U.S.

The findings of the research point to a high degree of correlation at the main index level, which high co-movement is not replicated proportionally at the financial index level. This provides useful information to investors approaching portfolio diversification through use of stock participation in different countries. On an S & P 500 to ALSI level portfolio diversification gains may not be as strong as envisaged but at the S5FINL versus the FINI15 level some opportunity for diversification, albeit still in financial stocks, can be found.

DECLARATION

I, Sithela Vusumuzi Mpofu, declare that this research report is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

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Sithela Vusumuzi Mpofu

15 April 2010

DEDICATION

To Thandiwe, Nanziwe and Mbali for all their patience and sacrifice, that has allowed me to follow this path.

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- My colleagues in the MBA class who have made an indelible impression on my life; and
- My teachers of 35 years in school, work and life, who have taught me all I know.

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1 INTRODUCTION

In a time of unprecedented turmoil in world markets this research investigates the reaction of South African markets to the 2008 global financial crisis. The effects on South African markets are investigated through an analysis of stock market co-movements. Particular focus is placed on the reaction of South African equity markets to events in the global financial markets tumult, which originated primarily from the sub-prime mortgage failures in the United States.

Grantham (2003) notes that in 27 cases of "classic asset bubbles" – not unlike the sub-prime instruments that triggered the 2008 financial crisis, "every single one retracted all of the gain (and went) all the way back to the original trend line". The bull-run evident in bourses the world over prior to the precipitation of the global financial crisis should have raised some danger signals, given the lessons of the past, as pointed out by Grantham.

Panzner (2005:261) concurs with Grantham, highlighting somewhat prophetically the very real and heightened risk of a major financial 'accident' taking place to impact investors globally, over the next few years. He goes on to add that,

> *"the widespread acceptance of venturesome behaviour; the complexity of instruments and portfolios that depend on significant computational analysis for valuation, monitoring, and assessment; the dispersion of risk through the use of derivatives and other synthetic instruments … all seem to boost the odds that something may eventually go spectacularly wrong"*

Indeed this scenario came to pass in 2008 with the sub-prime mortgage crisis sparking a chronic financial meltdown and plunging the world economy into recession.

1.1 Purpose of the study

The specific purposes of this research are as follows. One is to highlight the possible causes of the 2008 global financial crisis. Two is to identify key events in global markets over the period of study and point out how these have impacted South African financial markets. The third purpose is to include an analysis of interest rate spreads as indicators of market liquidity over the period under review. Specific to studying the reaction of South African markets to the global financial crisis cross-market correlations between stock indices in South Africa and the United States are analysed.

Broadly speaking, reactions on South African markets will be assessed with critical reference to the efficient market hypothesis formally proposed by Fama (1970).

1.2 Problem statement

The effect of events on markets is generally measured through the pricing of individual shares and in aggregate, specific sector indices. King and Wadhwani (1989) note that stock prices generally reflect market fundamentals.

Central, to market theory is the concept of diversification. Such diversification has typically been achieved through investment in different companies, different industry sectors and different stock markets across the globe. This strategy is premised on less than perfect correlation between the different investment environments as a function of the different risks and returns prevailing therein.

Studies show that global markets are becoming increasingly integrated and co-dependent. If investment decision are made without due consideration of market linkages, then investors are likely exposed to the risks of an undiversified portfolio. In the case of investments in stock exchanges in different countries, the exposure is to the potential negative effects of market contagion. Kaminsky *et al*, (2003) refer to contagion "as an episode in which there are significant *immediate* effects in a number of countries following an event".

The research to be conducted explores the linkages between different markets to determine their strength and propose strategies to mitigate the problems that such high contagion may cause. This analysis of international stock index linkages is conducted over a period of the most recent global financial crisis (i.e. the U.S. sub-prime originated debacle) where the transmission of identified shocks is to be used to measure the degree of contagion.

1.3 Objectives of the study

The identifiable objectives of this research follow from the above stated problem of likely repercussions of not factoring the increasing contagion of financial market

shocks in financing and investment decisions – whether such decision is in the local or international context.

Specifically the study is designed to;

- Highlight the possible causes of the global financial crisis
- Empirically identify structural breaks in global financial markets to ascertain whether these coincide with key reported events in the global financial crisis.
- Analyse interest rate spreads in the United States and in South Africa, as indicators of market liquidity in each country to compare conditions in the two environments prior to the crisis.
- Compare cross-market correlations between the Johannesburg Securities Exchange All Share Index (ALSI) and Standard and Poors 500 (S & P 500), before and after the crisis events identified to determine whether there are any statistically significant changes in cross-market correlations.
- Measure the ß co-efficients of the financial indices on the S & P 500 and the ALSI over the period of study to determine whether there are statistically significant changes over the crisis events identified.

1.4 Possible benefits of the Research

The study fills a gap in that it indicates whether or not South African markets are affected by global events and if so to what degree. In addition, the research ascertains whether or not South African financial institutions have fared better

than their global counterparts as events have unfolded. In comparing the effects of the financial crisis on financial institutions abroad and locally, factors contributing to the variation in the impact are identified. A better understanding of the degree of intensity of linkages South African markets have with global markets is valuable in the derivation of diversification and general global investment strategies.

Another benefit of the research is the potential value of the findings in managing country-specific risk. Information about the impact in a country due to events occurring globally enables market participants to formulate strategies from more informed perspectives, which strategies, if indeed superior, must ultimately translate into more profitable business decisions. This study focuses on the possible causes and the first wave of effects, as shown in Figure 1.

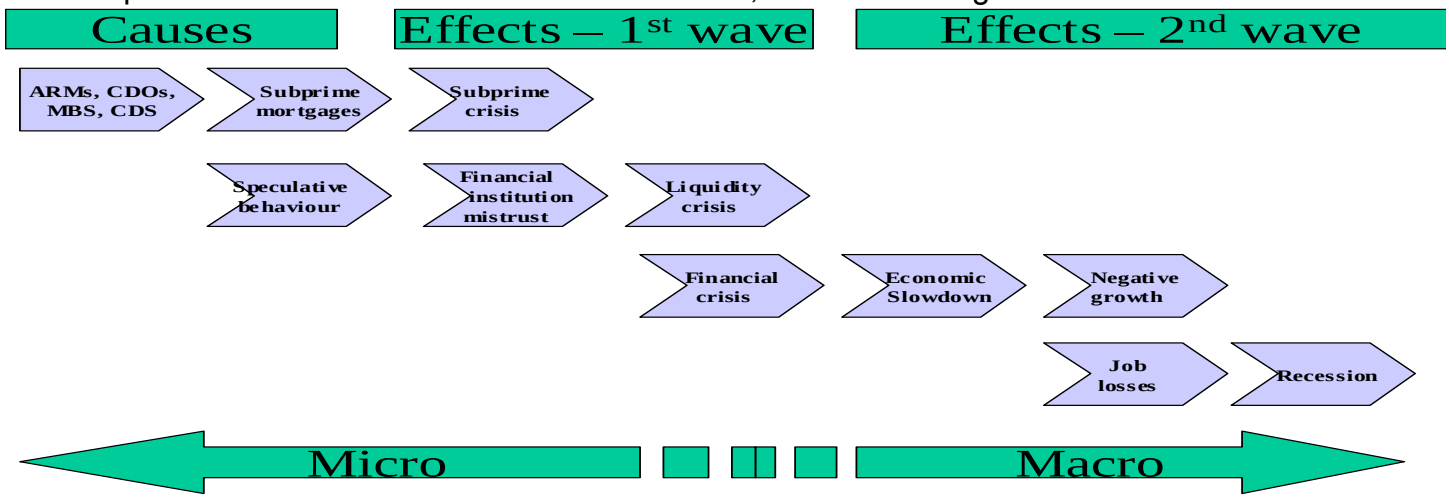

Figure 1. Causes and effects of the global financial crisis.

1.5 Delimitations and limitations of the study

1.5.1 Delimitations of the study

The following delimitations will apply:

- Impacts on markets are many and varied and are of both a macroeconomic and micro-economic nature. This study focuses mainly on the micro-economic impacts as reflected in stock markets. However, discussions on regulatory frameworks and monetary policy are included as facets to enhance the analytical review of the research findings;

- The empirical identification of key events in the global financial crisis and the analysis of linkages between the ALSI and S & P 500 spans the period June 2007 to October 2009;

- In testing hypotheses specific to the incidence of comparable conditions in South Africa, as existed in the United States prior to the global financial crisis and during the turmoil, the analysis of interest indicators conducted was from June 2007 to October 2009;

- With respect to the hypotheses proposed to test assertions on the behaviour of the stock markets, the study confined its investigations to periods of no longer than eleven days, being the day of the event E_0 and event day minus five, E_{0-5} and event day plus five E_{0+5}; and

- The analysis of results, which although it includes discussion on the market efficiency of the ALSI, establishes no conclusions in this regard.

1.5.2 Limitations of the study

The following limitations will apply:

The interpretation and conclusions derived from the results of the study may not be extrapolated wholly to other emerging markets owing to:

- the unique regulatory environment prevailing in South Africa, with specific reference to South African Reserve Bank Exchange Control Regulations and the National Credit Act No.34 of 2005;

- the South African banking sector was well ahead of its global peers, certainly the United States, in its implementation of Basel II guidelines especially with respect to minimum capital requirements; and

- the results obtained in this study relating to the specific research methodology and research analysis techniques used, and possibly not concurring with results using alternative procedures.

1.6 Definition of terms

Bank liquidity premium

Hibbert, Kirchner, Kretzschmar, Li, McNeil and Stark (2009) define the bank liquidity premium as the difference between the 1Yr swap rate and the 1Yr deposit rate.

ß coefficient

Brown and Warner (1985) define the ß coefficient as the coefficient attributed to systemic risk, i.e. that component of total risk that cannot be diversified away. In this study the beta coefficient of the financial index measures how sensitive the rate of return on the financial index is to changes in the overall market.

Contagion

Kaminsky *et al*. (2003) refer to contagion "as an episode in which there are significant *immediate* effects in a number of countries following an event".

Cross-market correlation

The correlation coefficient between two or more markets.

Financial crisis

Sundarajan and Balino (1991) note that a financial crisis, generally manifests itself through widespread insolvencies in the financial sector leading to significant government intervention. When this happens on an international scale then a crisis can be described as global.

Markets

For the purposes of this research markets include:

- selected interest rate markets such as the inter-bank market, 1 year swap markets and 1 year deposit markets; and
- stock markets, namely the Johannesburg Securities Exchange All Share Index (ALSI) and the New York Stock Exchange Standard and Poors 500 (S & P 500).

Reported event

An event published in print or electronic media relating specifically to the global financial crisis. In this research these were identified primarily from reputable financial publications and verified from official websites as shown in Appendix I, Key Reported Events in the Global Financial Crisis.

Structural break

Heizer and Render (2008) explain a structural break as a point in an economic time series where the parameters of the underlying model change. Specific to this research, this is where the daily returns on the S & P 500 (DR) exceed +/- 3 standard deviations ($3\sigma_{DR}$) of the mean daily return of the observations considered ($\overline{DR}$).

1.7 Assumptions

Those aspects of the research that relate to the stock exchange are premised on the following:

- Stock prices accurately reflect all information available to market participants as noted by Fama (1970);
- Stock prices respond immediately to all information available to all market participants as noted by Fama (1970); and
- No other events occur over the eleven-day window of investigation. These would typically be macroeconomic factors such as political instability, statutory and regulatory changes, changes in sovereign risk ratings, changes in interest rates or in monetary policy and other factors that influence emerging market positive appetite or risk aversion, which would invariably contaminate the results.

2 LITERATURE REVIEW

2.1 Introduction

This literature review provides background to the problem and objectives noted in Chapter 1.

The possible causes and effects of the global financial crisis are presented and discussed. In turn, key events in the crisis as it unfolded, are identified. Special care is taken in the literature review to focus on events emanating from the financial markets. It is important throughout the study to accept the catalytic role that the turmoil in the financial sector has played in precipitation to global recession, without delving deeply into pure macroeconomic metrics but rather to focus more on the impact, as evidenced in the markets.

In assessing the impact on South African markets of the global financial crisis, issues are raised on the factors or enabling environment in the respective markets that may have had a bearing on the crisis and its impact. Regulatory regimes prevailing in various markets globally, their degree of comparability and the effect such regulation may have had in different territories or types of markets, are discussed with a view to aiding interpretation of research findings. Interest rate spreads as an indicator of liquidity in the various markets and their role in the crisis as a whole, are also examined. This forms the foundation for the interpretation of findings with regard to the analysis of cross-market correlations between the ALSI and S & P 500.

The literature forms the basis of hypotheses formed and is interpreted with reference to the efficient market theory as formally proposed by Fama (1970).

2.2 Definition of topic or background discussion

This section outlines the historic main causes of financial crises. Drawing from various literature sources the discussion considers various factors before focusing on those at the centre of the sub-prime financial crisis triggered in 2008.

According to Roubini (2008), financial crises take many forms, including:

- currency crises;
- sovereign debt crises;
- systemic banking or financial crises; and
- systemic household debt crises.

This research focuses on the latter two defined as follows by Roubini (2008):

> A *systemic banking or financial crisis* is that which "occurs when a significant number of financial institutions (banks or non-banks) become financially distressed and need to be closed down, merged or restructured". A *systemic household debt crisis* "occurs when a large number of households are unable to service their debts (mortgages and consumer credit)"

Some definitions of financial crises explicitly include the influence of economic bubbles. Falkena, Bamber, Llewellyn and Store (2001) identify unrealistic

expectations and euphoria about the economic prospects of a country and sharp unsustainable rises in asset prices, leading to unrealistic demands for credit entertained by banks, as two of the conditions that tend to precede a crisis.

Speculative bubbles occur when asset prices collapse after a period when they have not been priced in accordance with their underlying intrinsic value. The 2008 financial crisis manifested through the *sub-prime crisis* preceded by a collapse in the price of sub-prime assets and a *global credit crunch*.

Another recurrent theme in identifying the causes of the global financial crisis is the part played by a weak or inadequate regulatory regime. The Managing Director of the International Monetary Fund (IMF), Dominique Strauss-Kahn (2008), highlights “a regulatory and supervisory failure in advanced economies” as one of the factors that resulted in the financial crisis.

2.3 Identification of the possible causes and effects of the global financial crisis

Prior to identifying the key events that have served as milestones as the crisis has unfolded, the research identifies possible causes and effects.

Falkena et al, (2001) summarise the main causes of financial crisis as:

- poor risk analysis by banks;
- weak internal control systems;
- connected lending;

- insufficient capital;
- ineffective regulation;
- weak monitoring and supervision by regulatory authorities; and
- weak internal governance.

Elements of all these factors were evident in the 2008 financial crisis, but it is important to note that crises of this ilk usually combine both micro and macro-economic factors. For the purposes of this research, the focus was on micro-economic factors.

Lane (1999), writing in the aftermath of the Asian Financial Crisis, cites amongst the causes of that particular crisis:

- substantial rises in equity and real estate prices, increasing the likelihood of a sharp deflation in asset prices;
- poor allocation of credit, contributing to increasingly visible problems at banks and other financial institutions;
- ineffective financial supervision and regulation; and
- monetary policies that allowed domestic credit to expand at breakneck pace.

These observations find resonance throughout the literature and in this review are approached from three broad angles as follows:

- sub-prime instruments;

- regulatory environments; and
- Interest rates as indicators of liquidity.

The comparison between the U.S. and S.A. financial regulatory environment was included to assist in interpretation of results. No hypothesis or research was proposed in this regard. The comparison of interest rate spreads is conducted to ascertain whether credit conditions in S.A. markets have been similar to those in U.S. markets. In reporting the findings of this analysis it is important to note that correlation or lack there-of will be reflective of multiple factors, which cannot be considered in their entirety for both countries in a research project of this nature. However, substantive determination on the similarity of liquidity conditions in the two markets will be possible.

2.3.1 Sub-prime crisis

The sub-prime crisis was a result of an increase in mortgage defaults on loans issued in the sub-prime market.

DiMartino and Duca (2007) distinguish between prime and sub-prime mortgages as summarized in Table 2.1.

Table 2.1. Distinctions between prime and sub-prime mortgages

Prime mortgages	Sub-prime mortgages
Type of borrower • Good credit history • Income is fully documented • Default risk is low • Traditionally a deposit is paid at inception of the loan	Type of borrower • Least creditworthy, with poor credit scores • Uncertain income prospects • High default risk and high interest rates • No deposit is paid at inception of the loan

Looking at the basic definition of a sub-prime mortgage, the rationale for issuing such a loan is hardly apparent. What then facilitated the phenomenal growth in the sub-prime market? The answer to that question begins with securitisation.

2.3.1 a Securitisation

Securitisation involves bundling loans into packages that are then sold to outside investors. The bundling up in this case, involved the aggregation of a portfolio of mortgages of different qualities to diversify the risk attributable to those with the lowest ratings. The major instruments used to securitise sub-prime loans were collateralized debt obligations (CDO) in the form of asset backed securities (ABS) or in this case, mortgage backed securities (MBS). Weaver (2008) notes a typical securitisation process as follows:

Initiation of loans by a bond originator before onward sale to a financial institution – this separation of loan ownership and origination invariably compromised the

quality of the loans. The broker was incentivised on volumes rather than on acceptable standards of risk assessment.

Mortgages pooled together were then sold into a trust, and in turn issued as sub-prime mortgage backed securities and sold to investors around the world.

Many of the debt instruments like the mortgage-backed securities were purchased through off balance sheet entities thus enabling financial institutions to circumvent capital adequacy provisions. As the model began to unravel the spectre of these assets returning to the balance sheets of the financial institutions appeared as a prominent cause of the crisis as it took shape.

Greenspan (2008), addressing the House of Representatives Committee on Oversight and Government reform, singled out unrealistically positive rating designations by credit agencies as core to the problem.

The reliance placed by investors on the ratings cannot be under estimated. Many of the sub-prime MBS were rated triple-A, and investors “may not have fully understood the credit risk in the underlying loans or many have felt that, by virtue of their position in the capital structure (and the ratings), they were sufficiently insulated from the mortgages’ credit quality” Weaver (2008).

The success of the sub-prime markets, although largely fuelled by a housing bubble in the United States, was also made more commercially acceptable by another prime suspect, credit default swaps.

2.3.1 b Credit Default Swaps

Brown (2008) describes credit default swaps (CDS) as insurance-*like* contracts that are sold as protection against default on loans. Emphasis is placed on the *like* because CDSs are not regulated, as is the case with insurance companies and are not subject to reserve requirements, statutory limits and scrutiny that would require demonstration of capability to cover potential claims. Morrissey (2008) notes that the lack of regulation allowed trading between investors without appropriate supervision of the underlying risks. This fact meant that instruments quickly become very opaque, in terms of linking the potential rewards or benefits to the potential risks. Morrissey (2008) builds on the notion that this opacity makes it difficult for the "insured or hedged" party to be able to identify the counter-party and indeed determine that counter-party's ability to make good in the event of a default. Morissey (2008) highlights the absence of transparency in the CDS market, as credit defaults began to come through from the sub-prime mortgage environment, as a major contributing factor to the credit crunch and general liquidity strain in the inter-bank markets.

Koseff cited by McNulty and Bisseker (2008), and Kruger cited McNulty and Rose (2008) make the now anecdotally, accepted assertion that there was no compelling evidence of similarities between the U.S. mortgage markets and South African mortgage markets in the years leading up to the crisis and during it, with respect to lending criteria and environs. No statistical confirmation has been presented either to support or dispel this assertion. While it is accepted that the root cause of the global financial crisis was the sub-prime debacle, its spill over from the U.S. was not premised on the existence of similar conditions in other

countries. Indeed, this is true of South Africa and many emerging market economies, but the effects were felt across the globe. This observation is also made by Falkena *et al.* (2005) who note that specific markets even if well regulated and financially sound may be adversely affected by distress in other markets.. This study investigates to what degree these effects were evident in South African markets.

2.3.2 Regulatory framework

Regulatory regimes invariably come under greater scrutiny when economic or financial crises occur. In determining the effects of the global financial crisis on South African markets, this research makes a high level comparison of the regulatory framework of financial markets in the United States, the epicentre of the crisis, and the framework in South Africa. The comparison is intended to aid interpretation of the findings in respect of effects on South African markets.

Falkena *et al.* (2001) identify the major components of a financial system as:

- financial instruments;
- markets in which these instruments trade; and
- market participants.

This classification is extended to the proposal of a regulatory framework.

2.3.2 a Regulatory framework in South Africa

2.3.2a i Regulation of financial instruments

Falkena *et al.* (2001) note that historically, the issue and trading of financial instruments has been subjected to market discipline only and has remained largely un-constrained in terms of official regulation. Figure 2.1 illustrates the regulation of financial instruments in South Africa. The figure has been revised to include developments after the date of publication of the original report.

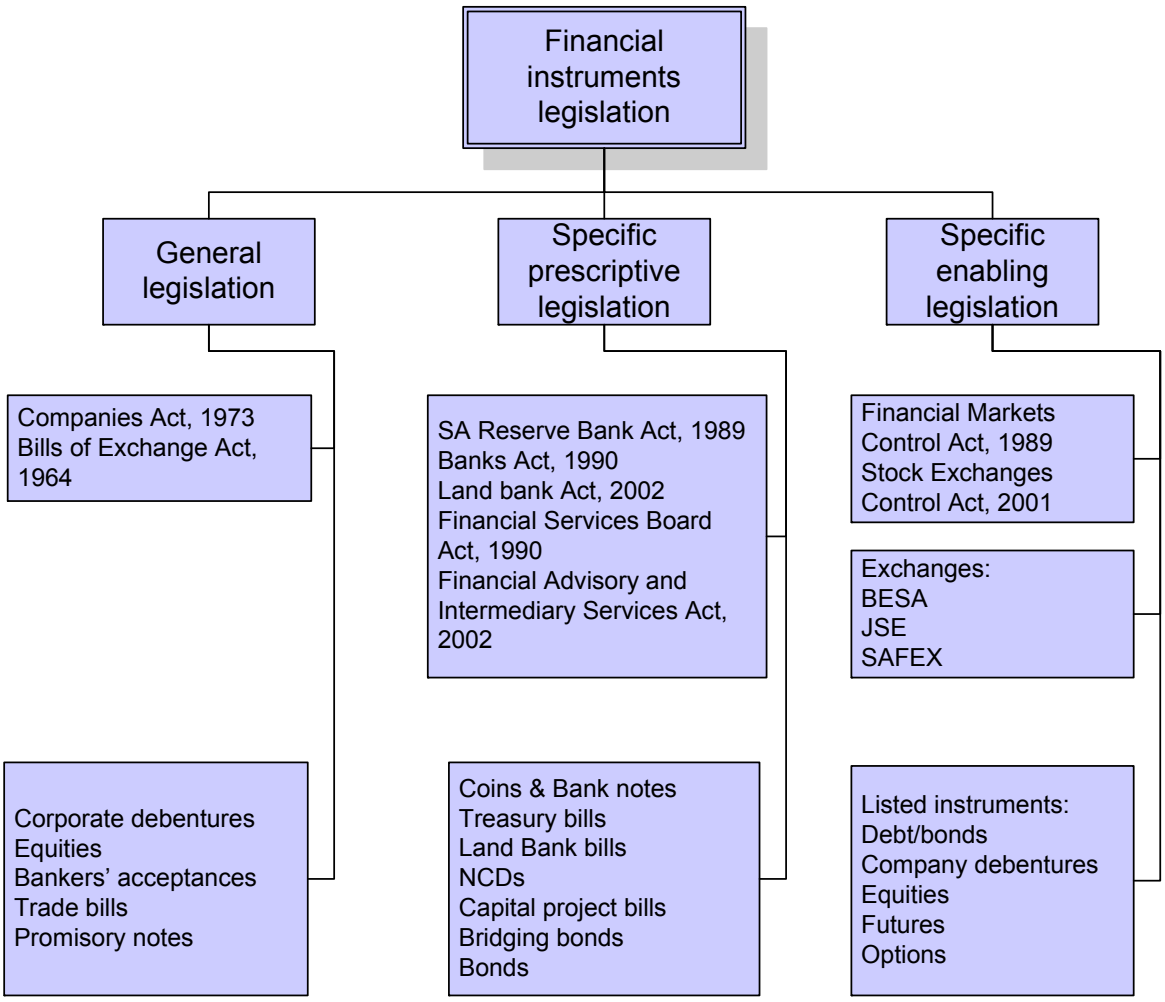

Figure 2.1: Regulation of financial instruments

Adapted from framework proposed by Falkena et al. (2001)

2.3.2.a ii Regulation of markets in which these instruments trade

Falkena *et al*. (2001) represent the regulatory structure of the markets in which instruments are traded as shown in Figure 2.2, Regulatory structure of exchanges. Again this has been modified to include developments from the time of initial publication.

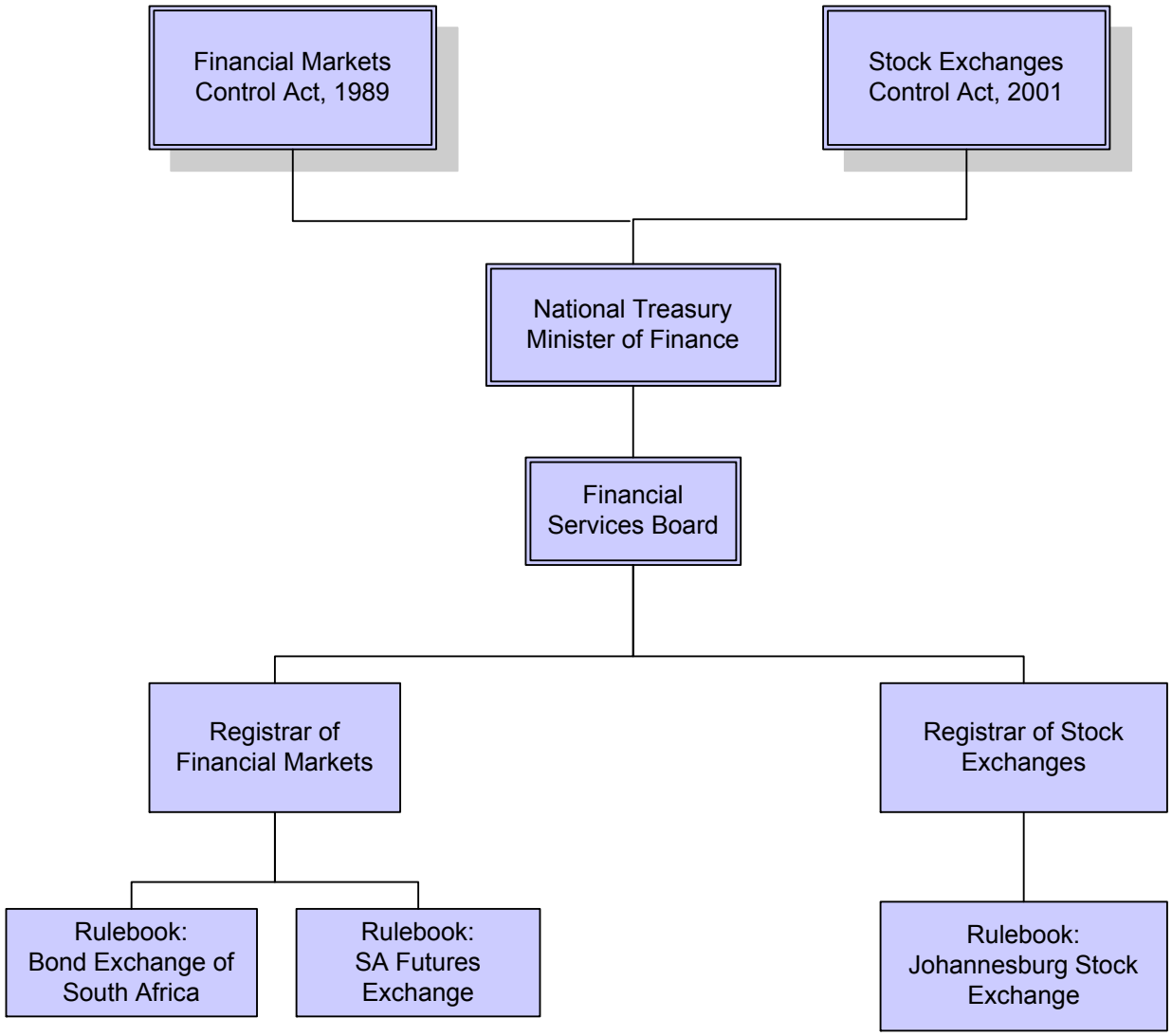

Figure 2.2: Regulatory structure of exchanges

Adapted from framework proposed by Falkena et al. (2001)

2.3.2.a iii Regulation of market participants

The regulation of market participants, much like the instruments and markets in South Africa, are increasingly being regulated according to minimum international standards prescribed by global bodies such as the International Accounting Standards Committee (IASC), the Basel Committee on Banking Supervision (BCBS), the International Organisation of Securities Commissions (IOSCO) and the International Association of Insurance Supervisers (IAIS). Falkena *et al*. (2001) note that "financial institutions are monitored and supervised by their respective registrars" in line with global best practice and guidelines. The Statutory regulation of financial intermediaries and advisers in South Africa is illustrated in Figure 2.3.

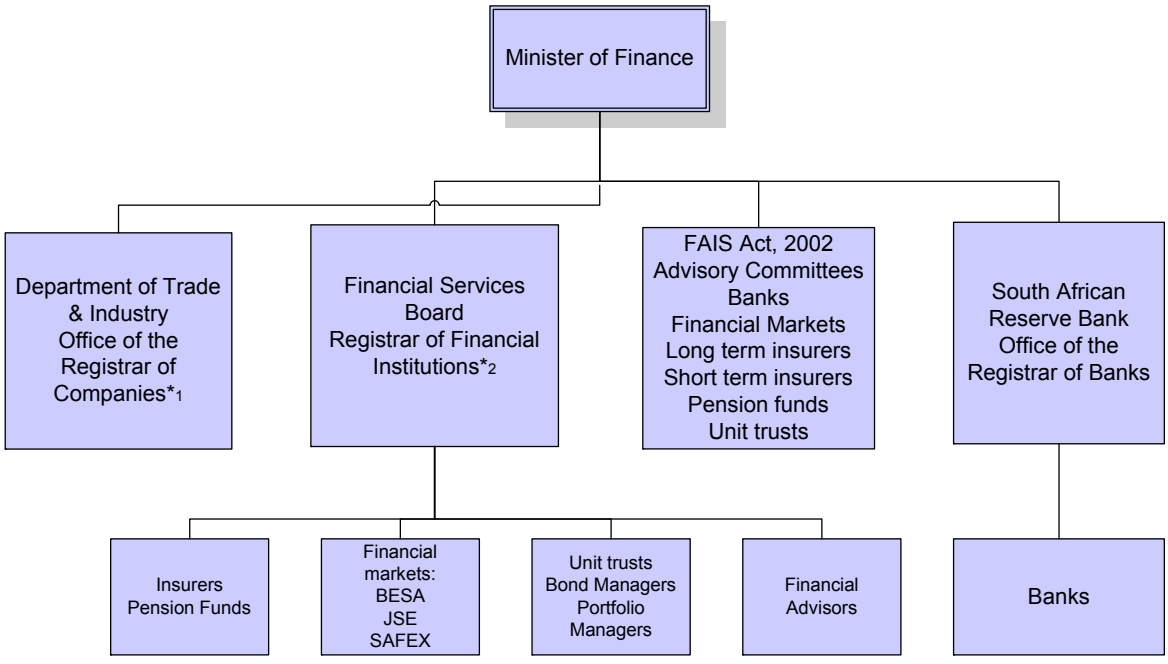

Figure 2.3: Statutory regulation of market participants in South Africa

*[1]The Office of the Registrar of Companies falls under the Department of Trade and Industry [*2]The Registrar of Financial Institutions encompasses the Registrars of: Stock Exchanges, Financial Markets, Insurers, Pension funds and Unit Trusts. *Adapted from framework proposed by Falkena et al. (2001)*

The regulatory framework in South Africa also incorporates the Exchange Controls Regulations, which the Minister of Finance has delegated to the officers of the South African Reserve Bank; and the National Credit Act, 2006, which primarily aims to protect consumers taking credit or entering into consumer credit transactions, and which is administered by the National Credit Regulator.

In addition, The National Credit Act makes provision for the control and regulation of all credit transactions, including mortgages, credit cards, overdrafts, micro-loans and pawn broking transactions. The Act also regulates all institutions that provide consumer credit, including banks, furniture companies, clothing and other retailers, micro-lenders and pawnbrokers.

A holistic view of the regulatory factors that will have impacted South African markets as global events unfolded, is important for the interpretation of the findings of this research.

Figure 2.4 illustrates the broad regulatory framework in the United States. It shows the host of regulatory bodies in the United States that currently oversee the financial industry. The pertinent question is whether the regulators and regulations in their current form are sufficient to signal or completely avert crises of this particular nature in the future. Rogoff (2008) notes the need for evolution of the regulatory environment, especially with regard to increased capital requirements and more transparency in the markets.

This research aims to identify the possible causes of the global financial crisis. If these causes are indeed rooted in certain financial instruments, the markets in which they trade or in the behaviour of market participants, it may be possible to identify gaps in the regulatory environment of financial markets.

A review of the regulatory frameworks presented for the two countries does not reveal any significant variance in approach but a number of changes in the US framework in the past ten to fifteen years suggest a policy trajectory towards greater financial institution self-regulation if indeed not deregulation, in many spheres of the banking environment. Barth, Brumbaugh and Wilcox (2000) raise this point in their analysis of the repeal of the Glass Steagell Act in November 1999, which ultimately changed the terrain of global banking and no doubt contributed to the precipitation of the global financial crisis. This act ensured clear limits in the activities of commercial banks and investment banks. The repeal of the act to be replaced by self-regulated Chinese walls in financial institutions, allowed investment banks to become commercial banks and vice versa. This unleashed massive leveraging that fuelled market liquidity and the excesses that followed. Stiglitz (2009) notes this and cites further deregulatory tendencies such as revision of capital adequacy ratios for investment banks in 2004, as another regulatory failure that contributed to the crisis. Conversely the South African environment has over the same period of time operated under tight exchange control regulations as well as the fortuitously implemented, (with regard to timing), National Credit Act promulgated in 2005. In addition the South African banking sector as promulgated through South African Reserve Bank Regulations in January 2008, has implemented the Basel II guidelines especially with respect to

minimum capital requirements more speedily and stringently than its peers globally.

Regulatory framework in the United States

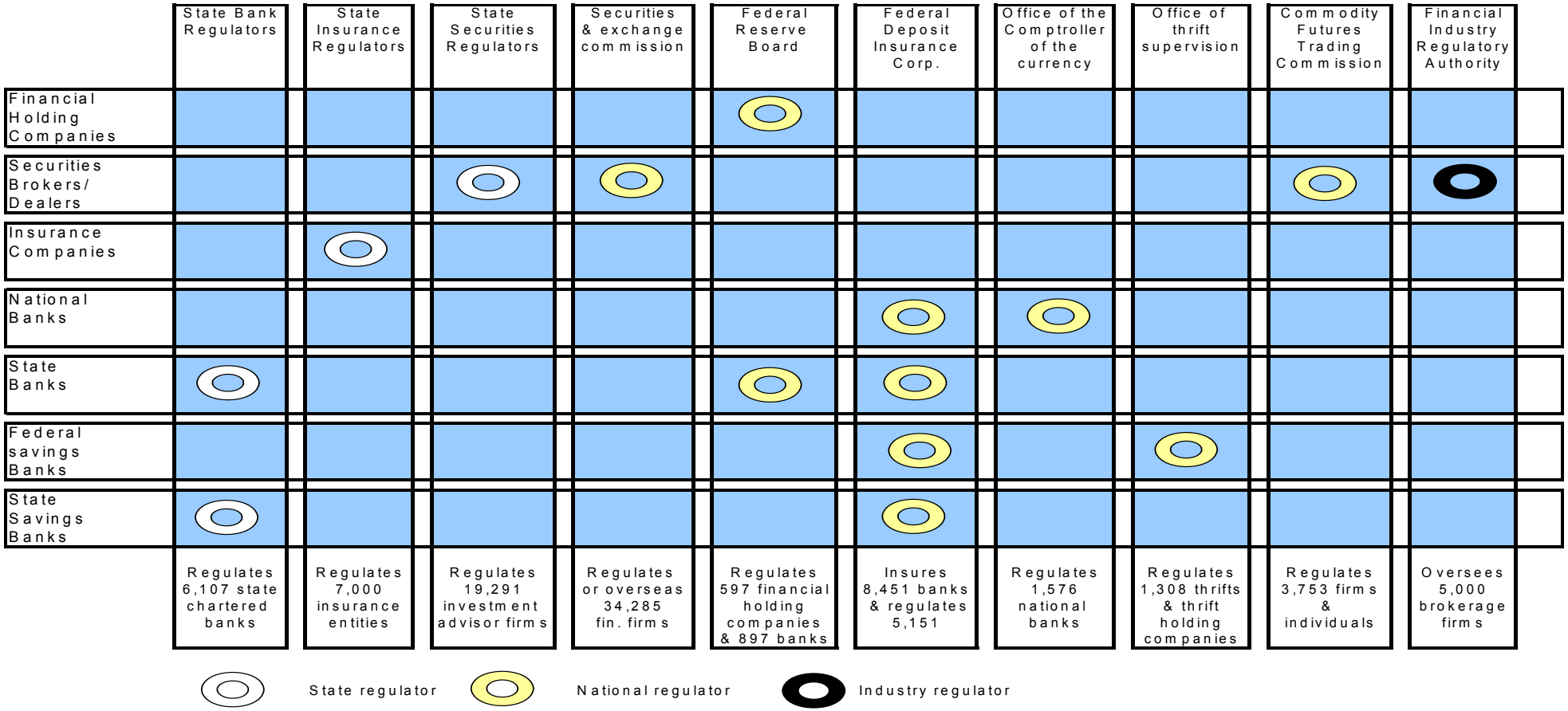

Figure 2.4: Financial Industry Regulators in the United States Cendrowski and Levenson (2008) Fortune October 2008.Sources: National Information Centre, FDIC, Federal Reserve Board, James R. Barth, Conference of State Bank Supervisors, National association of Insurance Commissioners, North American Securities Administrators Association, Sec. Office of Thrift Supervision, National Futures Association, Financial Industry Regulatory Authority. Information is current as of 26 September 2008.

2.4 Identification of structural breaks in global financial markets to ascertain association with reported global financial events

The identification of structural breaks in economic cycles and financial markets has been studied by various scholars, primarily in a bid to construct early detection models to pre-empt the breaks and thus implement reactive strategies before other market participants to best advantage. Ergashev (2004) compares the efficacy of three procedures used in the detection of change points in economic time series. A change point is defined as moment in time when the parameters of the underlying model change. He considers the following:

- Shiryayev – Roberts;
- Cumulative sum (CUSUM); and
- Exponentially weighted moving averages (EWMA)

The finding is that the different techniques perform with varying degrees of efficacy depending on the variable used in the analysis. The study highlights Chow tests as the most well known for structural change analysis but notes an important limitation, in that the change point must be known *a priori.* Nefcti (1982) also accepts this assumption in using Shiryayev's optional Bayesian detection rule.

Statistical process control (SPC) has for many years been used in engineering and manufacturing environments as a quality control tool. A stable process or

cycle is in a state of statistical control if the points are within the control limits. The control limits are set at +/- 3 standard deviations from the centreline, which represents the mean of all the observations.

Shewhart (1925, 1931) pioneered the concept in his work in *The Application of Statistics as an Aid in Maintaining Quality of a Manufactured Product (1925)* and *Applications of Statistical Method in Engineering (1931).*

Over time SPC has been applied to financial time series data. Hubbard (1967) employed control charts to study post-war stock price levels. He describes a control chart as “a statistical tool for the identification of significant shifts in a series of measurements from a continuing process”. Hubbard notes that a control chart accepts the hypothesis of the random walk model near the central line, but also assumes a high probability of significant shifts in stock price levels close to the control limits. Accepting that price levels at the control limits are not as random as near the central line means that this information translates into knowledge, which if applied appropriately will yield superior profits.

Alwan and Roberts (1988) explain that once a state of statistical control has been achieved, it is possible to identify deviations from the *in control* state by plotting and viewing data on a variety of control charts. The charts proposed include Shewhart, cumulative sum (CUSUM), exponentially weighted moving average (EWMA) and moving averages. Invariably, the objective is not only to identify the departures from a state of control but also to explain these departures. In this study the objective is to identify structural breaks and ascertain whether there is an association with reported key global financial events. This is a study in

assignable cause as introduced by Shewhart (1931) or in *special cause* as described by Deming (1982).

Andreou and Ghysels (2002) highlight the importance of recognising structural breaks or change points in financial risk management. Schmid and Tzotchev (2004) apply SPC techniques, particularly control charts, to sequentially detect changes in underlying parameters to signal structural breaks in interest rate cycles. Andersson, Bock and Frisen (2004) monitor business cycle turning points using SPC with the underlying parameters being movements in stock indices. They note that a turn in a leading index can be used to predict a turn in the business cycle. In this report similar techniques are applied, not with predictive intent, but rather to confirm *a priori* occurrence of a structural break. Golosnoy and Schmid (2008) note that SPC is useful for the detection of changes in the parameters of a process of interest. They go on to add that a control chart signals statistically significant changes in the process parameters. Accordingly, decision makers can then investigate the possible causes and effects of the signal or change point.

This research studies the impact of the global financial crisis on South African markets. The study was preceded by a scientifically derived measure of the crisis or the constituent events that cumulatively represent the global financial crisis. This research report employs SPC techniques in their simplest form to scientifically identify the structural breaks, which indicate the crisis events and periods, which then constitute the focus of the study.

To identify structural breaks in global financial markets and ascertain whether a relationship to reported global financial events exists, the first step is to determine whether or not SPC will identify structural breaks in the S & P 500 daily returns data, and the second step will be to determine whether the breaks identified are associated with reported key events in the global financial crisis.

Hypothesis 1

Therefore, in applying the test for structural breaks the null hypothesis states:

H_0: There are no structural breaks in the observed time series of daily returns over the period under review

Such that $H_{0:}$ DR ≤ UCL

The alternative hypothesis states:

H_A: There are structural breaks in the observed time series of daily returns over the period under review.

Such that $H_{A:}$ DR > UCL

Where DR **=** daily returns on the S & P 500 (difference between day end close over consecutive stock trading days)

And UCL = upper control limit (defined in section 3.4.1)

Hypothesis 2

To determine whether the breaks identified are associated with reported events in the global financial crisis, a simple regression between structural breaks identified

in Hypothesis 1 and reported events in the global financial crisis is conducted. This test is presented mathematically as follows:

$$SB = \alpha RE + K \qquad \text{Equation 2.4.1}$$

Where SB = structural break identified in hypothesis 1.

RE = a reported event in the global financial crisis.

α = factor defining degree of association.

K = linear equation constant

This test is for α, the factor that defines the degree of association. A similar approach is adopted by Steeg, Robinson and Willis (1998) in their study of coincidence of detection.

The null hypothesis states:

H_0: There is no association between structural breaks in the S & P 500 and reported key events in the global financial crisis.

Such that: $H_{0:}$ $\alpha = 0$

The alternative hypothesis states:

H_A: There is an association between structural breaks in the S & P 500 and reported key events in the global financial crisis.

Such that: $H_{A:}$ $\alpha \neq 0$

2.5 Interest rate indicators

One of the critical symptoms of the global financial crisis was the deterioration in market liquidity across global markets. As levels of mistrust grew amongst market participants the flow of funds in the system was severely encumbered.

Roubini (2008) suggests that failures in United States monetary policy contributed to the housing bubble, which eventually triggered the severe liquidity and credit crunch. A comprehensive analysis of monetary policy is not undertaken but interest rate premiums as indicators of market liquidity are correlated. The evolution of *bank liquidity premiums*, defined as the spread between the 1Yr Swap rate and 1Yr deposit rate in both markets, are analysed as the crisis unfolded. This analysis is conducted over a 2-1/2-year period to determine the degree of correlation between U.S. bank liquidity premiums and S.A. bank liquidity premiums.

Ideally the comparison would have been made using overnight indexed swaps (OIS). In the U.S. LIBOR - OIS spreads and in South Africa, Rand Overnight Deposit Swaps (RODS). Unfortunately, RODS were discontinued a few years after their 1996 introduction on the back of low interest and volumes of trades that never reached the levels envisaged for a viable market.

Hansen (2008) explains the relationship between LIBOR and the OIS – overnight index swap rate. The difference between these rates i.e. LIBOR *minus* OIS gives the LIBOR-OIS spread. When this increases it indicates illiquidity in the market, and vice versa. It is important to note that the charging of higher interest by one

financial institution to another is directly related to the default risk that the lender will be ascribing to extension of the loan. `

The same principles that guide the interpretation of the LIBOR-OIS spreads also apply to bank liquidity premiums and the respective findings have been analysed accordingly.

Kruger cited by McNulty and Rose (2008), discounted the primary impact of the financial crisis, as local banks had no direct exposure to the sub-prime mortgage market, but noted that the second round effects could come through in higher costs of debt and a slow -down in securitisation. Boardman quoted by McNulty and Bisseker (2008) also downplays the impact of the losses in US banks on South African banks. He cites the liquidity problems abroad as being due to the foreign banks not lending to each other, a problem that was not shared by the South African banks, which have each other as counterparties.

This analysis aims to test these assertions. If indeed liquidity in the South African inter-bank market has not been an issue, then there should be a statistically significant change in the correlation between U.S. and S.A. bank liquidity premiums as measured between stable and turmoil periods (stable periods before a turmoil event and turmoil periods in the aftermath of a turmoil event)

Hypothesis 3

The null hypothesis states:

H_o: The U.S. bank liquidity premium and S.A. bank liquidity premium correlation exhibits no statistically significant change from before a turmoil event period and during a turmoil event period.

Such that: $\mathbf{H_o: \rho_{LB} \neq \rho_{LA}}$

The alternative hypothesis states:

H_A**:** The U.S. bank liquidity premium and S.A. bank liquidity premium correlation exhibits a statistically significant change from before a turmoil event period and during a turmoil event period.

And $\mathbf{H_A: \rho_{LB} = \rho_{LA}}$

Let U.S. bank liquidity premium and S.A. bank liquidity premium coefficient of correlation $= \mathbf{\rho_L}$

$$\mathbf{\rho_L} = \mathrm{COV}(\mathbf{\delta_L, \delta_J}) / \mathbf{\sigma_L \sigma_J} \quad \text{Equation. 2.5.1}$$

where $\mathbf{\delta_L}$ = daily change in U.S. bank liquidity premium

$\mathbf{\delta_J}$ = daily change in S.A. bank liquidity premium

σ_L = standard deviation of monthly change in U.S. bank liquidity premium

σ_J = standard deviation of monthly change in S.A. bank liquidity premium

$COV(\delta_L, \delta_J)$ = covariance of monthly change in U.S. bank liquidity premium and S.A. bank liquidity premium

and U.S. bank liquidity premium and S.A. bank liquidity premium coefficient of correlation

before a turmoil event = ρ_{LB} Stable periods $\{S_1, S_2, S_3, S_4\}$

and U.S. bank liquidity premium and S.A. bank liquidity premium coefficient of correlation

during a turmoil event = ρ_{LA} Turmoil periods $\{T_1, T_2, T_3, T_4\}$

2.6 Impact of the global financial crisis on South African markets with particular focus on financial stocks

McNulty and Bisseker (2008) highlight the flight of international investors from emerging markets as global financial market fears and turmoil mount. They propose that South Africa cannot be immune to this trend of risk aversion and the flight of investor funds to markets of *perceived quality*.

To establish how the global financial crisis has impacted South African markets with particular focus on financial stocks, an event study is conducted. MacKinlay (1997) defines an event study as “an empirical study performed on a security that has experienced a significant catalyst occurrence, and has subsequently changed dramatically in value as a result of that catalyst event”.

In this research key events in the global financial crisis are identified and respective movements, on the S & P 500 and the ALSI, are compared over the period under review.

2.6.1 Comparison of impact of global events on the Standard and Poors 500 against impact on the Johannesburg Securities Exchange

Forbes and Rigobon (2002) studied the correlation between stock markets of different size, structure and geography. They note a high degree of co-movement that suggests the existence of mechanisms through which domestic shocks are transmitted internationally. Forbes and Rigobon (2002) describe the pre-eminent methodologies to measure these transmissions as the following:

- Cross-market correlation coefficients;
- ARCH and GARCH models;
- Co-integration techniques; and
- Direct estimation of specific transmission mechanisms.

For the purposes of this research the methodology used in analysing the impact of global financial crisis events as identified on Standard and Poors 500 against impact on the All Share Index, was cross-market correlation coefficients. This approach involves establishing the degree of correlation between two markets before an event of interest and after the event. Forbes and Rigobon (2002) suggest that if there is a significant increase in the correlation coefficient after the event, then this is evidence of contagion, which they describe 'as a significant increase in cross market linkages after a shock to one country'. Kaminsky *et al.* (2003) describe contagion 'as an episode in which there are significant immediate effects in a number of countries following an event'.

Similar studies on cross-market correlations as cited by Forbes and Rigobon (2002) have been conducted by;

- King and Wadhani (1990) – who find that cross-market correlations between U.S. and U.K. and U.S. and Japan increased after the U.S market crash of 1987 and
- Lee and Kim (1993) – whose analysis of 12 markets finds that average weekly cross-market correlations increased after the U.S 1987 crash.

The procedure to be followed to test for the impact of global events on South African markets adapts the methodology proposed by Forbes and Rigobon (2002) for the S & P 500 and ALSI:

i) Calculate cross-market correlation coefficients between the S & P 500 and ALSI for three periods:

- a stable period ρ_S ;
- the turmoil period ρ_T ; and
- the full period ρ_F

ii) The test for contagion is then conducted using the cross-market correlations of the different periods. The test determines whether there is a statistically significant increase in cross-market correlation coefficients over the turmoil period.

iii) Statistical significance is evaluated through the use of *t*-tests.

Presenting the methodology mathematically, from first principles;

Let co-fficient of correlation $\rho = COV(R_D,R_J) / \sigma_{Rd}\,\sigma_{Rj}$ Equation. 2.6.1

where

R_D = returns on S & P 500

R_J = returns on ALSI

σ_{Rd} = standard deviation of returns on S & P 500

σ_{Rj} = standard deviation of returns on ALSI

$COV(R_D,R_J)$ = covariance of returns on S & P 500 and returns on ALSI

Derived as follows

$COV(R_D,R_J) = \Sigma^{N}_{i=1} (R_D - \mu_D) (R_J - \mu_J) / N$

where

μ_D = population mean of returns on S & P 500

μ_J = population mean of returns on ALSI

N = number of observations

Hypothesis 4

The null hypothesis states:

H_o: The cross-market correlation between the S & P 500 and the ALSI do not exhibit a statistically significant increase during the crisis events identified.

Such that: $H_{o:}$ $\rho_F \leq \rho_T$

The alternative hypothesis states:

H_A: The cross-market correlation between the S & P 500 and the ALSI exhibit a statistically significant increase during the crisis events identified.

Such that: $H_{A:}$ $\rho_F > \rho_T$

2.6.2 Focus on the impact on the financial markets

To ascertain whether or not South African financial institutions have fared better than their global counterparts as events have unfolded, simple linear regression techniques are applied to gauge the rate of return on the financial indices in the S & P 500 and the ALSI against the overall boards respectively. The variation in the

observations prior to events of interest and subsequent, is then compared to ascertain whether the risk proportions between specific finance index attributable risk and overall market risk have changed.

Adapting the market model described by Brown and Warner (1985), the relationship can be represented mathematically as follows:

$$R_{FINI} = \beta_0 + \beta_1 R_m + \varepsilon \qquad \text{Equation. 2.6.2.1}$$

where

R_{FINI} = Return on the financial index

R_m = Return on the overall market index (S & P 500 or ALSI)

β_0 = y - intercept

β_1 = The beta coefficient of the financial index which measures how sensitive the rate of return on the financial index is to changes in the overall market.

ε = represents the error term in the regression model

The metrics of interest in the data analysis will be β_1 and R^2, the coefficient of determination, which measures the strength of a linear relationship.

The slope coefficient, β_1 is a measure of the market related or systematic risk of the financial index as it measures the volatility of the index against the volatility of the market as a whole.

The coefficient of determination, R^2 measures the proportion of the total risk that is market related.

Hypothesis 5

The null hypothesis states:

H_o: The beta coefficient of the financial index does not exhibit a statistically significant increase during the crisis events identified.

Such that: H_0: $\beta_{1B} \geq \beta_{1A}$

The alternative hypothesis states:

H_A: The beta coefficient of the financial index exhibits a statistically significant increase during the crisis events identified.

Such that: H_A: $\beta_{1B} < \beta_{1A}$

Where

β_{1B} = beta coefficient of the financial index *before* the crisis event

β_{1A} = beta coefficient of the financial index *after* the crisis event

2.7 Conclusion of Literature Review

In investigating the causes of the global financial crisis, the precedent sub-prime issues are identified as the major trigger of the crisis. Despite similar sub-prime conditions *not* being evident in S.A. before and during the period under review, the same cannot be said of the effects.

The comparison between the regulatory framework in the U.S. and in S.A. is included to aid interpretation of the findings of the research.

The discussion on interest rate spreads in the two countries, builds on the comparison of regulatory frameworks examining the notion that similar liquidity conditions as existed in the U.S. also prevailed in S.A., or otherwise. The test is of the assertion that no first wave liquidity pressure was brought to bear on S.A. inter-bank markets.

The impact of the global financial crisis on S.A. markets is reviewed through event studies performed on the ALSI and S & P 500 main boards and the ALSI and S & P 500, financial indices, respectively.

3 RESEARCH METHODOLOGY

This research adopts a quantitative methodology. The rationale for the choice of methodology is discussed for each hypothesis, with clarity being provided on the specific quantitative tools to be applied. The populations and samples of interest for each methodology are introduced before the analytical procedures and interpretation techniques are proposed. The section concludes with a discussion on the validity and reliability attributable to the methodologies applied.

3.1 Research methodology / paradigm

The methodology used in Hypothesis 1 is statistical process control (SPC) first applied to financial time series data, by Hubbard (1967). SPC techniques have subsequently been applied in various forms by Schmid and Tzotchev (2004), Andersson *et al.* (2005), Golosnoy and Schmid (2008) and Heizer and Render (2008), amongst others, as expounded in in paragraph 3.4.1. SPC is used to identify structural breaks in the S & P 500 daily returns data. The structural breaks in the S & P 500 daily returns data are identified as the events of interest, as the sub-prime instruments that precipitated the crisis largely originated in the U. S. and the financial institutions that led the descent into global financial turmoil are primarily listed on U. S. bourses where the decline was first heralded and most profound. This research uses these crisis events as identified on the S & P 500 as the independent variables from which hypotheses on daily returns on the ALSI as dependent variables are then framed. Once the events of interest have been determined, this research uses the metric explanation event study methodology to

investigate the hypotheses proposed. Variations of this approach have been widely used in financial economics. Bowman (1983) discusses the nature of event studies broadly, making four generic classifications:

- based on information content;
- testing degree of market efficiency;
- model evaluation; and
- metric explanation.

In practice clear differentiation is seldom possible and in the case of this study the metric explanation approach dominates, notwithstanding the influences from the other criteria identified. Bowman (1983) proposes a framework for the execution of event studies and also addresses issues of study interpretation, evaluation and design.

Brown and Warner (1985) conduct an event study in examining the properties of daily stock returns. This study replicates this approach on the financial and overall market indices of the S & P 500 and ALSI.

Building on the definition of event study as presented in paragraph 2.6, MacKinlay (1997) notes that the value of an event study is its ability to measure the immediate impact of events on market prices. This assertion of course assumes rational consumer behaviour.

Regression analysis is performed on the data. Specific to Hypotheses 3, 4 and 5, cross-market correlations are applied. Similar studies have been conducted by;

- Meric, Ratner and Meric (2007) who use rolling correlation techniques in their study of co-movements of the U.S. and E.U. stock markets;

- Hamao, Masulis, and Ng (1990) who make use of the autoregressive conditionally heteroskedastic (ARCH) models to investigate correlations in price changes and volatility across international stock markets while

- Forbes and Rigobon (2002) use heteroskedastic bias tests in their analysis of stock market co-movements.

3.2 Population and sample

The populations and samples used in the research vary as different hypotheses are considered.

For Hypothesis 1, identifying structural breaks in global financial markets, the population considered is the full complement of daily returns on the S & P 500 from the inception of the stock exchange. The sample of this study consists of daily returns on the S & P 500 for the period June 2007 to October 2009.

For Hypothesis 2, ascertaining whether a relationship to reported global financial events exists, the population comprises the daily returns on the S & P 500 for the period June 2007 to October 2009. The sample consists of the events as defined by the structural breaks identified in Hypothesis 1.

For Hypothesis 3, comparison of liquidity premiums in the U.S. against those in S.A. the population is the full complement of liquidity premiums in the U.S. and S.A. markets defined by the difference between the 1YR deposit rate and the 1YR

swap rate in each of the two markets from the time of availability of coincidental records in both countries. The sample consists of liquidity premiums as defined, for the period June 2007 to October 2009.

For Hypothesis 4, comparing the impact of global events on the S & P 500 against impact on the ALSI, the populations considered are the full complement of daily returns on the S & P 500 and the ALSI from the inception of the stock exchanges. The sample of this study consists of daily returns on the S & P 500 and the ALSI for the period June 2007 to October 2009.

For Hypothesis 5, determining whether or not South African financial institutions fared better than their global counterparts as events in the global financial crisis unfolded, the following populations are considered;

- the full complement of daily returns on the S & P 500 and the ALSI from the inception of the stock exchanges; and
- the full complement of daily returns on the S & P 500 financial index (S5FINL) and the full complement of daily returns on the JSE financial index (FINI 15) from the inception of the stock exchanges.

Similarly, the samples considered are as follows;

- daily returns on the S & P 500 and the ALSI for the period June 2007 to October 2009; and
- daily returns on the S5FINL and daily returns on the FINI 15 from the June 2007 to October 2009.

3.3 Procedure for data collection

The data used in this research have been collected from reputable electronic data platforms in the form of:

- Bloombergs;
- BFA McGregor; and
- Thomson Reuters

These companies are generally accepted by financial institutions and research units globally as providing an accurate and reliable service. Table 3.1 details the data used and the sources in respect of each hypothesis.

Table 3.1 Data used and respective sources

Hypothesis	Data	Source
Hypothesis 1 Identifying structural breaks in global financial markets.	Daily returns on the S & P 500	Bloombergs
Hypothesis 2 Ascertaining whether a relationship to reported global financial events exists.	Events derived from structural breaks in daily returns on the S & P 500	Bloombergs
Hypothesis 3 Comparison of liquidity premiums in the U.S. against those in S.A.	Liquidity premiums in the U.S. and S.A. markets defined by the difference between the 1YR deposit rate and the 1YR swap rate in each of the two markets	Thomson Reuters
Hypothesis 4 Comparing the impact of global events on the S & P 500 against impact on the ALSI.	Daily returns on the S & P 500 and the ALSI	Bloombergs & BFA McGregor
Hypothesis 5 Determining whether or not South African financial institutions fared better than their global counterparts as events in the global financial crisis unfolded,.	Daily returns on the S & P 500 and the ALSI Daily returns on the S & P 500 financial index (S5FINL) and the daily returns on the JSE financial index (FINI 15)	Bloombergs & BFA McGregor

3.4 Data analysis and interpretation

This section expands on the methodology proposed for the research and explores the detail of the various analytical procedures to be applied. This process is conducted for each hypothesis in turn.

3.4.1 Identification of structural breaks in global financial markets

The methodology used to identify structural breaks in global markets is SPC techniques in various forms, as applied by Hubbard (1967), Schmid and Tzotchev (2004), Andersson *et al.* (2005), and Golosnoy and Schmid (2008) amongst others. Heizer and Render (2008) describe SPC as being founded on the central limit theorem, which states that regardless of the distribution of a population, daily returns (DR), the distribution of the means DR bar will tend to follow a normal curve as the number of samples increases. Heizer and Render (2008) go on to explain that accepting a normal distribution implies that there is:

95.45% certainty that the sample average will fall within +/- 2 $\sigma_{\overline{DR}}$

99.73% certainty that the sample average will fall within +/- 3 $\sigma_{\overline{DR}}$

When a point falls outside the $3\sigma_{\overline{DR}}$ control limit then there is 99.73% certainty that the process has changed. The central limit theorem assumes:

1. the mean of the distribution = the mean of the population;

2. the standard deviation of the sampling distribution $\sigma_{\overline{DR}}$ = the standard deviation of the population σ; and

3. the process has only natural variations (as also assumed in the efficient market hypothesis in the form of the random walk model).

In the application of SPC techniques to the S & P 500, charts are used in much the same way as Schmid and Tzotchev (2004), and Golosnoy and Schmid (2007). R charts are used because the variable of interest, daily returns is a range computed as the difference between two successive index close figures. Structural breaks are identified where there is 99.73% certainty that the daily returns cycle has changed, i.e. daily returns DR > UCL ~ the upper control limit defined as $\overline{DR}$D4, where D4 is the upper range factor as shown in Appendix II, Factors for computing control chart limits. Similarly, the lower control limit, LCL = $\overline{DR}$D3, where D3 is the lower range factor. In the analysis conducted the sample size of the range is 2, as the computation of daily returns is the difference between closing index figures for consecutive trading days.

3.4.2 Ascertain association of structural breaks identified with reported global financial events

Subsequent to the identification of the events of interest in Hypothesis 1, tests are conducted for association of the structural breaks and reported events in the global financial crisis.

Event study methodology requires the setting of the number of days over which the effects of the events of interest will be monitored and analysed. This is called the event study window. McWilliams and Siegel (1997) note that, the shorter an event study window is, the more accurate a potential cause (event) and effect relationship will be. A short event study window reduces the likelihood of other causal events impacting the effect being studied. McWilliams and Siegel (1997) also note that if other financially relevant events occur during the event study window, it becomes difficult to definitively isolate the effects of one particular event.

This study uses an eleven-day event window to allow for an assessment of possible lag effects evident in the structural breaks identified and the reported events. Further justification for an event window of this duration is that the nature of the events being studied is such that the dissemination of news and information into the market is not instantaneous, but rather delivered piecemeal possibly over a number of days. Ball and Kothari (1991) use an event window of identical duration in their study of Security Returns around Earnings Announcements. The event window being the day of the event E_0 and event day minus five, E_{0-5} and event day plus five $E_{0+5.}$

To determine the association of structural breaks identified with reported global financial events, a simple regression is performed using Stattools. The regression is performed according to Equation 2.4.1 on a binary model where the incidence of a structural break SB or a reported event is coded 1, and no incidence is coded 0. (Steeg *et al*. 1998)

3.4.3 Comparison of bank liquidity premiums in the U.S. to bank liquidity premiums in S.A.

Using the event study methodology and an event study window as described in paragraph 3.4.2, a regression analysis is performed using Stattools. The regression analysis is conducted for time frames before, during and after the different event periods as derived in hypothesis 1. The evolution of correlation coefficients of bank liquidity premiums in the U.S. to bank liquidity premiums in S.A. is analysed and interpreted over the defined periods.

3.4.4 Comparison of impact of global events on the Standard and Poors 500 against impact on the Johannesburg Securities Exchange

Using the event study methodology and an event study window as described in paragraph 3.4.2, regression analysis is performed using Stattools before, during and after the different event periods as derived in Hypothesis 1. Paragraph 2.6.1 includes the detailed procedure for the cross-market correlation analysis to be conducted. This detail is presented in paragraph 2.6.1 to facilitate expression of the respective hypothesis.

3.4.5 Focus on impact on the financial markets

Using the event study methodology and an event study window as described in paragraph 3.4.2, regression analysis is performed using Stattools before, during and after the different event periods as derived in Hypothesis 1. Paragraph 2.6.2 includes the detailed procedure for the regression analysis to be conducted. This detail is presented in paragraph 2.6.2 to facilitate expression of the respective hypothesis.

3.5 Limitations of the study

Overarching potential limitations of the study are discussed in paragraph 1.5.2. This paragraph considers further limitations and potential weaknesses in the study relating to the methodology, sampling and analysis methods with a view to outlining the possible impact on findings.

McWilliams and Siegel (1997) highlight three critical assumptions underlying event study methodology:

- efficient markets especially with respect to perfect information;
- events are not anticipated – in this study the adjustment for the effect of possible anticipation by the market is the longer event study window; and
- there are no confounding effects during the event window – this is a genuine weakness in the study as discussed in paragraphs 3.4.2 and 3.6.1.

The predictive value of the study is limited as the analysis is premised on *a priori* data. All metric analysis has been conducted subsequent to the identification of an event in global markets. Notwithstanding, the analysis does afford one research information which, if correctly and timeously applied, can yield strategic business benefit.

In many cases a correlation analysis only holds for the periods being studied. To address this limitation correlation analyses were conducted for periods of varying definition with regard to stability and turmoil, within the full period and interpreted accordingly. In addition full regression analyses were conducted over the same periods to enhance the quality of findings.

The time frame of the study is relatively short and reduces the validity of the conclusions derived. The fact that this time frame is punctuated by the global financial crisis means there is insufficient time for the dissipation of global financial crisis specific information and effect into the cycle. Accordingly, conclusions are qualified clearly with respect to crisis or turmoil periods and stable periods.

The regression analyses conducted on the data assume the generic regression analysis assumptions as cited by Osborne and Waters (2002), namely:

- that variables are normally distributed;
- that a linear relationship exists between the independent and dependent variable being analysed;
- reliability – that the variables being analysed are measured without error; and

- homoscedasticity – that the variance of errors is the same across all levels of the independent variable.

3.6 Validity and reliability

If a research instrument measures what it is designed to measure, then it can be described as valid. The accuracy and the precision of the measurement procedure, determines reliability.

3.6.1 Validity

Validity is concerned with the accuracy of measure, or in other words the soundness or effectiveness of the measuring instrument. (Leedy 1989)

3.6.1.a External validity

External validity refers to the degree to which the findings of a study would hold for the population of interest as a whole. Leedy (1989) describes this as the extent to which conclusions are generalisable. Calder, Phillips, and Tybout (1982) define external validity as examining whether or not the results of an observed causal relationship can be generalised to and across different measures, persons, settings and times. An acceptable degree of external validity has been achieved with respect to settings and times as applicable but in respect of research measures this has been accepted as an inherent limitation of the research. The use of alternative measures may not yield similar results.

The external validity of the research was enhanced by the use of clearly defined and consistently applied stable periods, turmoil periods and the full period for all hypotheses, research methods and research analysis. Although samples and populations are clearly defined, the limited time frame of the study was noted as a potential weakness. This, however, does not invalidate the conclusions reached, as they are replicable for the research methodology and research instrument used.

Calder *et al.* (1982) also contend that efforts to examine the role of background factors in the conclusions reached, enhances the value of theory testing research. The research conducted concedes this limitation, as the effect of other factors that invariably affect daily returns on stock markets were not considered. According to McWilliams and Siegel (1997), in event study methodology the confounding effects or events, can be mitigated by shortening the event study window as much as practically possible. Furthermore, the authors contend that it is also not desirable to lose record of possible lag effects in the results. In this research, the possible confounding effects or extraneous independent variables with the potential to impact the dependent variable, daily returns, would include but not be limited to: political instability, statutory and regulatory changes, changes in sovereign risk rating, changes in interest rates or monetary policy changes, or factors affecting emerging markets in general such as positive appetite or indeed aversion of perceived risk.

3.6.1.b Internal validity

According to Leedy and Ormrod (2001), internal validity relates to the degree to which, the correct conclusions that an independent variable has causal influence on the dependent variable. If this link can be successfully demonstrated and tested then the study has internal validity. Calder *et al*. (1982) describe internal validity as addressing whether or not an observed co-variation should be considered a causal relationship. This research uses event study methodology and regression analysis techniques that have been extensively applied in similar stock market studies on indices in different global markets. Research where event studies have been undertaken would include that of Ball and Kothari (1991), Bhana (1998), Chan, Faff and Ramsey (2005) and Mushidzhi and Ward (2004). The limitations inherent in these techniques together with the underlying assumptions accepted in the application are discussed in paragraph 3.5.

3.6.2 Reliability

Reliability is concerned with the ability of the research instrument to produce consistent results when tests are repeated, at different times and under different conditions. (Emroy and Cooper 1991)

Event study methodology and regression analysis, the research instruments employed in this research, are generally accepted and widely used in the analysis of stock movements in response to underlying events. The limitations inherent in these instruments are discussed in paragraph 3.5.

4 PRESENTATION OF RESULTS

This chapter presents the results of tests conducted on the various hypotheses on the basis of the methodologies proposed. Findings are presented in tabular or graphical form as appropriate and explained.

4.1 Identification of structural breaks in global financial markets

This paragraph reports the findings of Hypothesis 1, the identification of structural breaks on the S & P 500. The daily returns on the S & P 500 were analysed as described in paragraph 3.5.1. The results obtained on the basis of this methodology yield the events and periods on which tests in respect of Hypotheses 2, 3, 4 and 5 were conducted. Of essence is the identification of the full period, the turmoil periods and the stable periods.

Observing the rules set out by the null and alternative hypotheses, Table 4.1 presents the respective periods identified. Essentially, turmoil and stable periods within the full period are defined on the basis of the identification of crisis or turmoil events as occurring where daily returns exceed the upper control limit, i.e. where DR > UCL. (Typically in SPC the cycle is out of control where UCL<DR<LCL = 0 as explained in paragraph 3.4.1. such that the condition DR > UCL is sufficient to indicate a crisis break point) This is event day 0, $E_{0,}$ which then becomes the point of reference around which the event study window is defined, 5 days prior to an event, E_{0-5} and 5 days after an event, E_{0+5}. Where

another crisis event occurs within an event window, that window is automatically extended from the new point of reference, a new E_0.

Table 4.1 includes the number of days for each period to allow for qualification of parametrics in Hypotheses 2, 3, 4 and 5. i.e. is the result returned based on a period that is of sufficient length to reflect the impact of the events in the global financial crisis. Such qualification considers whether the duration of the period over which a measure is taken, is sufficient for underlying factors to filter through into the data to allow for utility in the tests conducted.

Table 4.1: Identification of structural break events or periods on the S & P 500

Period	Date	Event window period	No' of days	Narration
Full period, *F*	01/06/07 – 07/10/09	01/06/07 – 07/10/09	770	Data collected over this period
Stable period 1, S_1	01/06/07 – 06/10/08	01/06/07 – 01/10/08	489	The first stable period before the first turmoil event or period. Where DR ≤ UCL
Turmoil period 1, T_1	07/10/08 – 24/10/08	02/10/08 – 29/10/08	28	The first turmoil event or period. Where DR > UCL
Stable period 2, S_2	25/10/08 – 19/11/08	30/10/08 – 14/11/08	16	The second stable period. Where DR ≤ UCL
Turmoil period 2, T_2	20/11/08 – 21/11/08	15/11/08 – 26/11/08	12	The second turmoil event or period. Where DR > UCL
Stable period 3, S_3	22/11/08 – 28/02/09	27/11/08 – 24/02/09	90	The third stable period. Where DR ≤ UCL
Turmoil period 3, T_3	01/03/09 – 02/03/09	25/02/09 – 07/03/09	11	The second turmoil event or period. Where DR > UCL
Stable period 4, S_4	03/03/09 – 07/10/09	08/03/09 – 07/10/09	213	The third stable period. Where DR ≤ UCL

The evidence presented in Table 4.1 and Figure 4.1 supports a rejection of the null hypothesis, that there are no structural breaks in the observed time series of daily returns over the period under review. This implies that there is 99.73% certainty that the underlying daily returns cycle has changed, thus we accept the alternative hypothesis that there *are* structural breaks in the observed time series of daily returns over the period under review.

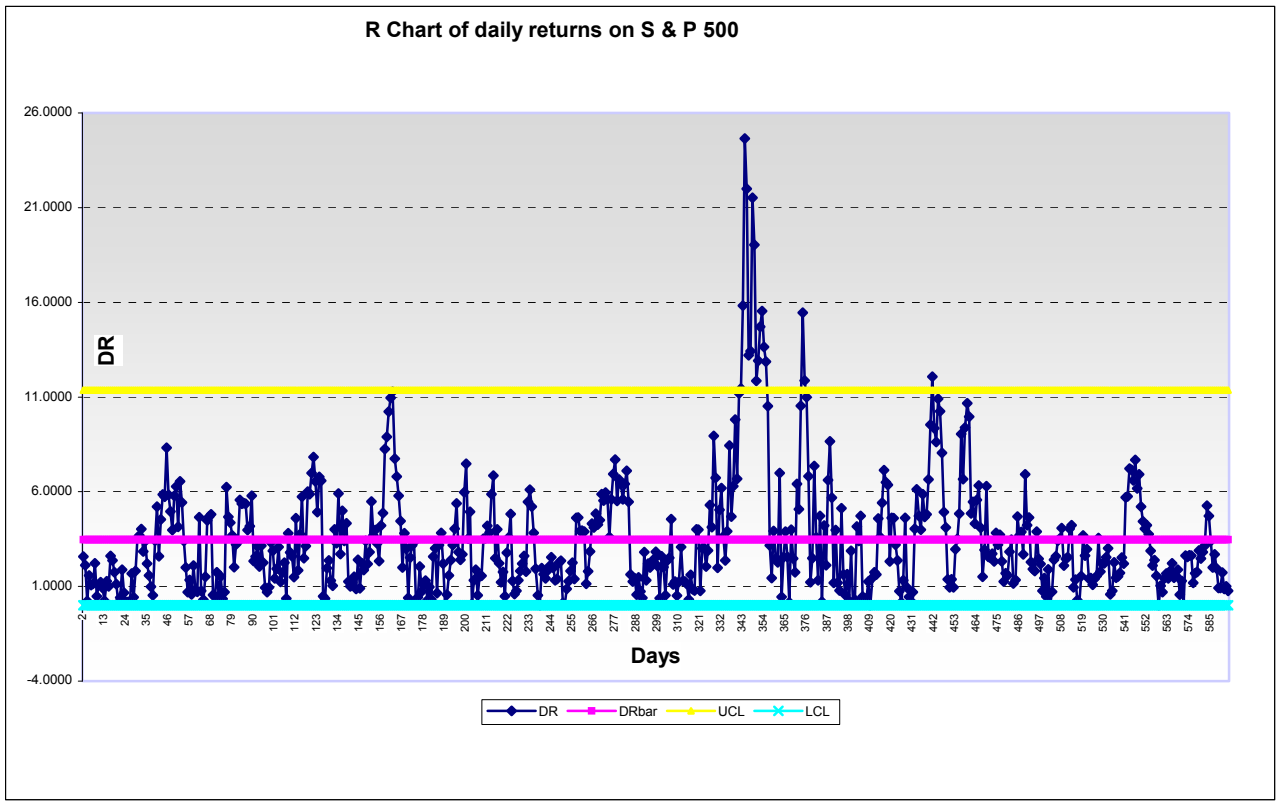

Figure 4.1 R- chart of daily returns on S & P 500

4.2 Ascertain association of structural breaks identified with reported global financial events

This paragraph reports the findings of Hypothesis 2 the results of tests for association between the breaks identified and reported events in the global financial crisis. The regression analysis conducted is summarised in Table 4.2.

Equation 4.2.1 from paragraph 2.4 is restated using data from Table 4.2.

$$SB = \alpha RE + K$$

Such that: $SB = 0.12RE + 0.0022$

The α returned is 0.12 i.e. not equal to zero. This implies that there is an association between structural breaks in the S & P 500 and reported key events in the global financial crisis, and the null hypothesis is not accepted.

Keller and Warrack (2003) note the leading indicators for association in a regression analysis as the p-value and the F-ratio, which indicate the overall significance of the relationship between the variables of interest. In this case the p-value returned is < 0.0001, a low p-value (< 0.05) which implies a significant relationship between reported events and structural breaks. This is confirmed by the co-indicator, an F-ratio of 59.0199. An F-ratio > 4 implies significance.

The results of the test of association between structural breaks and reported events as shown in Table 4.2, indicates that *α* is 99% significant (i.e. p < 1%). Keller and Warrack (2003) go on to add that R – square (**R^2**) the coefficient of

determination measures the strength of a linear relationship between two variables. The $\mathbf{R^2}$ returned by this model was 0.0908 which implies that ≈ 9 % of the variation, in the dependent variable, structural breaks (SB) identified, is attributable to the independent variable, reported events (RE).

On the basis of the statistical evidence presented in this section we reject the null hypothesis in favour of the alternative, concluding that there is an association between structural breaks in the S & P 500 and reported key events in the global financial crisis.

Table 4.2: Association of structural breaks identified with reported global financial events

StatTools Hypothesis 2 - Ascertain association of structural breaks identified with reported global financial events

Analysis: Regression H2
Performed By: MPOFU Vusi
Date: 18-Jan-10
Updating: Static

Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate
	0.3013	0.0908	0.0893	0.159384119

ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	1.499298851	1.499298851	59.0199	< 0.0001
Unexplained	591	15.0133487	0.025403297		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	0.002155172	0.007399222	0.2913	0.7709	-0.012376796	0.016687141
RE	0.121875835	0.015864214	7.6824	< 0.0001	0.090718741	0.15303293

4.3 Comparison of bank liquidity premiums in the U.S. to bank liquidity premiums in S.A.

This paragraph presents the comparison of bank liquidity premiums in the U.S. to bank liquidity premiums in S.A. Figure 4.2 presents this analysis graphically while Table 4.3 presents the evolution of correlation coefficients between bank liquidity premiums in the U.S. and bank liquidity premiums in S.A. over the full period of the study. This includes the same for stable and turmoil periods throughout the period of analysis.

Appendix III shows the results of regression analyses on the liquidity premiums, run for all the different periods: Full, Stable and Turmoil periods as defined. The results are interpreted with a view to assessing the degree to which the models proposed hold for basic regression assumptions. The scatter-plots of the residuals of fit and US liquidity premiums show a random pattern within a horizontal band, implying constant variance in the data. The random pattern with no clearly defined cycles or trends implies normality of the time series data analysed.

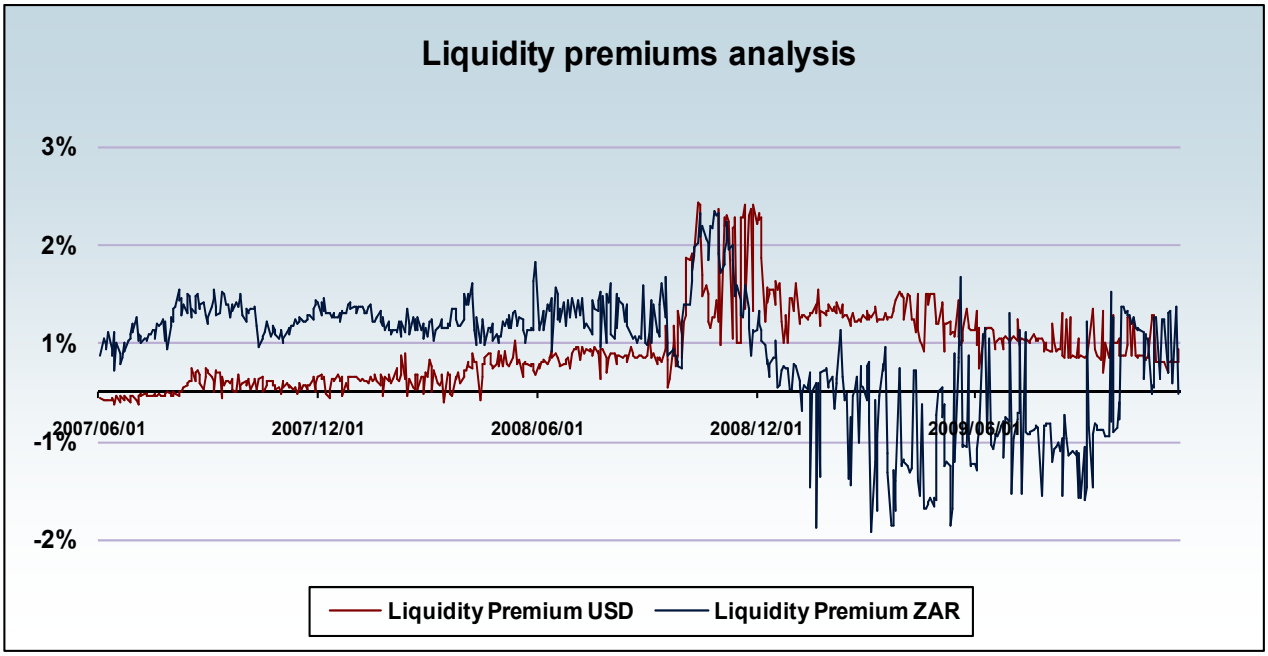

Figure 4.2: Liquidity premiums analysis for U.S. and S.A. markets

Table 4.3: Comparison of bank liquidity premiums in the U.S. to bank liquidity premiums in S.A.

The Impact of the Global Financial Crisis on South African Markets
Hypothesis 3 - Analysis of US bank liquidity premiums to SA bank liquidity premiums
Liquidity premium data

StatTools	Summary of liquidity premium correlations + parametrics
Analysis:	Correlation matrix H3
Performed By:	MPOFU Vusi
Date:	16-Jan-10
Updating:	Live

Period	F	S1	T1	S2	T2	S3	T3	S4
Correlation	-0.195	0.091	-0.137	0.225	-0.475	-0.487	-0.115	-0.206
p-value	< 0.0001	0.0892	0.5656	0.4829	0.2348	<0.0001	0.7862	0.0108
F-ratio	21.8165	2.9046	0.3426	0.5311	1.7441	19.2476	0.0804	6.6637
R-Square	0.0382	0.0083	0.0187	0.0504	0.2252	0.2369	0.0132	0.0423

F – Full period; S_1 ,S_2, S_3, S_4 - Stable period 1,2,3 & 4 ; T_1, T_2, T_3 & T_4 – Turmoil period 1,2,3 & 4

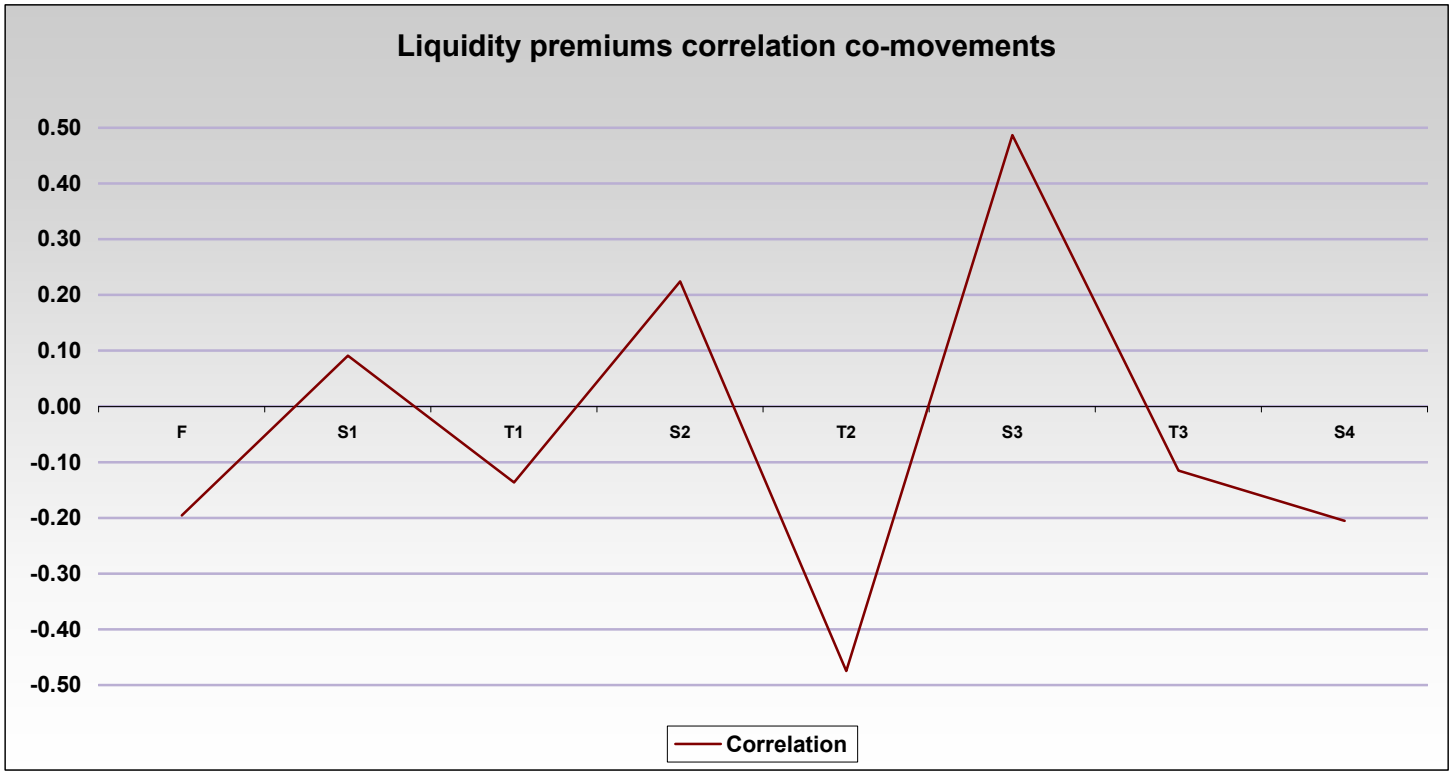

Figure 4.3 Evolution of U.S._S.A. liquidity premium correlation co-movements

F – Full period; S_1 ,S_2, S_3, S_4 - Stable period 1,2,3 & 4 ; T_1, T_2, T_3 & T_4 – Turmoil period 1,2,3 & 4

The changes evident in the correlation coefficient of US_SA liquidity premiums result in the null hypothesis being rejected in favour of the alternative hypothesis such that we can conclude that the U.S. bank liquidity premium and S.A. bank liquidity premium correlation exhibits a change from before the turmoil event periods and during turmoil event periods.

4.4 Comparison of the impact of global events on the Standard and Poors 500 against the impact on the All Share index

This section compares the impact of reported events on the S & P 500 against the impact on the ALSI. The comparison is made through an analysis of cross-market correlations for the full period of study including the stable and turmoil periods as defined. The respective correlation coefficients are summarised in Table 4.4. Of interest is the change in correlation coefficients between stable and turmoil periods. Figure 4.4 is included to aid this analysis. The null hypothesis states that the cross-market correlation between the S & P 500 and the ALSI does not exhibit a statistically significant increase during the crisis events identified. If the base reference is the full period of the study the correlation coefficient returned in turmoil periods 1 and 2, T1 & T2 is greater than that for the full period while the correlation coefficient in turmoil period 3, T3 is less than for the full period (F). Such that:

$$\rho_F < \rho_{T1}, \qquad \rho_F < \rho_{T2}, \qquad \& \qquad \rho_F > \rho_{T3}.$$

This would suggest contagion in T1 and T2 but not in T3.

Conversely if the base reference for the test for contagion is an increase in correlation coefficient from the preceding stable period then;

$$\rho_{S1} < \rho_{T1}, \qquad \rho_{S2} > \rho_{T2}, \qquad \& \qquad \rho_{S3} > \rho_{T3}.$$

This would suggest contagion in T1 but not in T2 and T3.

Accordingly, guided by the comparison of turmoil period correlation coefficients against those of the full period in respect of:

- T1: the null hypothesis that states that the cross-market correlation between the S & P 500 and the ALSI does not exhibit a statistically significant increase during the crisis events identified, is rejected in favour of the alternative hypothesis that states that cross-market correlations between the S & P 500 and the ALSI exhibit a statistically significant increase during the crisis events identified.

- T2: the null hypothesis that states that the cross-market correlation between the S & P 500 and the ALSI does not exhibit a statistically significant increase during the crisis events identified is rejected in favour of the alternative hypothesis that states that cross-market correlations between the S & P 500 and the ALSI exhibit a statistically significant increase during the crisis events identified.

- T3: the null hypothesis that states that the cross-market correlation between the S & P 500 and the ALSI does not exhibit a statistically significant increase during the crisis events identified is ***not*** rejected in favour of the alternative hypothesis that states that cross-market correlation between the S & P 500 and the ALSI exhibit a statistically significant increase during the crisis events identified.

Table 4.4: Comparison of impact of reported events on the S & P 500 to impact on the ALSI

The Impact of the Global Financial Crisis on South African Markets
Hypothesis 4 - Comparison of impact of global events on the Standard and Poors 500 against impact on the JSE ALSI
S & P 500 and ALSI daily returns data

StatTools	Hypothesis 4 - Comparison of impact of global events on the S & P 500 against impact on the ALSI
Analysis:	Correlation matrix H4
Performed By:	MPOFU Vusi
Date:	19-Jan-10
Updating:	Live

Period	F	S1	T1	S2	T2	S3	T3	S4
Correlation	0.2290	0.2640	0.3890	0.2830	0.2450	0.2460	0.2180	0.0730
p-value	<0.0001	<0.0001	0.0902	0.3730	0.5589	0.0541	0.6035	0.3719
F-ratio	33.4047	25.7124	3.2059	0.8697	0.3827	3.8605	0.3002	0.8021
R-Square	0.0522	0.0695	0.1512	0.0800	0.0600	0.0605	0.0476	0.0053

F – Full period; S_1 ,S_2, S_3, S_4 - Stable period 1,2,3 & 4 ; T_1, T_2, T_3 & T_4 – Turmoil period 1,2,3 & 4

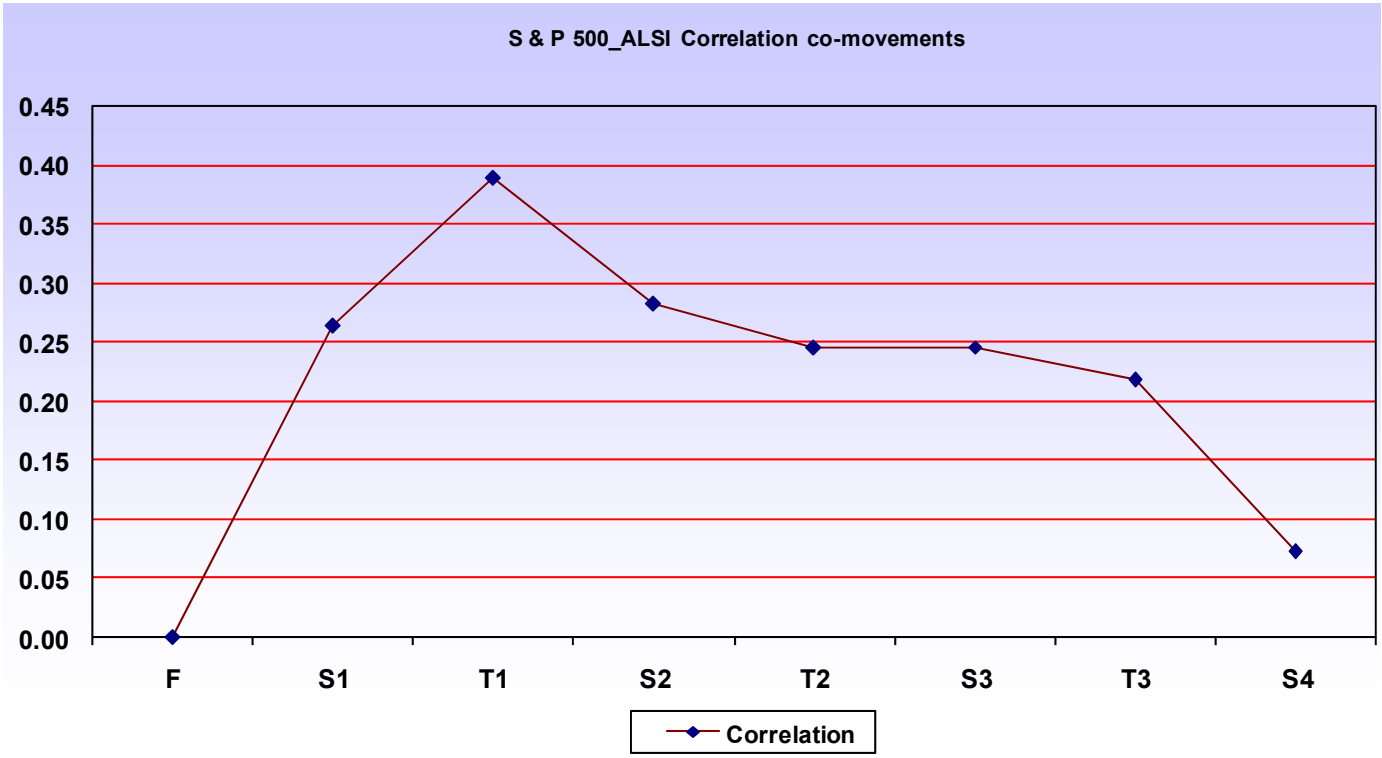

Figure 4.4. Evolution of S & P 500 and ALSI correlation co-movements

Appendix IV shows the results of regression analyses on the daily returns on each exchange, run for all the different periods: Full, Stable and Turmoil periods as defined. The results are interpreted with a view to assessing the degree to which the models proposed hold for basic regression assumptions. The scatter plots of the residuals of fit and impact of reported events on the S & P 500 and the impact of reported events on the ALSI show a random pattern within a horizontal band, implying constant variance in the data. The random pattern with no clearly defined cycles or trends implies normality of the time series data analysed.

4.5 Focus on impact on the financial markets

This section analyses the impact of reported events on the financial markets as measured by stock movements in the financial indices of the S & P 500 and the ALSI. The comparison is made through an analysis of **β**-coefficient correlations for the full period of study including the stable and turmoil periods as defined for both the S5FINL and the FINI 15. The evolution of the beta **β**-coefficients in each index is presented in Table 4.5 and Table 4.6 respectively.

As noted in paragraph 2.6.2 the variation in the observations prior to events of interest and subsequent, is then compared to ascertain whether the risk proportions between specific finance index attributable risk and overall market risk have changed.

4.5.1 Intra-market analysis ALSI_FINI15

This paragraph presents the results in respect of the intra-market analysis involving the ALSI_FINI 15 **β**-coefficients.

The p-values and F-ratios, from period to period, indicate the existence of a significant relationship between the FINI15 and the ALSI. The significance of the relationship is also reflected in the predominantly high correlation coefficients, which hold for all the periods except T3. Similarly, R^2 is high throughout but dips markedly in T3.

Table 4.5 Summary parametrics of ALSI vs FINI 15 regression analysis

The Impact of the Global Financial Crisis on South African Markets
Hypothesis 5 - Focus on financial markets
ALSI and FINI daily returns data

StatTools	Summary parametrics
Analysis:	Regression
Performed By:	MPOFU Vusi
Date:	20-Feb-10
Updating:	Static

Period	**F**	**S1**	**T1**	**S2**	**T2**	**S3**	**T3**	**S4**
β - coefficient	0.2170	0.2253	0.2006	0.1381	0.1299	0.2526	-0.0944	0.2018
Correlation	0.7268	0.7143	0.7974	0.8086	0.6638	0.7862	0.3762	0.7541
p-value	< 0.0001	<0.0001	< 0.0001	0.0015	0.0727	<0.0001	0.3583	<0.0001
F-ratio	662.718	350.067	31.4254	18.8820	4.7257	160.253	0.9894	138.440
R-Square	0.5282	0.5103	0.6358	0.6538	0.4406	0.6181	0.1416	0.5687

F – Full period; S_1 ,S_2, S_3, S_4 - Stable period 1,2,3 & 4 ; T_1, T_2, T_3 & T_4 – Turmoil period 1,2,3 & 4

In Table 4.5 focussing on the **β**-coefficients in respect of the FINI 15 and the ALSI, **β** is lower in the turmoil periods than it is for the full period and lower against each stable period preceding a turmoil period, with the exception of S3 and T3.

$$\beta_F < \beta_{T1}, \quad \beta_F < \beta_{T2}, \quad \beta_F < \beta_{T3}, \text{ and}$$

$$\beta_{S1} < \beta_{T1}, \quad \beta_{S2} < \beta_{T2}, \text{ but } \beta_{S3} > \beta_{T3}$$

This suggests that the market attributable risk in the financial index on the ALSI did not increase as global financial crisis events unfolded. The predominant

observation, that of no significant increase in the **β**-coefficient of the financial index during the crisis events identified, supports the null hypothesis that states that the **β**-coefficient of the financial index does not exhibit a statistically significant increase during the crisis events identified and rejection of the alternative that the **β**-coefficient of the financial index exhibits a statistically significant increase during the crisis events identified.

4.5.2 Intra-market analysis S & P 500_S5FINL

The p-values and F-ratios as indicators of the existence or lack of a relationship between the S5FINL and the S & P 500 suggest a significant relationship for the full period (F), but on a period to period basis the indicators fluctuate in and out of significance. This interpretation is re-enforced by the relatively low correlation coefficients. R^2 is low throughout the study but T3 shows a significant spike.

Table 4.6 Summary parametrics of S & P 500 vs S5FINL regression analysis

The Impact of the Global Financial Crisis on South African Markets
Hypothesis 5 - Focus on financial markets
S & P 500 and S5FINL daily returns data

StatTools	Summary parametrics
Analysis:	Regression
Performed By:	MPOFU Vusi
Date:	20-Feb-10
Updating:	Static

Period	F	S1	T1	S2	T2	S3	T3	S4
β - coefficient	0.4050	0.5142	0.4442	1.1709	0.7174	0.3553	4.4100	0.3962
Correlation	0.2096	0.1903	0.1965	0.3761	0.2338	0.2049	0.7749	0.2309
p-value	< 0.0001	0.0004	0.4063	0.2282	0.5773	0.0399	0.0239	0.0167
F-ratio	27.2057	12.6208	0.7230	1.6479	0.3470	4.3370	9.0203	5.9113
R-Square	0.0439	0.0362	0.0386	0.1415	0.0547	0.0420	0.6005	0.0533

F – Full period; S_1 ,S_2, S_3, S_4 - Stable period 1,2,3 & 4 ; T_1, T_2, T_3 & T_4 – Turmoil period 1,2,3 & 4

Extending a similar analysis to the U.S. market, Table 4.6 shows the **β**-coefficients in respect of the S5FINL and the S & P 500. **β** is higher in the turmoil periods than it is for the full period of the time series reviewed.

$$\beta_F < \beta_{T1}, \quad \beta_F < \beta_{T2}, \quad \beta_F < \beta_{T3},$$

This pattern is not replicated on a period to period to period basis i.e. S1 - T1, S2 – T2 and S3 – T3. The **β**-coefficients returned for all the stable periods are greater than that for the full period but are not more than that for the subsequent turmoil period, such that;

$$\beta_F < \beta_{S1}, \quad \beta_F < \beta_{S2}, \quad \beta_F < \beta_{S3} \quad \text{but}$$

$$\beta_{S1} > \beta_{T1}, \quad \beta_{S2} > \beta_{T2}, \quad \beta_{S3} > \beta_{T3}$$

The **β**-coefficients returned for the S5FINL and the S & P 500 show higher betas in the turmoil periods and lead to a rejection of the null hypothesis that states that coefficient of the financial index does not exhibit a statistically significant increase during the crisis events identified, in favour of the alternative that the beta coefficient of the financial index exhibits a statistically significant increase during the crisis events identified.

The fact that this observation does not subsist on a period to period basis suggests that the risk attributable to the S5FINL in the S & P 500 was generally high over the period under review.

The high R^2 returned for the ALSI vs FINI15 analysis is indicative of the high proportion of financial stock capitalisation on the ALSI, second only to the resource counters. Conversely the low R^2 returned for the S5FINL vs S & P 500 analysis is indicative of the much lower financial stock proportion in the S & P 500. This supports similar findings by Gilbertson and Goldberg (1981) on the relatively low degree of sector diversification on the ALSI as compared to other bourses globally and in this case the S & P 500.

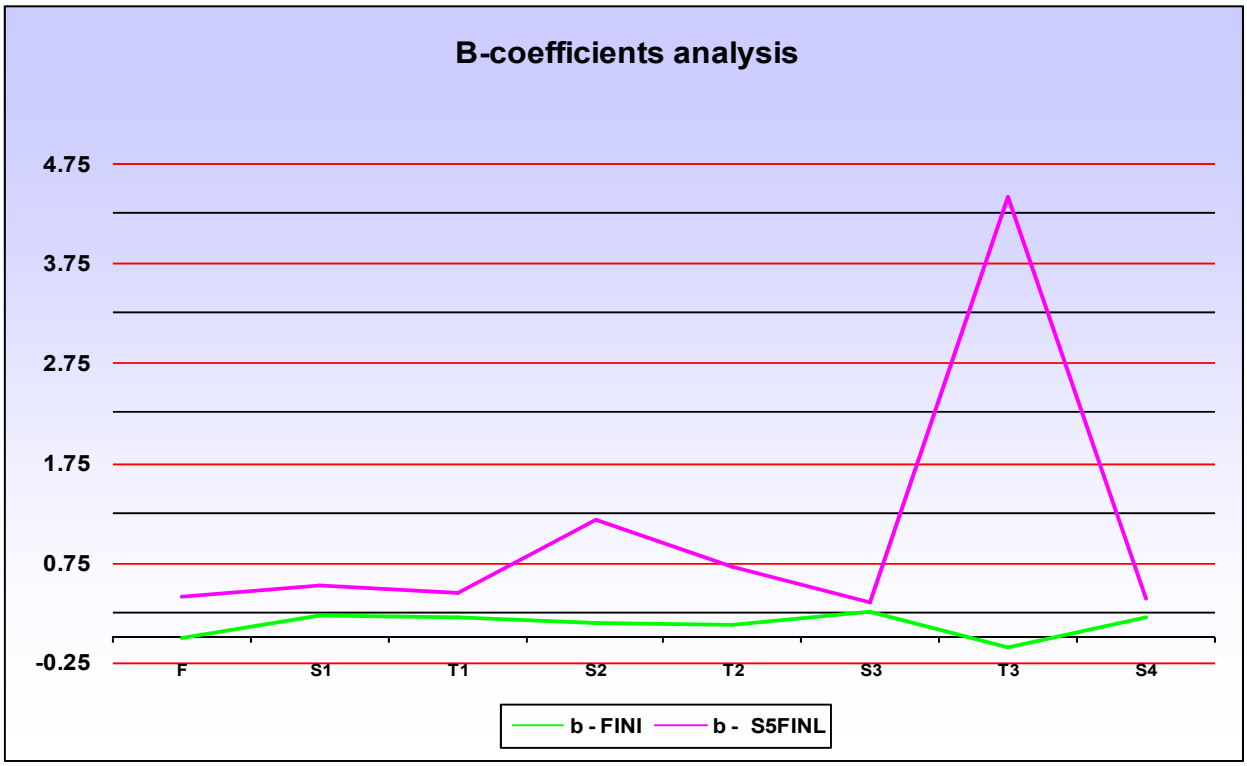

Figure 4.5 Cross-market beta analysis

F – Full period; S_1 ,S_2, S_3, S_4 - Stable period 1,2,3 & 4 ; T_1, T_2, T_3 & T_4 – Turmoil period 1,2,3 & 4

Figure 4.5 presents a comparison of the β-coefficients for each of the markets respectively. The evolution of S5FINL_S & P 500 β-coefficients shows significant increases over the turmoil periods while the evolution of FINI15_ALSI β-coefficients shows no significant increases. This observation would tend to

suggest that the impact of global financial crisis events was greater on U.S. financial institutions than was the case on S.A. markets. This supports the argument that S.A. financial institutions fared better than their global counterparts as events have unfolded.

5 INTEPRETATION OF RESULTS

This section builds on the results presented in section 4. The results are interpreted with reference to concepts proposed in Chapter 2, the literature review section. The research report findings are discussed in the context of the respective hypotheses proposed, and the actual events in global and South African financial markets, that punctuated the global financial crisis.

5.1 Identification of structural breaks in global financial markets

This research studies the impact of the global financial crisis on South African markets. The study is preceded by a scientifically derived metric defining the crisis as a whole or in this instance the constituent events that cumulatively represent the global financial crisis. The approach taken has been to apply statistical process control to the S & P 500 to identify the crisis events. Paragraph 4.1 presents the results of the statistical determination of these crisis events based on the methodology described in paragraph 3.4.1.

Structural breaks as defined in paragraph 1.6 are identified where DR > UCL. It is around these points of reference that the event study window is derived and subsequent hypotheses in the research tested. The results in paragraph 4.1 show a rejection of the null hypothesis, that there are no structural breaks in the time series of daily returns observed, in favour of the alternative hypothesis that there are structural breaks in the time series of daily returns observed. This is consistent

with the findings of Andreou and Ghysels (2002) who detect change points in the volatility dynamics associated with the Asian and Russian financial crises. The global financial crisis led to structural breaks in the financial markets. A structural break implies distortions in the markets. These distortions manifested in the form of increased volatility of daily returns.

Andersson *et al.* (2005) monitor business cycle turning points using SPC with the underlying parameters being movements in stock indices. They note that a turn in a leading index can be used to predict a turn in the business cycle. Paragraph 4.1 represents the results of monitoring a business cycle through movements in daily returns on the S & P 500. Golosnoy and Schmid (2008) note that SPC is useful for the detection of changes in the parameters of a process of interest. They go on to add that a control chart signals statistically significant changes in the process parameters. Accordingly decision makers can then investigate the possible causes and effects of the signal or change point. Paragraph 4.1 and Figure 4.1 show where statistically significant changes in process parameters have occurred. The change points signalled point to the question of *assignable cause* as introduced by Shewhart (1931) or of *special cause* as described by Deming (1982).

In this report this leads to consideration of the next assertion where the null hypothesis states that there is no association between structural breaks in the S & P 500 and reported key events in the global financial crisis. This hypothesis seeks to establish the possible existence and degree of coincidence between structural

breaks and reported events in the global financial crisis. Once an association and its degree, is determined then, a holistic conclusion can be framed.

5.2 Ascertain association of structural breaks identified with reported global financial events

This section interprets the findings of Hypothesis 2; the results of tests for association between the breaks identified and reported events in the global financial crisis. Hypothesis 1 tested the existence of structural breaks in the S & P 500 time series studied. The subsequent test conducted by Hypothesis 2, that for association between the structural breaks noted and reported events in the global financial crisis, is important if any inference is to be made on the reaction of South African markets in the form of the ALSI to global financial crisis events as they unfolded.

As noted in paragraph 4.2 the p-value returned is < 0.0001, a low p-value (< 0.05), which implies a significant relationship between reported events and structural breaks. Paragraph 4.2 shows the $\mathbf{R^2}$ returned by this model as 0.0908 which implies that ≈ 9 % of the variation, in the dependent variable structural breaks (SB) is explained and is attributable to the independent variable reported events. Similarly, this infers that the balance of 91% of the variation in SB is not due to RE but to other market factors such as intrinsic market valuations and other information available to market participants which may not have been prominently reported in public media platforms. This challenges the perfect information assumption that underlies the efficient market hypothesis proposed by Fama (1970).

The most important result from the regression reported in paragraph 4.2 is the α returned, of 0.12, not equal to zero. As noted in the results section Equation 4.2.1 from paragraph 2.4 is restated using data from Table 4.2.

$$SB = \alpha RE + K$$

Such that: $SB = 0.12RE + 0.0022$

This leads to a rejection of the null hypothesis that there is no association between structural breaks in the S & P 500 and reported key events in the global financial crisis, in favour of the alternative that there *is* an association between structural breaks in the S & P 500 and reported key events in the global financial crisis. This phenomenon was clearly evidenced in the crisis events that were reported during the global financial crisis. The period was punctuated by significant losses in asset values and global liquidity pressures, which led to immense strain on financial institutions, precipitating some of the turmoil events as recorded in Appendix 1.

The α of 0.12, although indicative of the existence of an association between structural breaks in the S & P 500 and reported events, is relatively low if we accept that a perfect association coefficient would return an α of 1. This brings into consideration the intensity of the structural break, in this analysis, represented by the duration of the turmoil period recorded. The low α suggests that not all reported events are detected as structural breaks. As reported in paragraph 4.1, it stands to reason that the longer the turmoil period computed, the greater the probability of coincidence between structural breaks and reported events.

Similarly, the greater the shock in the cycle the greater and possibly more protracted the impact on the underlying parameters (daily returns on the stock indices) and the greater the probability of detection. This is similar to conclusions reached by Andersson et al. (2005), who note that the intensity of the exogenous shock is a major factor in the successful detection of a turning point in a business cycle.

Having established that there are indeed structural breaks in the time series of daily returns on the S & P 500 observed, and that there *is* an association between these structural breaks and reported key events in the global financial crisis results in the conclusion that publicly available information impacts the intrinsic valuation of stocks traded as reflected in investor behaviour. This is evident in the statistically significant changes in the daily returns in the S & P 500. This concurs with the assertion by King and Wadhwani (1989) who note that stock prices generally reflect market fundamentals. The random walk model as expounded by Fama (1970), is premised on the concept of central tendency. In an efficient market any deviations from the central price trend give rise to arbitrative correction by free market forces. The SPC approach in stock market analysis infers that when daily returns (DR) no longer fall within control limits, then there has been some exogenous shock and the cycle is no longer in control. Table 4.1 and Figure 4.1 illustrate this very occurrence and present the crisis or turmoil events, which subsequently define the study. The association established in paragraph 4.2. forms the basis of the inter-market analysis that follows.

5.3 Comparison of bank liquidity premiums in the U.S. to bank liquidity premiums in S.A.

The results presented in paragraph 4.3 and interpreted in this section, test the null hypothesis, that states that the U.S. bank liquidity premium and the S.A. bank liquidity premium correlation exhibits no statistically significant change from before a turmoil event period and during a turmoil event period. The broader objective is not only that of comparing liquidity patterns across markets but of testing the similarity of conditions in S.A. and U.S. markets before and during the global financial crisis.

The correlation coefficient for the full period, ρ_F exhibits a slightly negative association of - 0.195 as shown in Table 4.3. The negative association suggests that when U.S. liquidity premiums have been in a low cycle, S.A. liquidity premiums have been in a high cycle and vice versa. The overarching finding is that the correlation before a turmoil period is not equal to the correlation after a turmoil period i.e $\rho_{LB} \neq \rho_{LA}$, such that the null hypothesis that the U.S. bank liquidity premium and S.A. bank liquidity premium correlation exhibits no statistically significant change from before a turmoil event period and during a turmoil event period, is rejected in favour of the alternative that the U.S. bank liquidity premium and S.A. bank liquidity premium correlation exhibits a statistically significant change from before a turmoil event period and during a turmoil event period. The dynamic correlation for the period under review suggests that interest spreads in the U.S. and in S.A. did not behave in similar fashion, i.e. movements in correlation did not evolve in sympathy.

A negative correlation is shown in the majority of the periods included in the review. This is not surprising as it comprises the overall negative correlation shown for the full period. What is of interest are the relative increases in the correlation coefficients between the stable periods and the turmoil periods. In particular, the correlation coefficient in turmoil period 2, ρ_{T2} is – 0.475; which is approaching the significant association threshold of +/- 0.5. The correlation coefficient for stable period 3, ρ_{S3} the next period swings to + 0.487. This indicates that the association of U.S. liquidity premiums to S.A. liquidity premiums behaves differently under different cycles. The quality of the conclusions made in this regard, would benefit from a longer period of study. Indeed, fluctuations in the correlation coefficient from negative to positive may be indicative of a lag effect between the two liquidity premium markets. Figure 4.2 supports this view, showing that although the correlation coefficients are specific to the periods as defined, their interpretation must take cognisance of the residual effects of events in preceding periods. The different lengths of the periods over which the measures have been taken will also contribute to the variations noted.

Generally over period S1 the liquidity premiums are positively correlated i.e. slim premiums in the U.S. against slim premiums in S.A. In the months preceding period T1 and during the crisis period, the correlation swings to negative. On the ground, while liquidity premiums in the U.S. widened significantly and for a protracted period, those in S.A. widened by proportionately smaller margins and for a shorter time. This pattern is what was reported as the global credit crunch. As levels of mistrust grew between the banks, the inter-bank system became incapacitated in its ability to fulfil its primary responsibility, that of allocating

liquidity between economic areas of surplus and deficit. This is evidenced by multiple government bail-out interventions for financial institutions in the United States, Belgium and the United Kingdom, as shown in Appendix 1.

The comprehensive analysis of model parametrics presented in Appendix III is summarised in Table 4.3. The correlation coefficients are predominantly negative, although periods S and S2 return positive correlations. This asynchronous pattern is mirrored in Figure 4.2. suggesting that there may be a time lag in the liquidity premium regimes in the two countries. Full period, F and period S3 p-values and F-ratios indicate a significant relationship but this is not reflected in other periods. This supports the time lag possibility and co-indicates asynchrony.

The changes evident in the correlation coefficient of US_SA liquidity premiums results in the null hypothesis being rejected in favour of the alternative hypothesis, such that we can conclude that the U.S. bank liquidity premium and S.A. bank liquidity premium correlation exhibits a change from before the turmoil event periods and during turmoil event periods. Having defined this as an indicator of similar conditions or lack thereof between U.S. and S.A. markets, we can infer that conditions in the U.S. and S.A. markets were not the same before and during the global financial crisis. This view is given additional credence by the absence of sub–prime defaults in South Africa and government bail-out interventions for South African financial institutions. Specific to Hypothesis 3, where liquidity conditions moved in sync between U.S. and S.A. markets, the degree of sympathy has been markedly varied. The inference of different conditions prevalent before and during the crisis in the two different markets supports the assertion of section

2.3, which highlights the differences in the regulatory environment between the U.S. and S.A. In addition, while it is accepted that the root cause of the global financial crisis was the sub-prime debacle, its spill over from the U.S. was not premised on the existence of similar conditions in other countries. Indeed, this observation holds for South Africa and many emerging market economies, in that conditions in respect of regulatory regimes, mortgage bond markets and the evolution of interest rate liquidity premiums, were not similar to those in the U.S., but the subsequent effects were felt across the globe. This study investigates to what degree these effects were evident in South African markets.

5.4 Comparison of the impact of global events on the Standard and Poors 500 against the impact on the All Share Index

The correlation coefficient for F is almost 23%. The positive trends prevail throughout the different periods bar S4, indicating a predominantly consistent linkage between the two markets. On the basis of the definition proposed by Kaminsky *et al.* (2003) in paragraph 1.6, this would imply contagion. Forbes and Rigobon (2002) caution that such interpretation must also take into account the effects of market volatility, which tends to typify crisis periods. The period to period correlation co-movements are presented in Table 4.4. The apparent failure of a comparison of cross market correlation coefficients to detect what were potentially contagion events or periods of strong market inter-linkage, as is the case with T3, where $\rho_F > \rho_{T3}$ implying that there has been no contagion as defined by Hypothesis 3, could be as a result of the time frames of the actual turmoil periods.

This observation is also noted in paragraph 4.4. which shows T1 is for 28 days due to a concentration of crisis events over that time while turmoil periods, two and three, T2 (12 days) and T3 (11 days) are much closer to the 11-day event window as defined around one triggering crisis event, in each of the respective turmoil periods. A similar detection limitation is noted by Forbes and Rigobon (2002).

Reduced correlations are returned between S2 & T2 and S3 & T3 indicating reduced association between U.S. and S.A. markets. This reduced correlation is supportive of the market diversification argument, but the apparent change in S.A. investor behaviour could be induced by an event in the U.S. market, in which instance there is a case for as a bare minimum, market inter-linkage. Kaminsky *et al.* (2009) re-iterate that contagion occurs as a result of informed investors rebalancing their portfolios in response to a macroeconomic risk that although it pervades all countries, originates from an event in one country. As events unfolded in the global financial crisis, stock market volatility in the S & P 500 as demonstrated in Hypothesis 1 and Hypothesis 2, filtered through to other markets, in this instance the ALSI. Throughout the crisis the evidence of S & P 500 market volatility spilling over to the ALSI may have been informed by intrinsic market fundamentals of stocks traded on the ALSI but the influence of general emerging market risk aversion cannot be discounted. This phenomenon is noted by McNulty and Bisseker (2008) who highlight the flight of international investors from emerging markets as global financial market fears and turmoil mount. They propose that South Africa cannot be immune to this trend of risk aversion and the flight of investor funds to markets of *perceived quality*.

5.5 Focus on the impact on the financial markets

This section analyses cross-market **β**-coefficients as computed on the ALSI and FINI15 and on the S & P 500 and SFINL, respectively. Exhibition of a statistically significant change in the **β**-coefficients as the crisis unfolded, indicates whether patterns emerging from U.S. markets were similar or otherwise, to those in S.A.

The interpretation of results first considers an intra-market comparison i.e. evolution of **β**-coefficients from period to period in one market then extension of the analysis to inter-market comparison, i.e. comparison of patterns between the S & P 500 and the ALSI.

5.5.1 Intra-market analysis ALSI_FINI15

In this section the results of tests performed on the ALSI and the FINI15 are analysed and interpreted.

β-coefficients fluctuate from period to period but not by significant margins. This suggests that the risk profile attributable to the financial index on the ALSI did not change significantly over the period of study. The FINI15_ALSI **β-**coefficients returned, exhibited no statistically significant increase over the period under review, indicating that the market related or systematic risk of the financial index did not increase in any great disproportion to the ALSI i.e. FINI15 volatility did not increase against the volatility of the market as a whole.

As noted in paragraph 4.5 the predominant observation is that of no significant increase in the **β**-coefficient of the financial index during the crisis events

identified, supporting the null hypothesis that states that the **β**-coefficient of the financial index does not exhibit a statistically significant increase during the crisis events identified, and rejection of the alternative that the **β**-coefficient of the financial index exhibits a statistically significant increase during the crisis events identified. This means that financial sector stocks on the ALSI did not prove more volatile over the period of global financial crisis, i.e. the increase in non-diversifiable risk on the FINI15 was not disproportionate to the increase in the same on the ALSI.

5.5.2 Intra-market analysis S & P 500_S5FINL

In this section the results of tests performed on the S & P 500 and the S5FINL are analysed and interpreted.

β-coefficients fluctuate markedly between the periods, indicating a high degree of volatility in the financial index risk in the S & P 500. **β**-coefficients fluctuate from period to period by significant margins. This suggests that the risk profile attributable to the financial index on the S & P 500 changed significantly over the period of study. The S5FINL_S & P 500 **β-**coefficients returned, exhibited statistically significant increases over the period under review, indicating that the market related or systematic risk of the financial index increased in great disproportion to the S & P 500, i.e. S5FINL volatility increased against the volatility of the market as a whole.

As stated in section 4.5 the **β**-coefficients returned for the S5FINL and the S & P 500 show higher betas in the turmoil periods and lead to a rejection of the null

hypothesis that states that **β**-coefficient of the financial index does not exhibit a statistically significant increase during the crisis events identified, in favour of the alternative that the **β**-coefficient of the financial index exhibits a statistically significant increase during the crisis events identified. This means that financial sector stocks on the S & P 500 proved more volatile over the period of global financial crisis, i.e. the increase in non-diversifiable risk on the S5FINL was not disproportionate to the increase in the same on the S & P 500.

5.5.3 Inter-market analysis S & P 500_ALSI

The parametrics analysed in the two markets do not exhibit similar characteristics. Noting that the objective was to gauge the rate of return on the financial indices in the S & P 500 and the ALSI against the overall boards respectively, the analysis of **β**-coefficients shows that the risk proportions between specific finance index attributable risk and overall market risk, behaves differently within each of the markets and indeed when compared with each other. The pattern that emerges on the evolution of risk attributable to the S5FINL in the S & P 500 (as measured by **β**-coefficients) is not replicated in the evolution of risk attributable to the FINI15 in the ALSI. This is evident in Figure 4.5., where the different trends in the **β**-coefficients is illustrated most profoundly with the greater volatility in the S5FINL evident over the less pronounced movements in the FINI15. This supports the notion that similar conditions did not exist in S.A. as they did in the U.S. prior and during the global financial crisis as demonstrated by the findings in respect of Hypothesis 3, which concluded that conditions in respect of regulatory regimes,

mortgage bond markets and the evolution of interest rate liquidity premiums, in S.A. were not similar to those in the U.S.

These observations imply that financial institutions in the U.S. market were at the very core of the global financial crisis, which is consistent with the view that the crisis was precipitated by sub-prime instruments traded by these entities. Conversely, although the S.A. market was impacted by the global financial crisis as a whole, the financial institutions were not disproportionately impacted when compared to the rest of the ALSI. In comparing the volatility of the two markets, on the evidence presented, the conclusion is that the impact on U.S. financial institutions, of the global financial crisis, was considerably greater than that on S.A. financial institutions.

6 CONCLUSIONS AND RECOMMENDATIONS

The objective of this research was to investigate the reaction of South African markets to the 2008 global financial crisis. This was done through:

- a discussion of possible causes of the global financial crisis;
- empirically identifying structural breaks in global financial markets to ascertain whether these coincided with key reported events in the global financial crisis;
- analysing interest rate spreads in the United States and in South Africa, as indicators of market liquidity in each country to compare conditions in the two environments prior to the crisis;
- comparing cross-market correlations between the Johannesburg Securities Exchange All Share Index (ALSI) and Standard and Poors 500 (S & P 500), before and after the crisis events identified to determine whether there are any statistically significant changes in cross-market correlations; and
- Measuring the ß coefficients of the financial indices on the S & P 500 and the ALSI over the period of study to determine whether there are statistically significant changes over the crisis events identified.

The conclusions of the research conducted according to this framework are presented in sections 6.1 to 6.6.

6.1 Possible causes of the global financial crisis

Fundamental to the study was the identification of the possible causes of the global financial crisis. This was done through a discussion of the regulatory environments in the United States and in South Africa as well as the sub-prime crisis, as epicentred in the U.S. The motivation for this exercise was to ascertain whether similar conditions existed in S.A. prior to the global financial crisis. No quantitative hypothesis was proposed in this regard, but a review of the literature showed that the regulatory frameworks presented for the two countries does not reveal any significant variance in approach, but a number of changes in the U.S. framework in the past ten to fifteen years suggests a policy trajectory towards greater financial institution self-regulation, if indeed not deregulation, in many spheres of the banking environment. Barth *et al.* (2000) raise this point in their analysis of the repeal of the Glass Steagell Act in November 1999, which ultimately changed the terrain of global banking and no doubt contributed to the precipitation of the global financial crisis. Conversely the South African environment has over the same period of time operated under tight exchange control regulations as well as promulgation of the National Credit Act in 2005.

The literary evidence strongly suggests that the sub-prime crisis in the U.S. precipitated the global meltdown as a whole, but conditions in S.A. were not similar to those in the U.S. with respect to regulatory environment and the prevalence of sub-prime activity, prior to the global financial crisis.

6.2 Identification of structural breaks in global financial markets

In applying the test for structural breaks the null hypothesis states there are no structural breaks in the observed time series of daily returns over the period under review. The alternative hypothesis states there are structural breaks in the observed time series of daily returns over the period under review.

$$H_0: \quad DR \leq UCL$$

$$H_A: \quad DR > UCL$$

This research finds that there *are* structural breaks in the observed time series of daily returns over the period under review.

6.3 Ascertain association of structural breaks identified with reported global financial events

In determining the association of structural breaks with reported global financial events, the null hypothesis states that there is no association between structural breaks in the S & P 500 and reported key events in the global financial crisis. The alternative hypothesis states that there is an association between structural breaks in the S & P 500 and reported key events in the global financial crisis.

$$H_0: \quad \alpha = 0$$

$$H_A: \quad \alpha \neq 0$$

Where α is the coefficient representing association as explained in equation 4.2.1. The research found that there is an association between structural breaks in the S & P 500 and reported key events in the global financial crisis.

6.4 Comparing bank liquidity premiums in the U.S. to bank liquidity premiums in S.A.

In comparing bank liquidity premiums in the U.S. to bank liquidity premiums in S. A. the null hypothesis states that the U.S. bank liquidity premium and S.A. bank liquidity premium correlation exhibits no statistically significant change from before a turmoil event period and during a turmoil event period.

The alternative hypothesis states that the U.S. bank liquidity premium and S.A. bank liquidity premium correlation exhibits a statistically significant change from before a turmoil event period and during a turmoil event period.

$$H_o: \quad \rho_{LB} \neq \rho_{LA}$$

$$H_A: \quad \rho_{LB} = \rho_{LA}$$

This research finds that the U.S. bank liquidity premium and S.A. bank liquidity premium correlation exhibits a change from before the turmoil event periods and during turmoil event periods. Asynchronous correlation means the liquidity premium cycles were not the same. The underlying rationale for comparing liquidity premiums in the U.S. to those in S.A. was to approximate the degree of similarity or lack thereof between the two markets particularly because illiquidity is

one of the elements that punctuated the global financial crisis. In this research a comparison of liquidity premiums suggests that similar conditions did not prevail in the two markets. This conclusion supports the observation made in section 6.1 of dissimilar regulatory and sub-prime conditions being evident in the U.S. and in S.A. before and during the crisis, and in this instance with respect to liquidity.

6.5 Comparison of impact of global events on the Standard and Poors 500 against impact on the All Share Index

The comparison of the impact of global events on the S & P 500 against the impact on the ALSI used a cross market correlation analysis for the period spanning sub periods before, during and after turmoil events in the global financial crisis.

The null hypothesis states that the cross-market correlation between the S & P 500 and the ALSI do not exhibit a statistically significant change during the crisis events identified. The alternative hypothesis states that the cross-market correlation between the S & P 500 and the ALSI exhibit a statistically significant change during the crisis events identified.

$$H_0: \quad \rho_F = \rho_T$$

$$H_A: \quad \rho_F < \rho_T$$

Guided by the predominant period to period finding that the cross-market correlation between the S & P 500 and the ALSI exhibit a statistically significant change during the crisis events identified, this research concludes that there is an

argument for contagion or at a bare minimum, strong market inter-linkage flowing from U.S. markets to S.A. markets.

6.6 Focus on impact on the financial markets

Having established the impact of the global financial crisis on S.A. markets the focus shifted to the proportion of the impact on the financial markets as constituent indices of the respective main boards in each of the two countries respectively.

The null hypothesis states that the beta coefficient of the financial index does not exhibit a statistically significant increase during the crisis events identified. The alternative hypothesis states that the beta coefficient of the financial index exhibits a statistically significant increase during the crisis events identified.

$$H_0: \quad \beta_{1B} \geq \beta_{1A}$$

$$H_A: \quad \beta_{1B} < \beta_{1A}$$

For the intra-market analysis for the FINI15_ALSI this research finds that the **β**-coefficient of the financial index does not exhibit a statistically significant increase during the crisis events identified. For the intra-market analysis for the S5FINL_S & P 500 this research finds that the **β**-coefficient of the financial index *does* exhibit a statistically significant increase during the crisis events identified. The overarching conclusion therefore, would be that greater risk was in evidence in U.S. financial stocks in proportion to the S & P 500 bourse as a whole, than was

in evidence in S.A. financial stocks in proportion to the ALSI as a whole, over the period reviewed.

6.7 Resolution of research problem

The main problem of this research was to identify the possible causes and effects of the global financial crisis and establish how these impacted South African markets.

An analysis of conditions in the U.S. and in S.A. showed that the regulatory environment and sub-prime issues at the centre of the global financial crisis as existed in the U.S. were not evident in S.A. The discussion of these factors as possible causes of the crisis was part of the first sub-problem, namely that of identifying the possible causes and effects of the global financial crisis.

This problem was resolved through Hypotheses 1 to 3, where:

Hypothesis 1 identified structural breaks in global financial markets.

Hypothesis 2 established an association between structural breaks in global financial markets and reported events in the course of the crisis. This was principally to lay the foundation for a cross market analysis of the effects around the crisis events identified.

Hypothesis 3 compared bank liquidity premiums in the U.S. to bank liquidity premiums in S. A. and found that the two were dissimilar. This finding is consistent with the observation that the causes of the global financial crisis as manifested in the U.S. were not evident in S.A.

Despite the apparent lack of commonality of pre-global financial crisis conditions between the U.S. and S.A. there is evidence of greater similarity of the effects in both markets respectively. The second sub-problem identified key events in global markets over the period of study and established how these impacted South African markets. This problem was resolved through Hypotheses 4 and 5 where:

Hypothesis 4 compared the impact of global events on the S & P 500 against the impact on the ALSI, concluding that the effects of crisis events were evident in both markets, suggesting some degree of contagion from U.S. to S.A. markets.

Hypothesis 5 focussed the analysis within the specific stock indices, the S & P 500 and the ALSI respectively, to gauge the impact on the financial indices as representative of financial institutions in the U.S. and S.A. The conclusion of greater risk being evident in U.S. as opposed to S.A. financial institutions, suggests that the global financial crisis impacted S.A. financial institutions to a lesser degree. This is consistent with the view that S.A. banks weathered the storm of the financial crisis better than their U.S. counterparts, as noted by Kruger cited by McNulty and Rose (2008) and also evidenced by there being no bank closures in South Africa, no sustained liquidity problems and no government bail-out interventions to pre-empt or mitigate events of this nature.

The findings of the research point to a high degree of correlation at the main index level, which high co-movement is not replicated proportionally at the financial index level. This provides useful information to investors approaching portfolio diversification through use of stock participation in different countries. On an S & P 500 to ALSI level portfolio diversification gains may not be as strong as

envisaged, but at the S5FINL versus the FINI15 level some opportunity for diversification, albeit still in financial stocks, can be found.

6.8 Recommendations for future research

The recommendations for future research are informed by the limitations noted in this study and the results returned. The research topics proposed would not only complement the findings of this study but also give a clearer, multi-dimensional view of the effects of the global financial crisis on South African markets. Future research areas could include:

- Replication of this study for an extended period of time. The fact that the research findings would have been improved by a larger data set, i.e. a longer period of review cannot be overemphasised;

- The identification of structural breaks is arrived at through SPC tests conducted on the daily returns of the S & P 500. Additional value could be derived through the conduct of similar tests on the ALSI.

- Extension of this study to indices across regions. A better understanding of contagion on global markets would be achieved if the study was replicated for indices in more than the two countries presented in this research. Such a study would also consider the effects of the advent of the 24 hour new cycle presented by the modern age, and could span bourses in various regions as listed below:

- Asia/Pacific Nikkei in Japan, Hang Seng in Hong Kong, ASSX in Australia;
- Europe/Africa CAC in Paris, FTSE in London;
- Americas Bovespa in Sao Paulo; and
- MSCI global and MSCI emerging markets which would allow for a more comprehensive interpretation and greater relevance across territories, of the results returned; and

- Extension of the **β**-coefficient analysis to other sectors on the main boards. The conclusions derived in respect of the impact of the global financial crisis on financial institutions in S.A. This would involve the consideration of **β**-coefficient evolutions such as the resources sub-index and the industrials sub-index on the ALSI against comparable indices on the S & P 500. This would also allow for an investigation and possible adjustment for the effect of resource stock dominance on the ALSI on results as noted by Gilbertson and Goldberg (1981).

- An assessment of the impact of the 2008/09 global financial crisis on indices in different countries, where there have been localised financial crises in recent history. The objective would be to ascertain whether past crises and responses thereto, have helped insulate certain countries particularly in emerging markets from the full impact of the crisis. The comparison would include a comparative analysis of U.S. markets that were at the centre of the storm against indices in countries affected by the

Asian Financial Crisis and countries in Central and South America where currency crises have wreaked catastrophe in recent decades.

- Extension of the research to the second wave macroeconomic effects to include the analysis of data such gross domestic product and job loss figures, to gauge the degree of economic contraction as a result of the crisis. This would build on the key focus areas of this research, being the first wave effects of the global financial crisis as highlighted in paragraph 1.4 and illustrated in figure 1. These included the sub-prime crisis, the subsequent liquidity crisis, bank failures and precipitation into the full scale global financial crisis of 2008/09. This would be similar to the model proposed by Chen, Roll and Ross (1986) which studied the extent to which macroeconomic variables affect daily returns on stock markets.

- An investigation of the effectiveness of global responses to the financial crisis in their various forms including:

    - government bail-outs;
    - fiscal stimulus packages; and
    - monetary policy regimes typified by benign interest rates;

or have these merely transferred a systemic financial crisis to a sovereign debt crisis.

- A study into the effects of the global financial crisis on the global financial framework in the form of:

- The regulatory environment – introduction of more stringent regulations, increased monitoring and central bank supervision as well as counterparty surveillance;

- An analysis of banking practices in the aftermath of the crisis in terms a return to single purpose banking, a clear separation in financial institutions between traditional deposit taking and lending banking and riskier more venturesome investment banking.

- Review of capital adequacy requirements and interconnected lending between banks;

- Review of risk assessment structures in banks with regards to lending practices, incentive schemes to discourage short term venturesome behaviour, and measured financial innovation to ensure transparency and complete understanding of financial risks attributable to a product or trade; and

- Revision of rating agency procedures and assessment of ratings.

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8 APPENDICES

8.1 Appendix I Key reported events in the global financial crisis

Date	Event	Source	Verification	
			Article	Web reference
11 /01/08	Bank of America announces transaction to acquire struggling mortgage lender Countrywide	Fin24.com	Bank of America Agrees to Purchase Countrywide Financial Corp	http://newsroom.bankofamerica.com/index.php?s=43&item=7956
18/02/08	Northern Rock nationalized by the exchequer due to concerns resulting in part from risky property loans	Fin24.com	Q&A: Nationalised Northern Rock - What next?	http://news.bbc.co.uk/2/hi/europe/7249655.stm
24/03/08	Bear Stearns becomes the first major US investment bank to succumb to sub-prime exposure	Fin24.com	Bear Stearns Cos Inc.	http://topics.nytimes.com/top/news/business/companies/bear_stearns_companies/index.html
01/04/08	UBS announces massive losses due to risky investments	Fin24.com	UBS hit badly by financial crisis Banking giant expects writedowns of CHF 12 billion	http://www.expatica.com/ch/news/local_news/UBS-hit-badly-by-financial-crisis-.html

			in the first quarter	
29/05/08	JP Morgan Chase acquires Bear Stearns	BOE	Bear Stearns Cos Inc.	http://topics.nytimes.com/top/news/business/companies/bear_stearns_companies/index.html
07/09/08	US mortgage giants Freddie Mac and Fannie Mae taken into public ownership	Fin24.com/ BOE	Credit crunch	http://www.ibscdc.org/Case_Studies/Economics/Economic%20Crisis/ECC0020.htm
15/09/08	Merryll Lynch acquired by Bank of America	BOE	Bank of America Buys Merrill Lynch Creating Unique Financial Services Firm	http://newsroom.bankofamerica.com/index.php?s=43&item=8255
15/09/08	Lehman Brothers files for bankruptcy	Fin24.com/ BOE	Banking crisis: Lehman Brothers files for bankruptcy protection	http://www.guardian.co.uk/business/2008/sep/15/lehmanbrothers.creditcrunch
16/09/08	American International Group receives government support	Fin24.com/ BOE	U.S. to Take Over AIG in $85 Billion Bailout; Central Banks Inject Cash as Credit Dries Up	http://online.wsj.com/article/SB122156561931242905.html
13/09/08	Lloyds TSB acquires HBOS saving it from bankruptcy	Fin24.com	Financial crisis: HBOS takeover by Lloyds TSB in turmoil	http://www.telegraph.co.uk/finance/financetopics/financialcrisis/3110792/Financial-crisis-HBOS-takeover-by-Lloyds-TSB-in-turmoil.html

3/10/08	Fortis bailed out by Belgium, Netherlands & Luxembourg	Fin24.com	Fortis statement on transaction with Government of the Netherlands	http://www.holding.fortis.com/press/info/UK_PR_Fortis_03102008.pdf
2/10/08	US administration approves 700b bail out plan	Fin24.com	US Senate backs $700bn bail-out plan	http://www.guardian.co.uk/business/2008/oct/02/creditcrunch.marketturmoil
28/09/08	Bradford & Bingley Mortgage business nationalised / UK Govt. Savings operation bought by Group Santander	Fin24.com	Financial crisis: Bradford & Bingley to be nationalised by Treasury	http://www.telegraph.co.uk/finance/financetopics/financialcrisis/3095471/Financial-crisis-Bradford-and-Bingley-to-be-nationalised-by-Treasury.html
20/10/08	ING Group EUR10b receives capital injection from Dutch govt.	BOE	Financial Crisis Dutch government invests Euro 10 billion in ING Groep	http://www.welt.de/english-news/article2600863/Dutch-government-invests-Euro-10-billion-in-ING-Groep.html
29/09/08 6- 8/10/08	Iceland nationalises major banks	Fin24.com	The Icelandic Government Information Centre - Timeline	http://www.iceland.org/info/iceland-crisis/timeline/
22/09/08	Group Santander acquires Alliance & Leicester	BOE	In the Face of the Financial Crisis, Spanish Banks Gain Strength through Acquisitions	http://www.wharton.universia.net/index.cfm?fa=viewArticle&id=1589&language=english

17/11/08	Chinese government announces US$ 586b economic stimulus package	Fin24.com	Stimulus package details revealed	http://www.chinaeconomicreview.com/dailybriefing/2008_11_17/Stimulus_package_details_revealed.html
23/11/08	Citigroup receives US$40b capital injection from US government and guarantee on $306b assets	BOE	Citigroup Bailout Press Release	http://www.docstoc.com/docs/2742123/Citigroup-Bailout-Press-Release
16/01/09	Bank of America receives $20b capital injection and $118b guarantee from US government		Financial crisis: Bank of America given $138bn rescue package	http://www.guardian.co.uk/business/2009/jan/16/bank-of-america-20bn-rescue
31/12/08	Wachovia acquired by Wells Fargo		Wells Fargo Merger	https://www.wellsfargo.com/press/2009/20090126_Wachovia_HMS
Compiled from: Fin24.Com and BOE Private Clients. (Verified for accuracy from various sources as disclosed)				

8.2 APPENDIX II factors for computing control chart limits

Number of measurements in	Factors for R Chart	
	D_3 (lower)	D4 (upper)
2	0	3.268
3	0	2.574
4	0	2.282
5	0	2.114
6	0	2.004
7	0.076	1.924
8	0.136	1.864
9	0.184	1.816

8.3 APPENDIX III Comprehensive research results & summary statistics

8.3.1 Identification of structural breaks in global financial markets

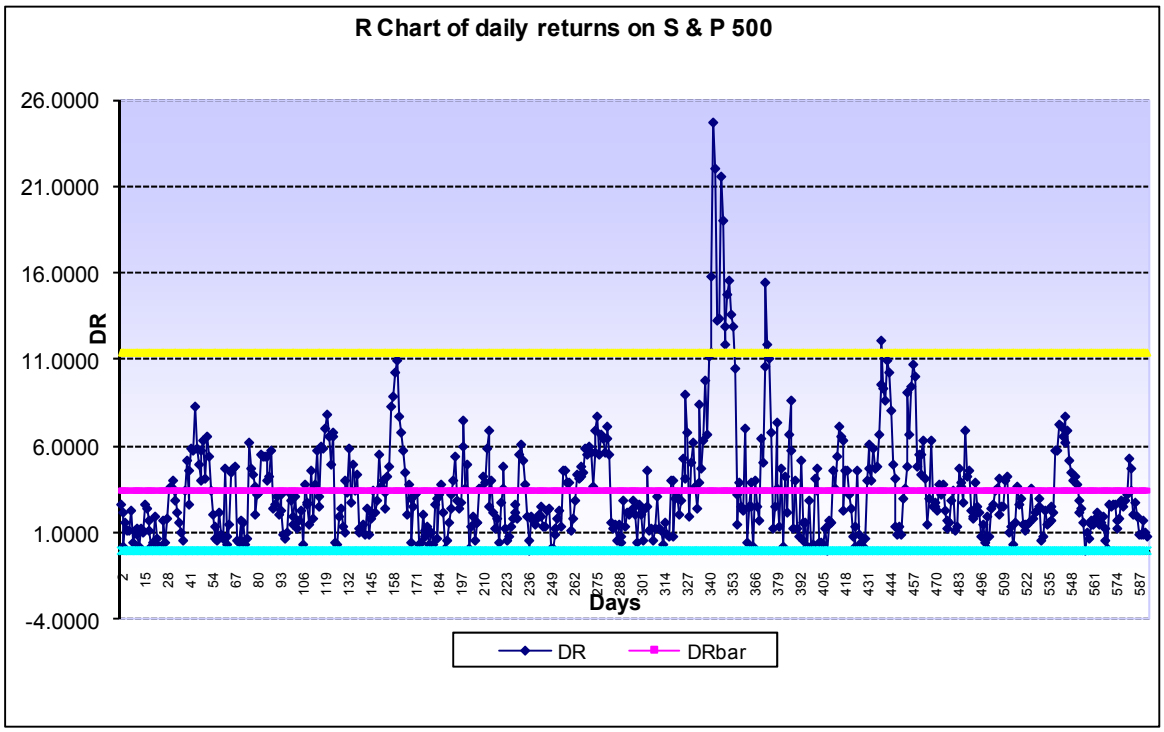


Figure 4.1 R- chart of daily returns on S & P 500

8.3.2 Ascertain association of structural breaks identified with reported global financial events

Table 4.2: Association of structural breaks identified with reported global financial events

StatTools Hypothesis 2 - Ascertain association of structural breaks identified with reported global financial events

Analysis: Regression H2
Performed By: MPOFU Vusi
Date: 18-Jan-10
Updating: Static

Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate
	0.3013	0.0908	0.0893	0.159384119

ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	1.499298851	1.499298851	59.0199	< 0.0001
Unexplained	591	15.0133487	0.025403297		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	0.002155172	0.007399222	0.2913	0.7709	-0.012376796	0.016687141
RE	0.121875835	0.015864214	7.6824	< 0.0001	0.090718741	0.15303293

8.3.3 Comparison of bank liquidity premiums in the U.S. to bank liquidity premiums in S.A.

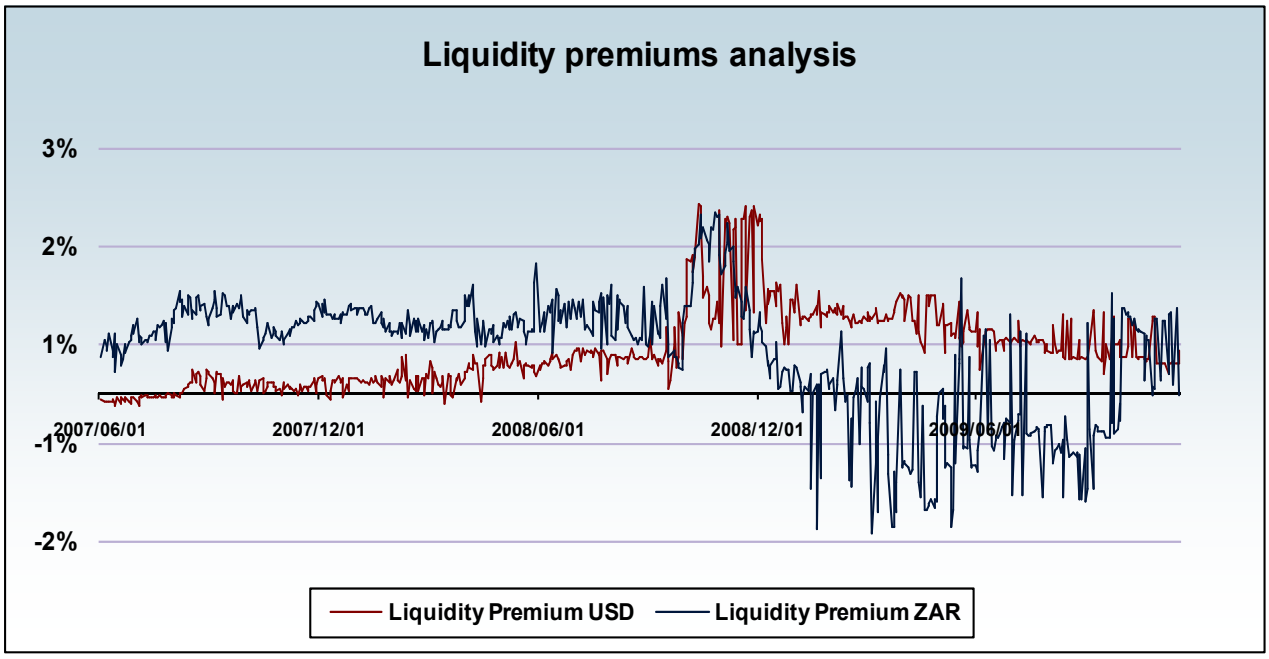


Figure 4.2: Liquidity premiums analysis for U.S. and S.A. markets

Table 4.3: Comparison of bank liquidity premiums in the U.S. to bank liquidity premiums in S.A.

The Impact of the Global Financial Crisis on South African Markets
Hypothesis 3 - Analysis of US bank liquidity premiums to SA bank liquidity premiums
Liquidity premium data

StatTools	Summary of liquidity premium correlations + parametrics
Analysis:	Correlation matrix H3
Performed By:	MPOFU Vusi
Date:	16-Jan-10
Updating:	Live

Period	F	S1	T1	S2	T2	S3	T3	S4
Correlation	-0.195	0.091	-0.137	0.225	-0.475	-0.487	-0.115	-0.206
p-value	< 0.0001	0.0892	0.5656	0.4829	0.2348	<0.0001	0.7862	0.0108
F-ratio	21.8165	2.9046	0.3426	0.5311	1.7441	19.2476	0.0804	6.6637
R-Square	0.0382	0.0083	0.0187	0.0504	0.2252	0.2369	0.0132	0.0423

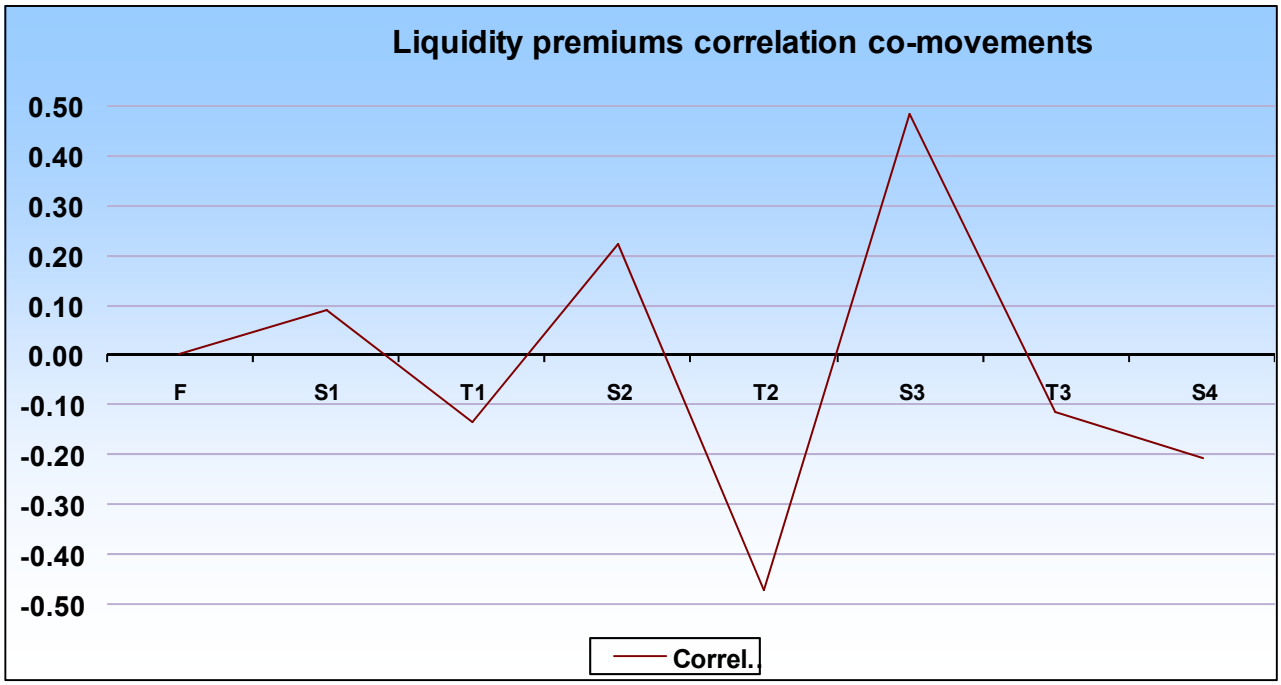


Figure 4.3 Evolution of U.S._S.A. liquidity premium correlation co-movements

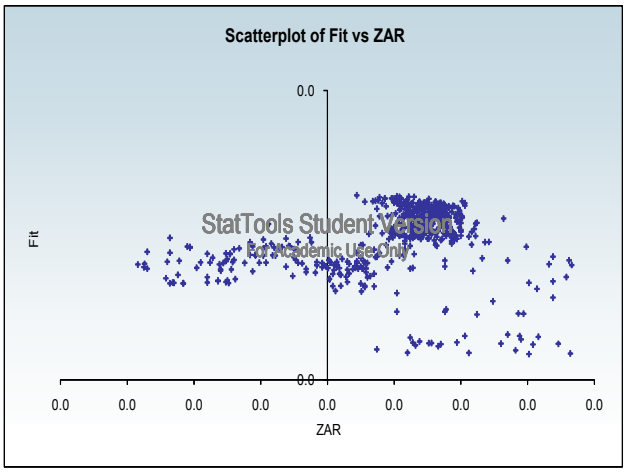
The Impact of the Global Financial Crisis on South African Markets
Hypothesis 3 - Analysis of bank liquidity premiums in the US to bank liquidity premiums in SA
Liquidity premium data

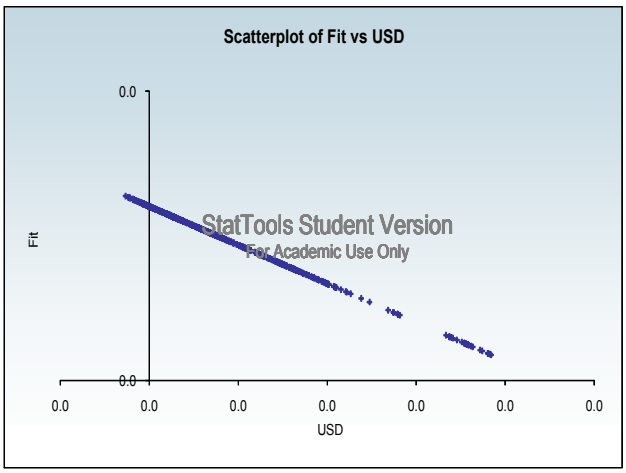
StatTools Full period, F
Analysis: Regression
Performed By: MPOFU Vusi
Date: 04-Feb-10
Updating: Static

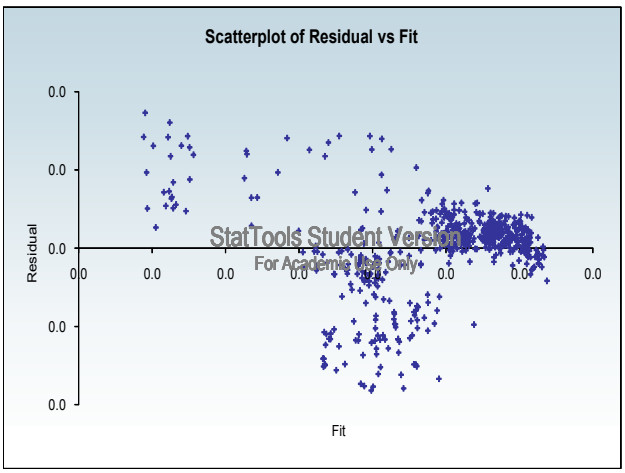
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.1955	0.0382	0.0365	0.005833761	0.3357

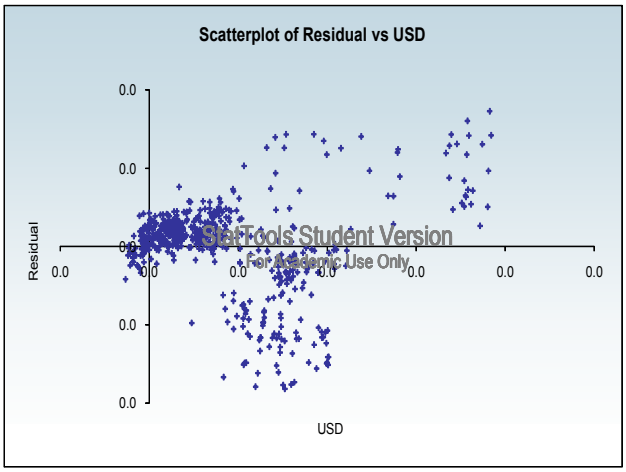
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	0.000742476	0.000742476	21.8165	< 0.0001
Unexplained	549	0.018683992	3.40328E-05		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	0.006018171	0.000352553	17.0703	< 0.0001	0.005325654	0.006710688
USD	-0.267114432	0.057188001	-4.6708	< 0.0001	-0.379448504	-0.154780359









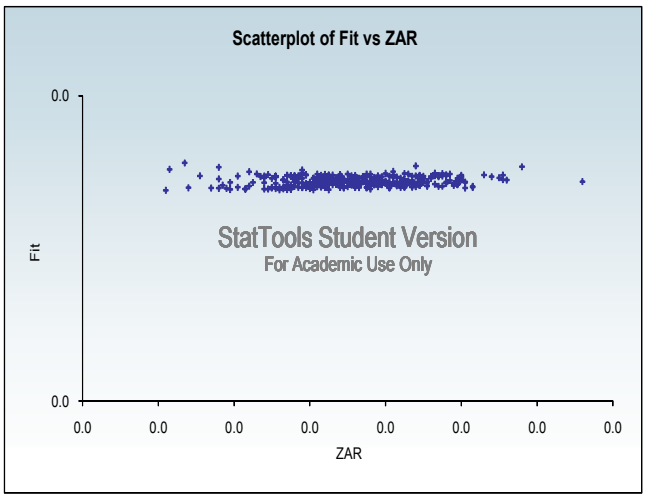
The Impact of the Global Financial Crisis on South African Markets
Hypothesis 3 - Analysis of bank liquidity premiums in the US to bank liquidity premiums in SA
Liquidity premium data

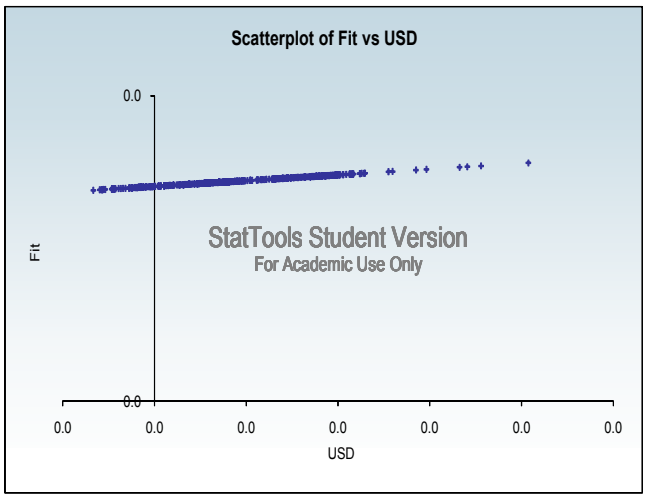
StatTools Stable period 1, S1
Analysis: Regression
Performed By: MPOFU Vusi
Date: 04-Feb-10
Updating: Static

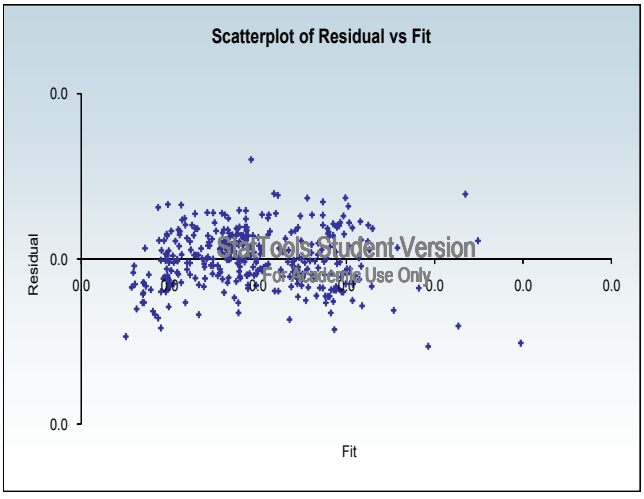
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.0911	0.0083	0.0054	0.001723775	0.9222

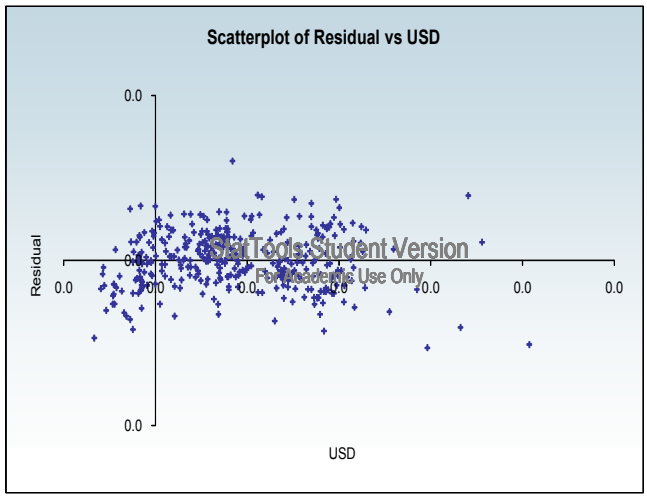
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	8.63058E-06	8.63058E-06	2.9046	0.0892
Unexplained	347	0.001031075	2.9714E-06		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	0.007026737	0.000133723	52.5468	< 0.0001	0.006763727	0.007289748
USD	0.094269879	0.055313794	1.7043	0.0892	-0.014522618	0.203062377









The Impact of the Global Financial Crisis on South African Markets
Hypothesis 3 - Analysis of bank liquidity premiums in the US to bank liquidity premiums in SA
Liquidity premium data

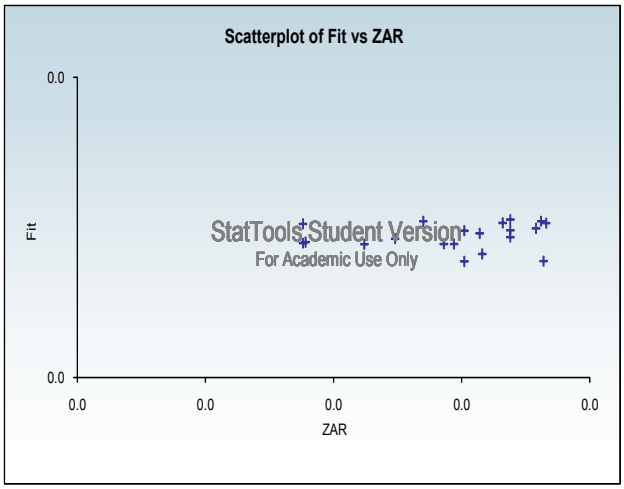
StatTools Turmoil period 1, T1

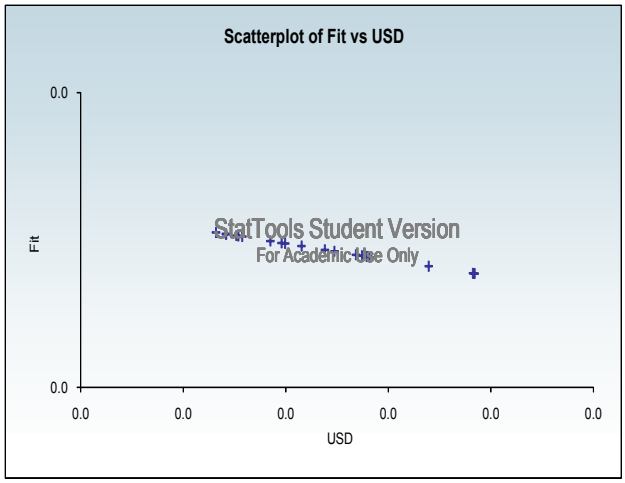
Analysis: Regression
Performed By: MPOFU Vusi
Date: 04-Feb-10
Updating: Static

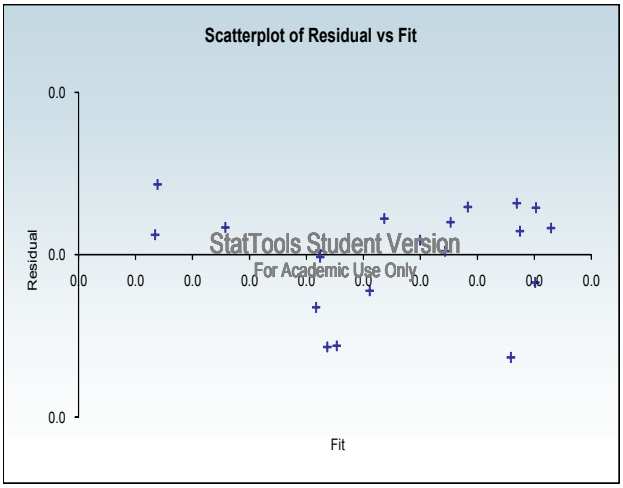
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.1367	0.0187	-0.0358	0.003219033	0.2622

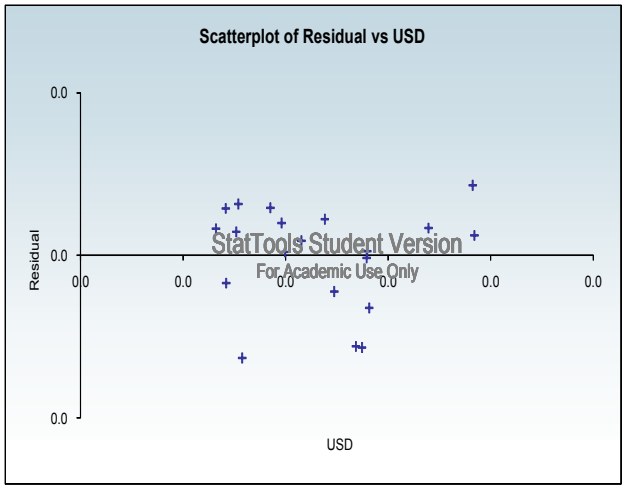
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	3.5504E-06	3.5504E-06	0.3426	0.5656
Unexplained	18	0.000186519	1.03622E-05		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	0.015986151	0.002304027	6.9384	< 0.0001	0.01114557	0.020826733
USD	-0.110211287	0.188283856	-0.5853	0.5656	-0.50578099	0.285358416









The Impact of the Global Financial Crisis on South African Markets
Hypothesis 3 - Analysis of bank liquidity premiums in the US to bank liquidity premiums in SA
Liquidity premium data

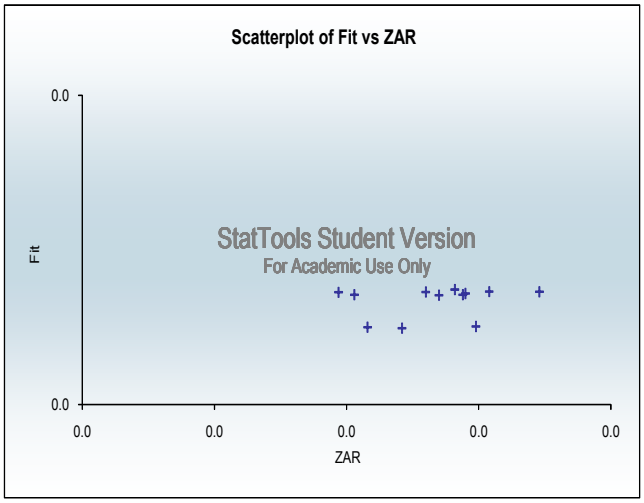
StatTools Stable period 2, S2

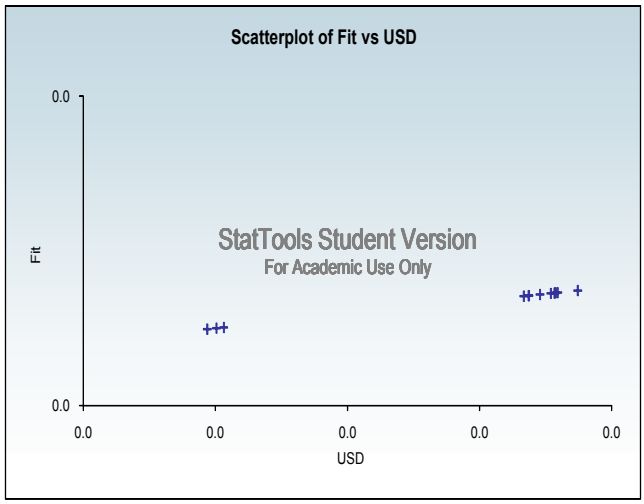
Analysis: Regression
Performed By: MPOFU Vusi
Date: 04-Feb-10
Updating: Static

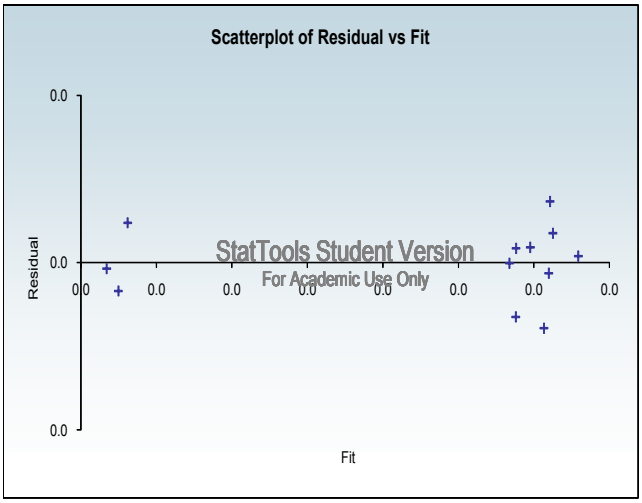
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.2246	0.0504	-0.0445	0.002306542	0.7251

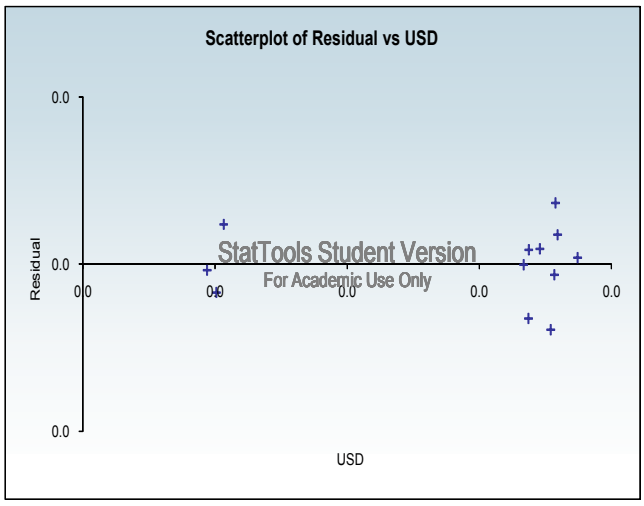
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	2.82533E-06	2.82533E-06	0.5311	0.4829
Unexplained	10	5.32013E-05	5.32013E-06		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	0.012049448	0.00188341	6.3977	< 0.0001	0.007852949	0.016245947
USD	0.089120001	0.122293147	0.7287	0.4829	-0.183366111	0.361606113









The Impact of the Global Financial Crisis on South African Markets
Hypothesis 3 - Analysis of bank liquidity premiums in the US to bank liquidity premiums in SA
Liquidity premium data

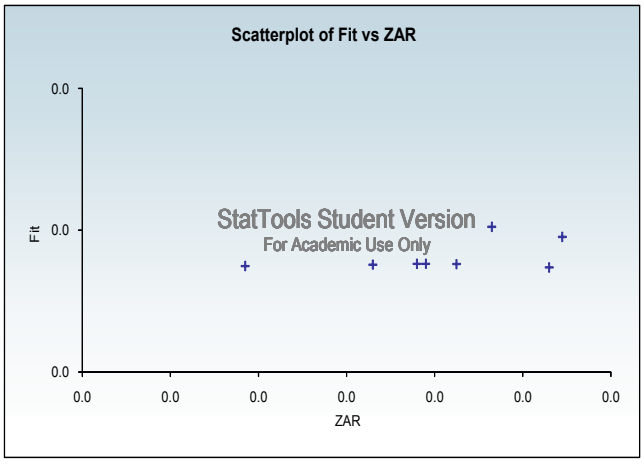
StatTools Turmoil period 2, T2

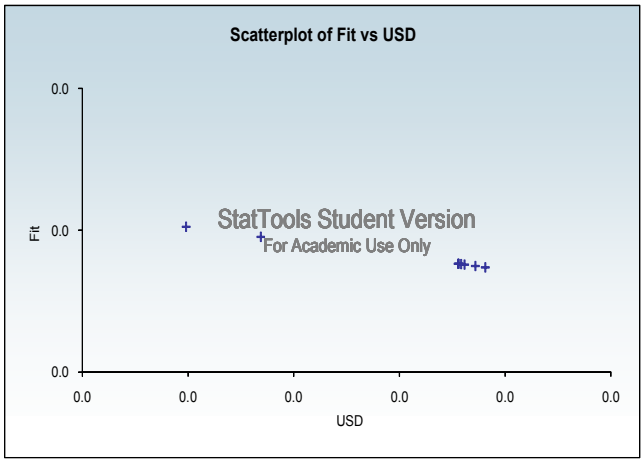
Analysis: Regression
Performed By: MPOFU Vusi
Date: 04-Feb-10
Updating: Static

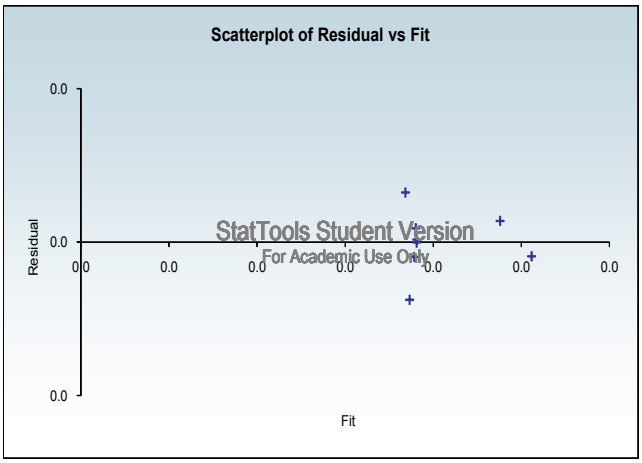
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.4746	0.2252	0.0961	0.002204505	0.9193

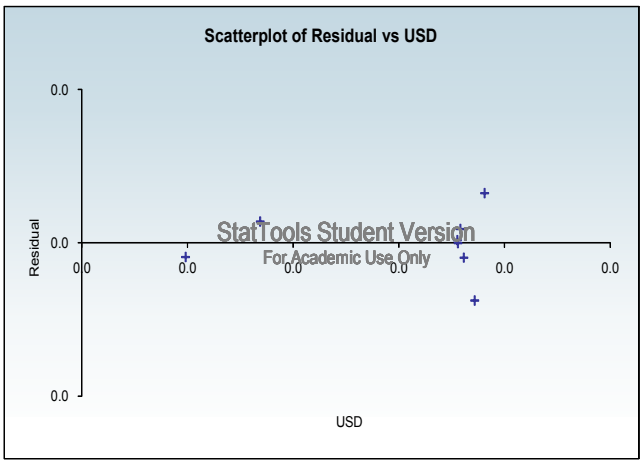
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	8.47595E-06	8.47595E-06	1.7441	0.2348
Unexplained	6	2.91591E-05	4.85984E-06		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	0.01122608	0.002474145	4.5374	0.0039	0.005172066	0.017280094
USD	-0.202420362	0.153274934	-1.3206	0.2348	-0.577470613	0.172629889









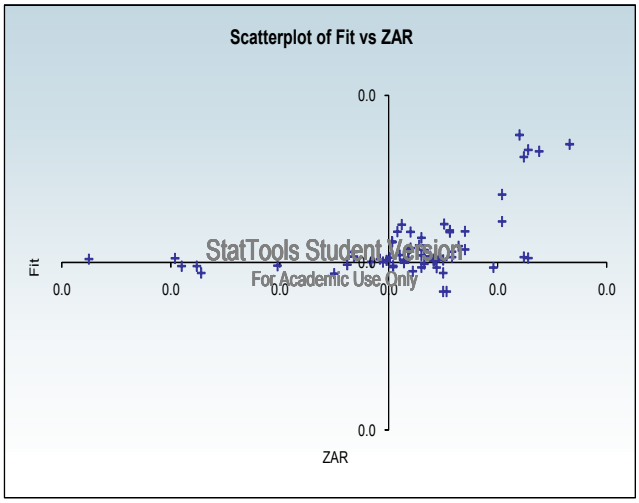
The Impact of the Global Financial Crisis on South African Markets
Hypothesis 3 - Analysis of bank liquidity premiums in the US to bank liquidity premiums in SA
Liquidity premium data

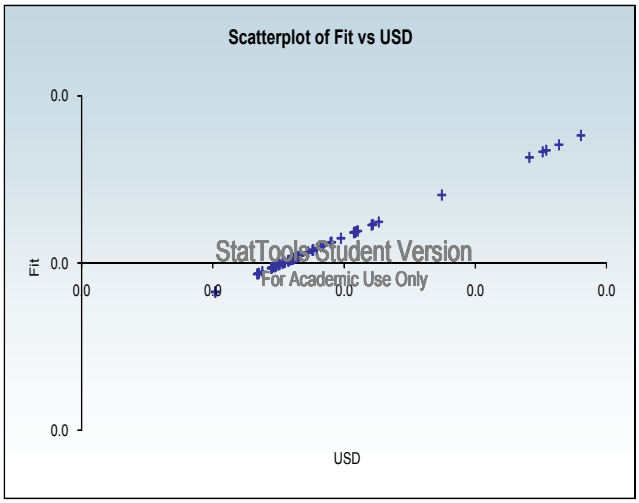
StatTools Stable period 3, S3
Analysis: Regression
Performed By: MPOFU Vusi
Date: 04-Feb-10
Updating: Static

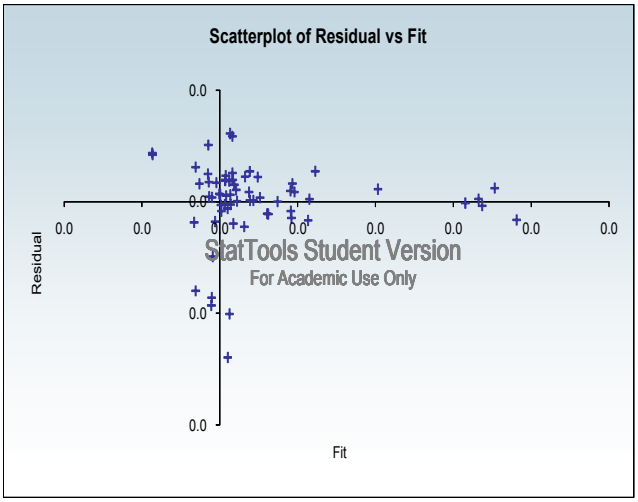
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.4867	0.2369	0.2246	0.003584697	1.6890

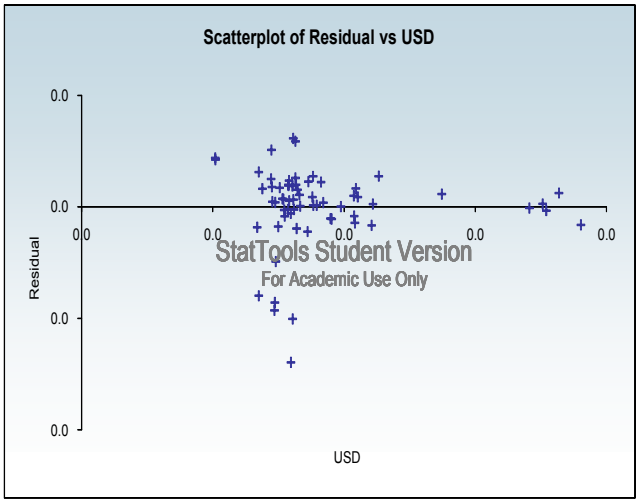
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	0.000247333	0.000247333	19.2476	< 0.0001
Unexplained	62	0.000796703	1.28501E-05		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	-0.005153138	0.00146647	-3.5140	0.0008	-0.008084569	-0.002221707
USD	0.671958327	0.153163061	4.3872	< 0.0001	0.365789731	0.978126922









The Impact of the Global Financial Crisis on South African Markets
Hypothesis 3 - Analysis of bank liquidity premiums in the US to bank liquidity premiums in SA
Liquidity premium data

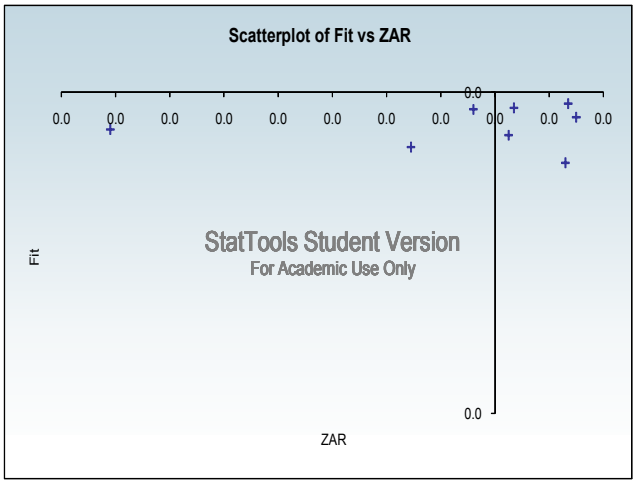
StatTools Turmoil period 3, T3

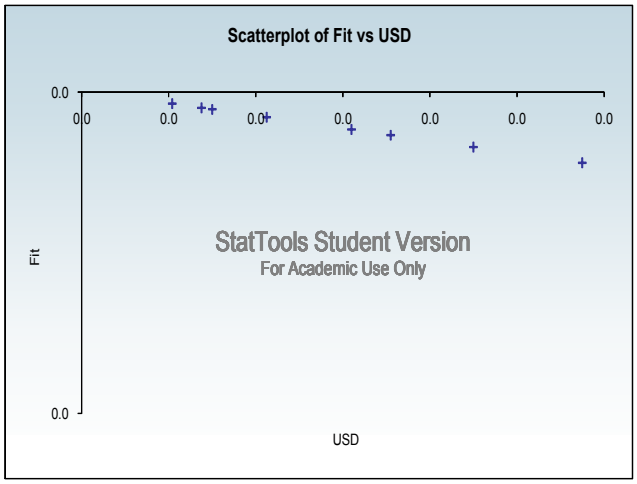
Analysis: Regression
Performed By: MPOFU Vusi
Date: 04-Feb-10
Updating: Static

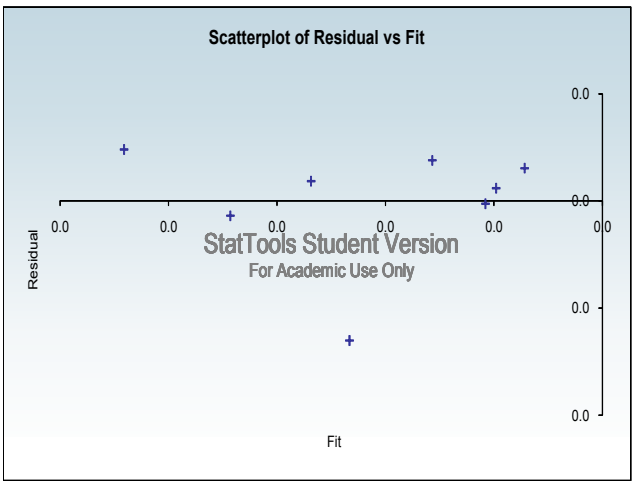
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.1150	0.0132	-0.1512	0.006102455	0.8838

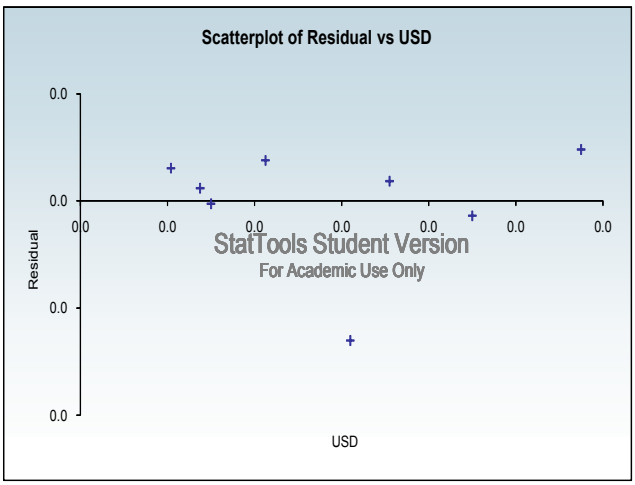
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	2.99523E-06	2.99523E-06	0.0804	0.7862
Unexplained	6	0.00022344	3.724E-05		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	0.013772751	0.052398456	0.2628	0.8015	-0.114441651	0.141987154
USD	-1.960487414	6.91279036	-0.2836	0.7862	-18.87547605	14.95450123









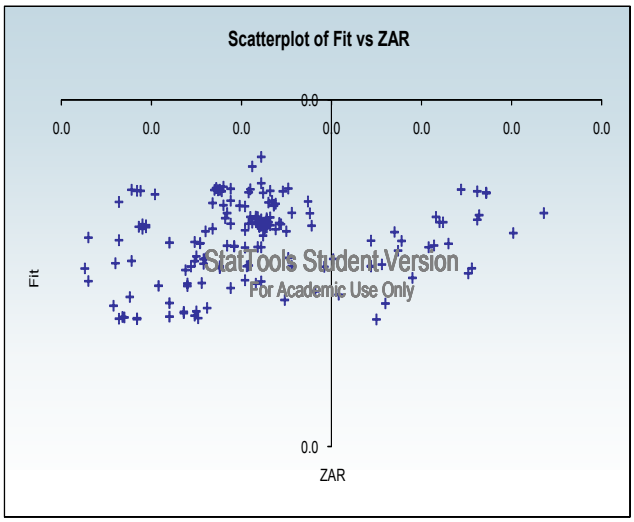
The Impact of the Global Financial Crisis on South African Markets
Hypothesis 3 - Analysis of bank liquidity premiums in the US to bank liquidity premiums in SA
Liquidity premium data

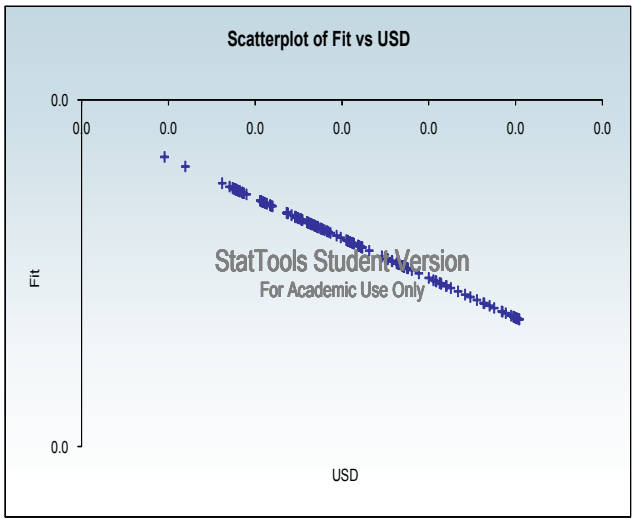
StatTools Stable period 4, S4
Analysis: Regression
Performed By: MPOFU Vusi
Date: 04-Feb-10
Updating: Static

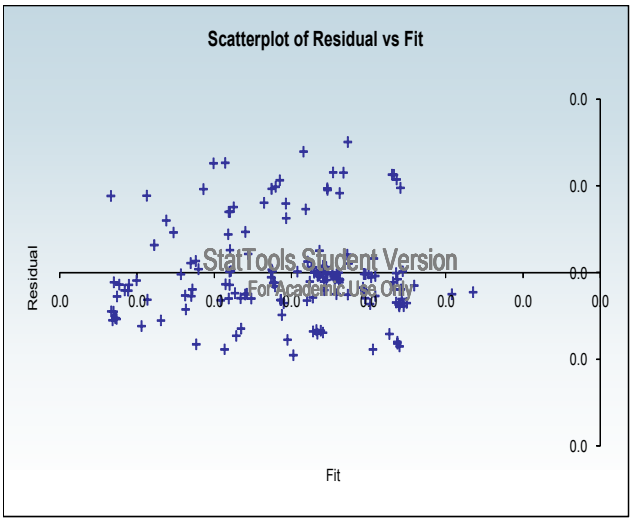
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.2056	0.0423	0.0359	0.005362819	1.2886

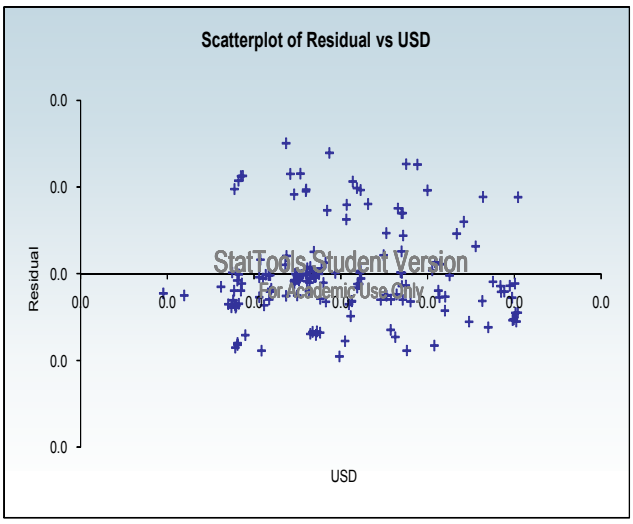
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	0.000191648	0.000191648	6.6637	0.0108
Unexplained	151	0.004342734	2.87598E-05		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	-0.000550984	0.001422267	-0.3874	0.6990	-0.003361098	0.002259131
USD	-0.57363865	0.222218063	-2.5814	0.0108	-1.012696859	-0.13458044









8.3.4 Comparison of the impact of global events on the S & P 500 against impact on the ALSI

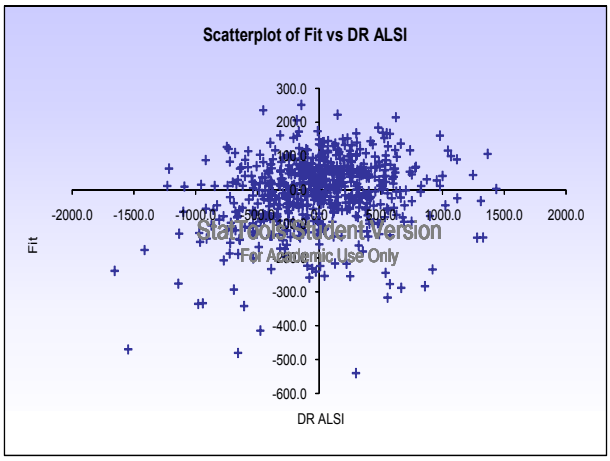
StatTools Full period F

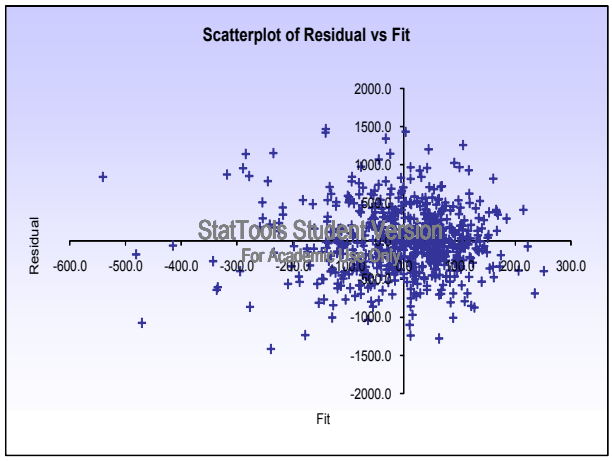
Analysis: Hypothesis 4 - Impact of global financial crisis on South African markets
Performed By: MPOFU Vusi
Date: 17-Feb-10
Updating: Static

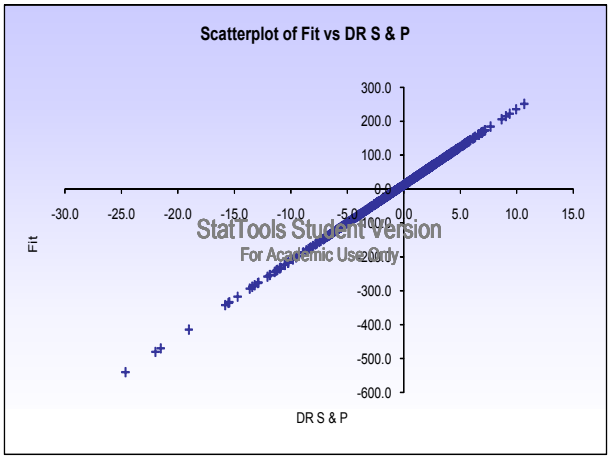
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.2286	0.0522	0.0507	436.8033827	1.9585

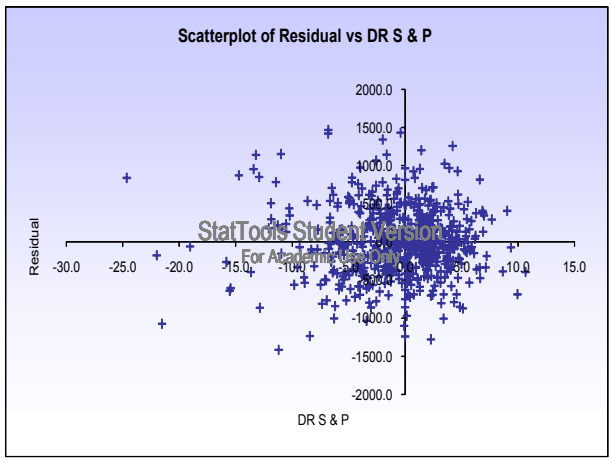
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	6373517.545	6373517.545	33.4047	< 0.0001
Unexplained	606	115623100.3	190797.1952		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	11.94354924	17.96184984	0.6649	0.5063	-23.33148195	47.21858044
DR S & P	22.41276752	3.877857863	5.7797	< 0.0001	14.79709551	30.02843953









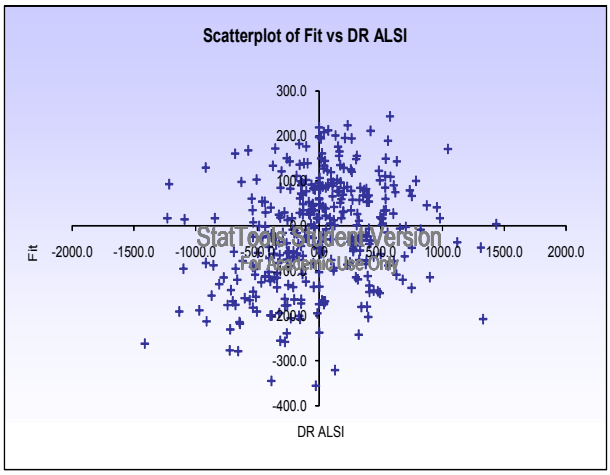
StatTools Stable period 1, S1

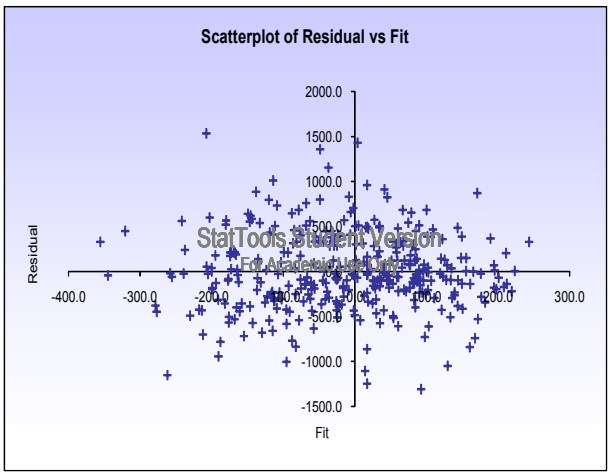
Analysis: Hypothesis 4 - Comparison of impact of global events on the Standard and Poors 500 against impact on the JSE ALSI
Performed By: MPOFU Vusi
Date: 17-Feb-10
Updating: Static

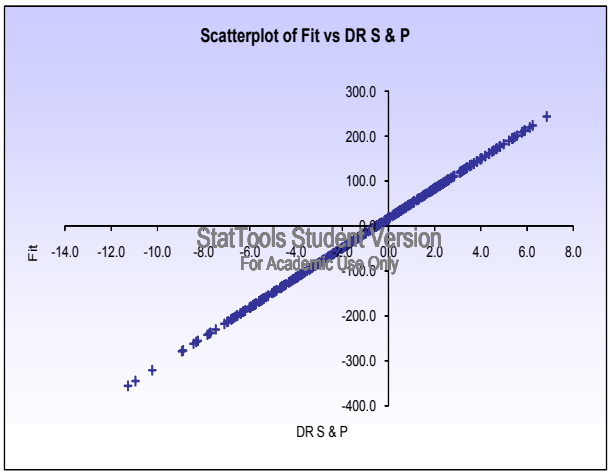
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.2637	0.0695	0.0668	425.3156163	2.0541

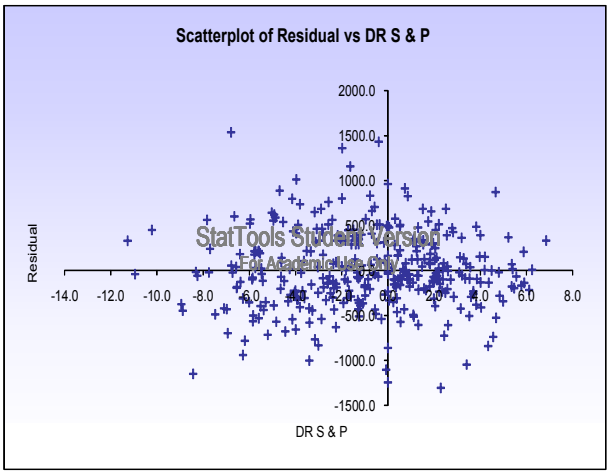
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	4651197.146	4651197.146	25.7124	< 0.0001
Unexplained	344	62227320.48	180893.3735		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	16.99601846	23.67040866	0.7180	0.4732	-29.56093047	63.55296739
DR S & P	33.04088967	6.515994181	5.0707	< 0.0001	20.22468474	45.85709461









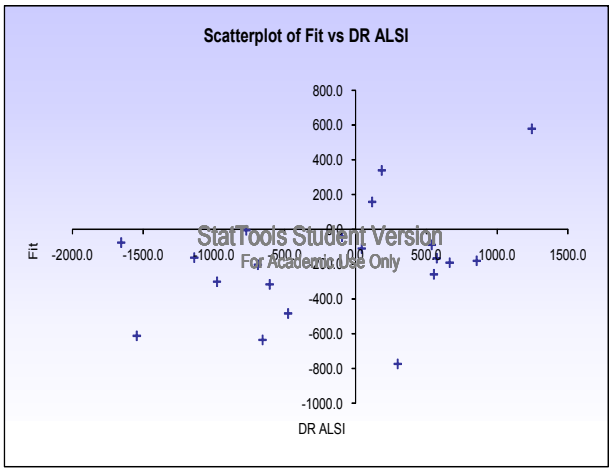
StatTools Turmoil period 1, T1

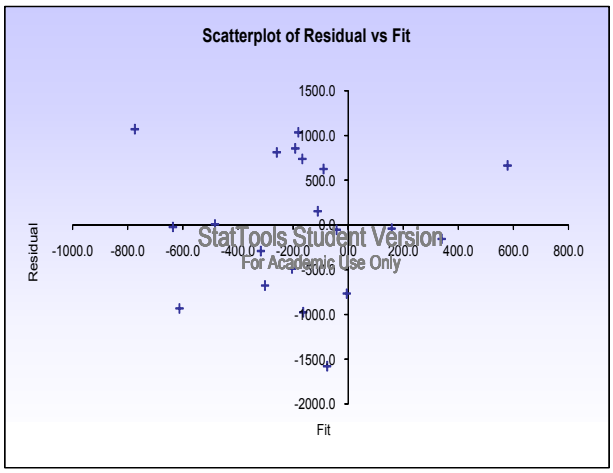
Analysis: Hypothesis 4 - Comparison of impact of global events on the Standard and Poors 500 against impact on the JSE ALSI
Performed By: MPOFU Vusi
Date: 17-Feb-10
Updating: Static

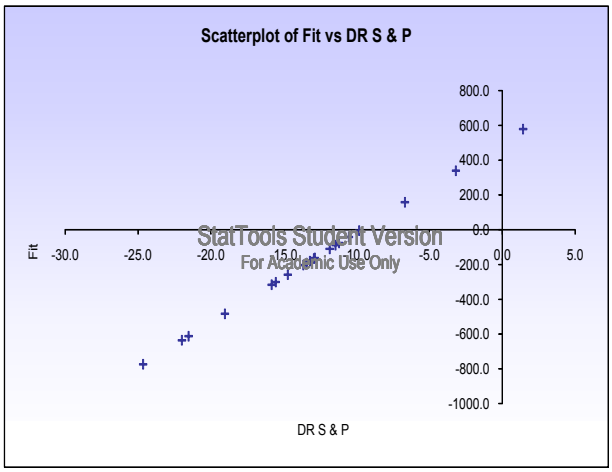
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.3888	0.1512	0.1040	772.6043325	1.9827

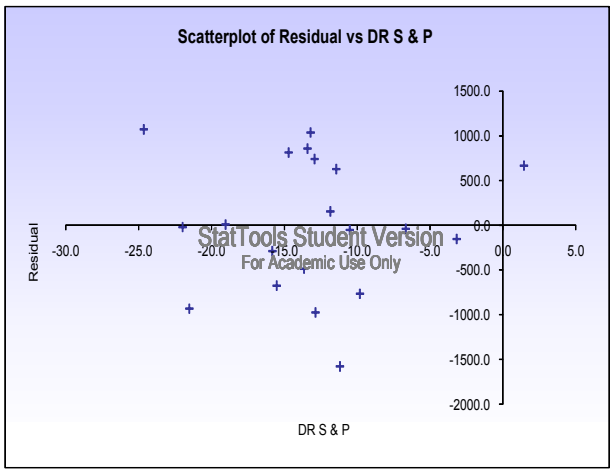
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	1913676.69	1913676.69	3.2059	0.0902
Unexplained	18	10744514.18	596917.4546		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	503.8047987	417.5832093	1.2065	0.2433	-373.5049694	1381.114567
DR S & P	51.84708068	28.95657311	1.7905	0.0902	-8.98842198	112.6825833









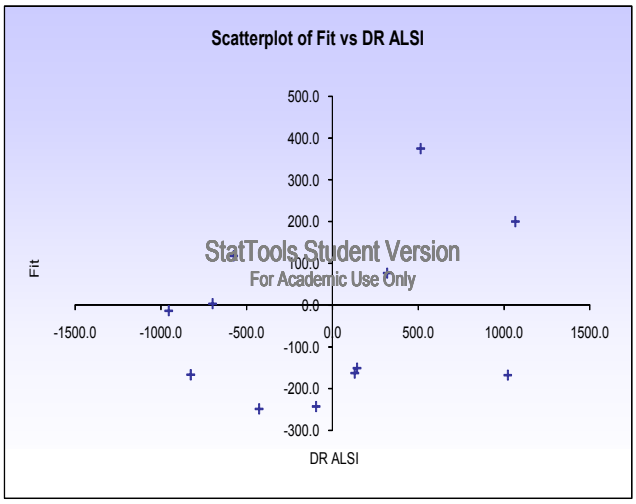
StatTools Stable period 2, S2

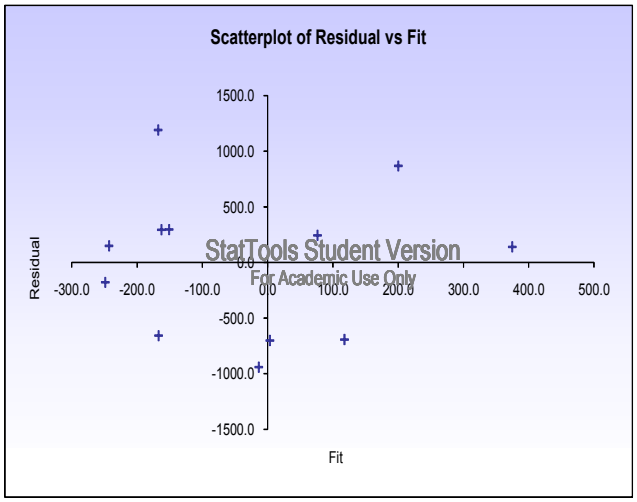
Analysis: Hypothesis 4 - Comparison of impact of global events on the Standard and Poors 500 against impact on the JSE ALSI
Performed By: MPOFU Vusi
Date: 17-Feb-10
Updating: Static

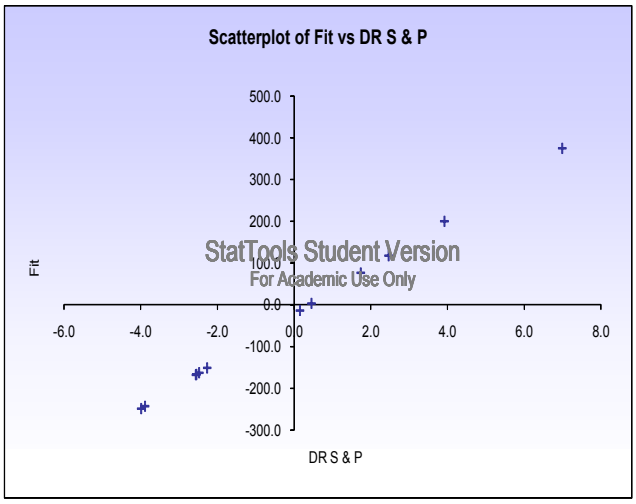
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.2829	0.0800	-0.0120	690.2841659	1.9019

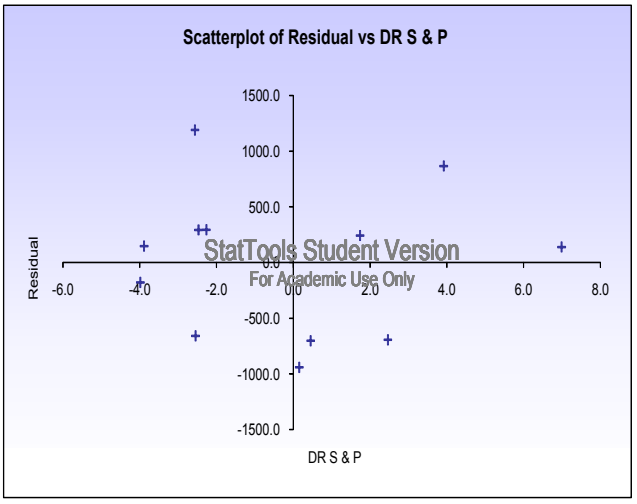
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	414401.033	414401.033	0.8697	0.3730
Unexplained	10	4764922.297	476492.2297		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	-22.33810896	199.5234685	-0.1120	0.9131	-466.904101	422.2278831
DR S & P	56.7752522	60.88026986	0.9326	0.3730	-78.8744424	192.4249468









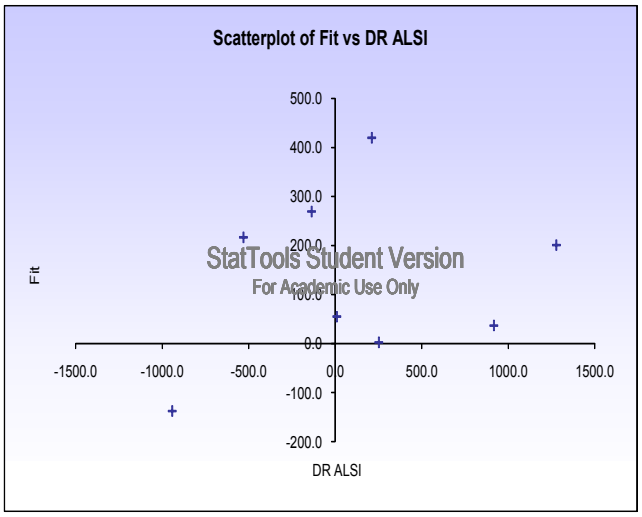
StatTools Turmoil period 2, T2

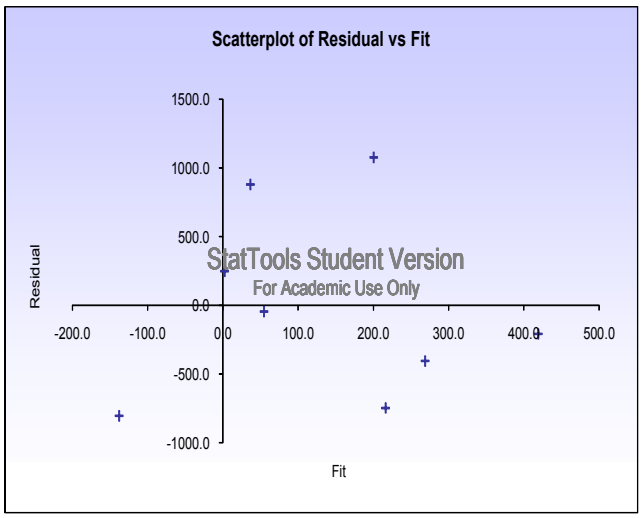
Analysis: Hypothesis 4 - Comparison of impact of global events on the Standard and Poors 500 against impact on the JSE ALSI
Performed By: MPOFU Vusi
Date: 17-Feb-10
Updating: Static

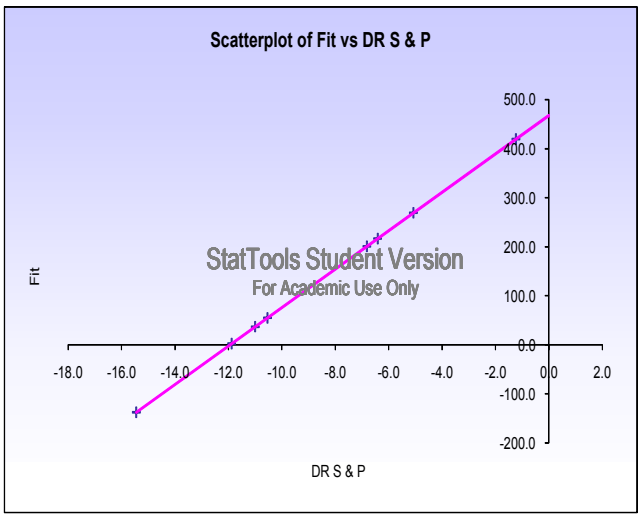
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.2449	0.0600	-0.0967	754.4867469	1.1786

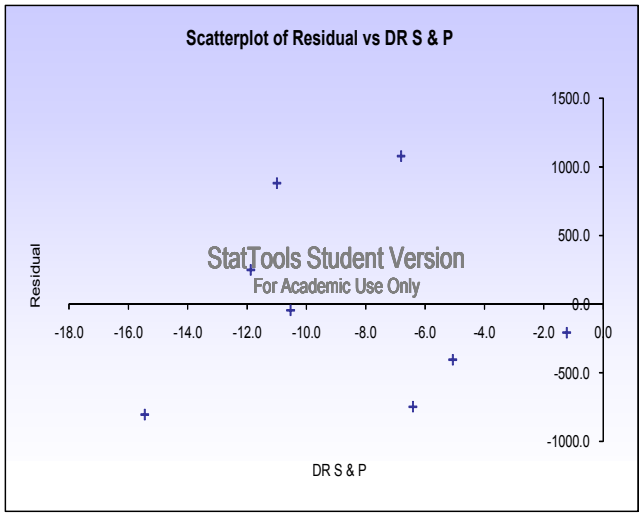
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	217867.7789	217867.7789	0.3827	0.5589
Unexplained	6	3415501.507	569250.2512		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	467.5284405	603.4993695	0.7747	0.4679	-1009.181317	1944.238198
DR S & P	39.18062995	63.3324847	0.6186	0.5589	-115.7883773	194.1496372









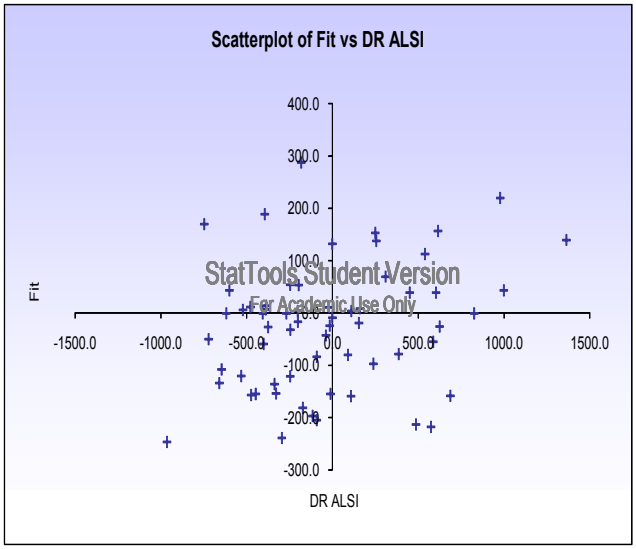
StatTools Stable period 3, S3

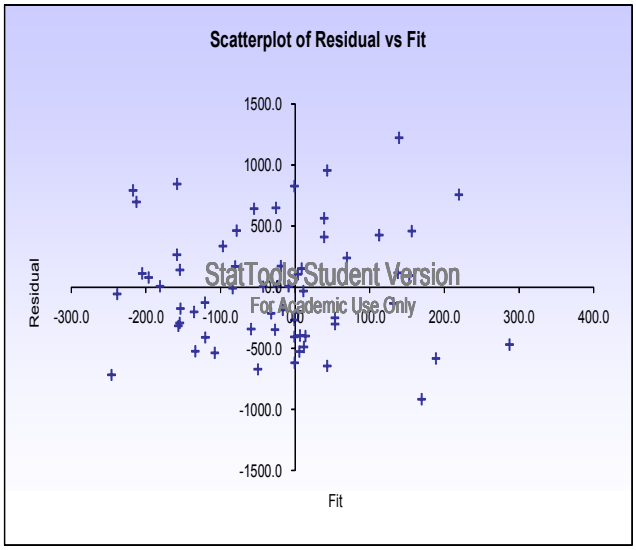
Analysis: Hypothesis 4 - Comparison of impact of global events on the Standard and Poors 500 against impact on the JSE ALSI
Performed By: MPOFU Vusi
Date: 17-Feb-10
Updating: Static

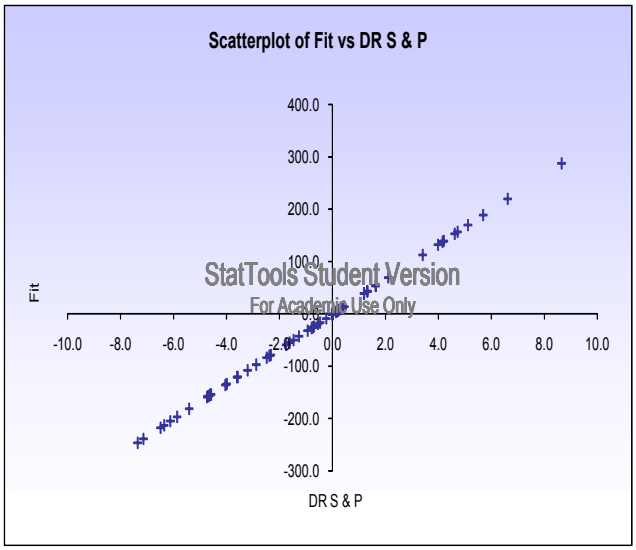
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.2459	0.0605	0.0448	476.174077	1.9088

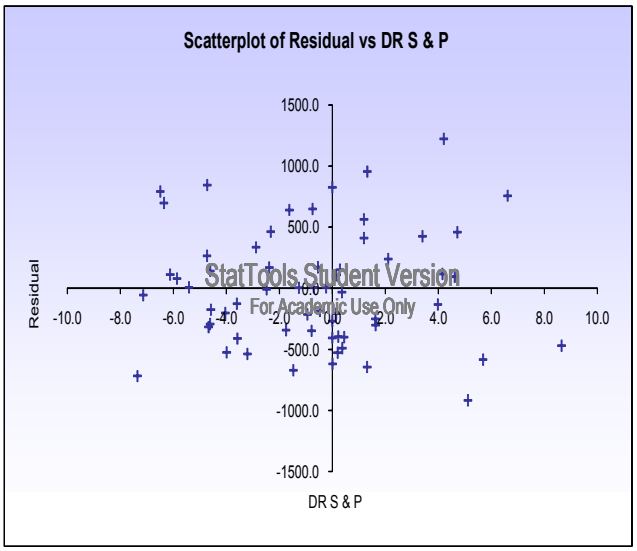
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	875341.4862	875341.4862	3.8605	0.0541
Unexplained	60	13604505.09	226741.7516		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	-1.101205211	61.87194136	-0.0178	0.9859	-124.8635147	122.6611043
DR S & P	33.32331889	16.95997633	1.9648	0.0541	-0.601684803	67.24832258









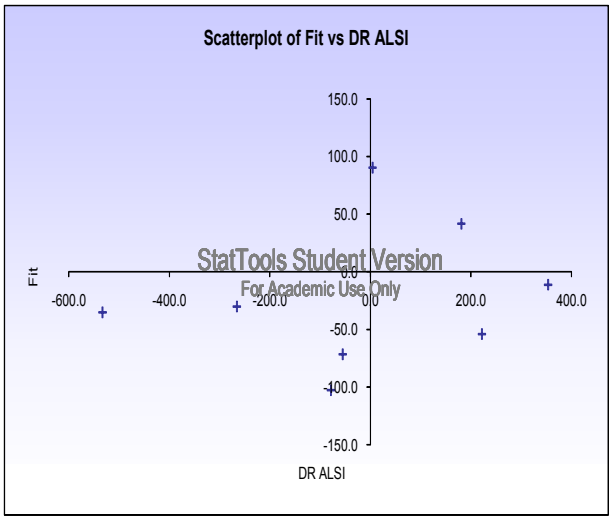
StatTools Turmoil period 3, T3

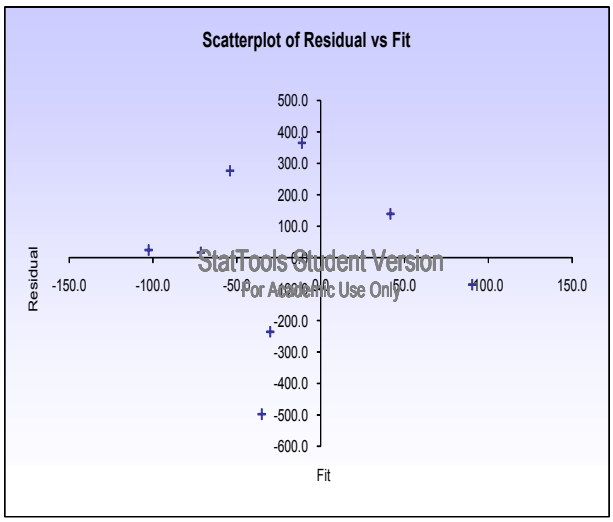
Analysis: Hypothesis 4 - Comparison of impact of global events on the Standard and Poors 500 against impact on the JSE ALSI
Performed By: MPOFU Vusi
Date: 17-Feb-10
Updating: Static

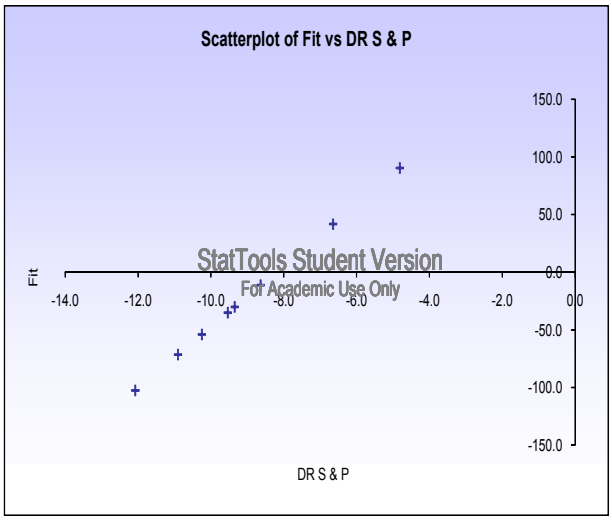
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.2183	0.0476	-0.1111	300.0708248	2.4908

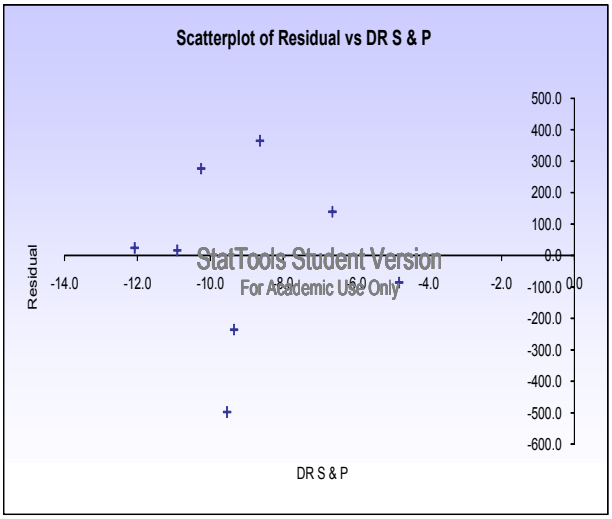
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	27030.3414	27030.3414	0.3002	0.6035
Unexplained	6	540254.9993	90042.49988		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	218.2064958	450.3056156	0.4846	0.6452	-883.6516507	1320.064642
DR S & P	26.57001503	48.49420081	0.5479	0.6035	-92.09101954	145.2310496









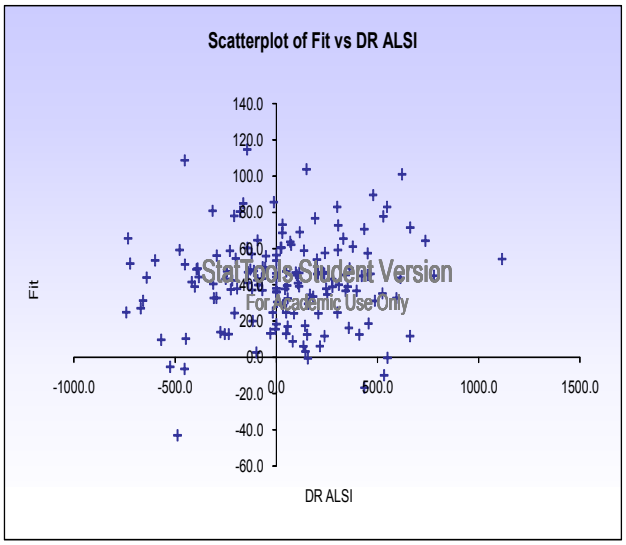
StatTools Stable period 4, S4

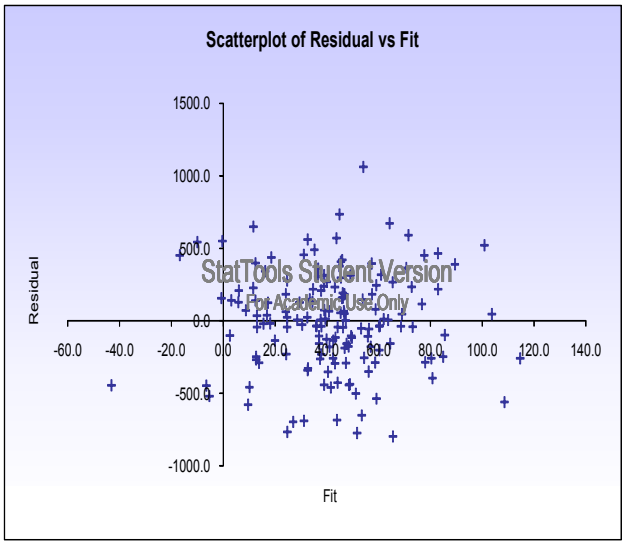
Analysis: Hypothesis 4 - Comparison of impact of global events on the Standard and Poors 500 against impact on the JSE ALSI
Performed By: MPOFU Vusi
Date: 17-Feb-10
Updating: Static

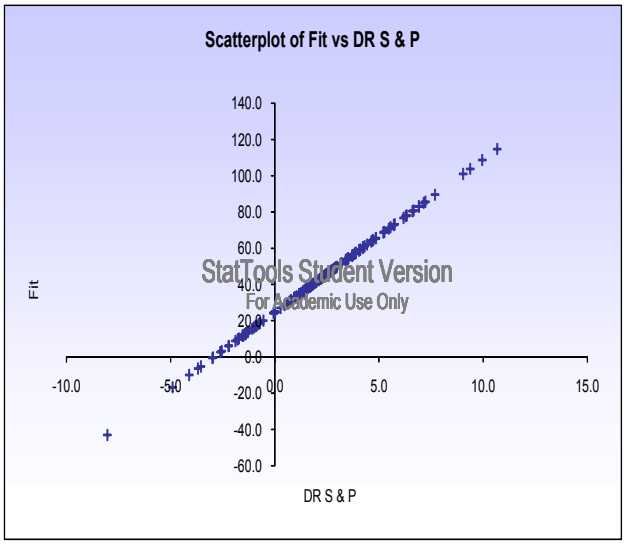
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.0729	0.0053	-0.0013	340.205411	1.9186

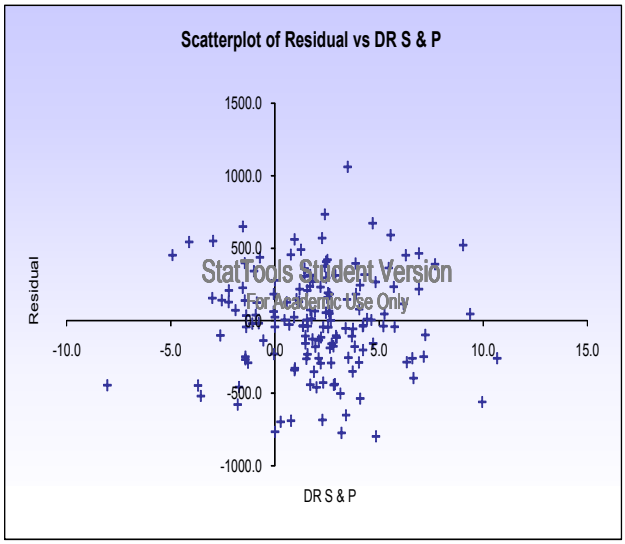
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	92831.29369	92831.29369	0.8021	0.3719
Unexplained	150	17360958.25	115739.7216		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	24.63894758	33.70137776	0.7311	0.4659	-41.95178439	91.22967955
DR S & P	8.429168609	9.411931474	0.8956	0.3719	-10.16791696	27.02625418









8.3.5 Focus on the financial markets

a. Intra-market analysis ALS_FINI15

The Impact of the Global Financial Crisis on South African Markets
Hypothesis 5 - Focus on financial markets
ALSI and FINI daily returns data

StatTools	Summary parametrics
Analysis:	Regression
Performed By:	MPOFU Vusi
Date:	20-Feb-10
Updating:	Static

Period	F	S1	T1	S2	T2	S3	T3	S4
β - coefficient	0.2170	0.2253	0.2006	0.1381	0.1299	0.2526	-0.0944	0.2018
Correlation	0.7268	0.7143	0.7974	0.8086	0.6638	0.7862	0.3762	0.7541
p-value	< 0.0001	<0.0001	< 0.0001	0.0015	0.0727	<0.0001	0.3583	<0.0001
F-ratio	662.718	350.067	31.4254	18.8820	4.7257	160.253	0.9894	138.440
R-Square	0.5282	0.5103	0.6358	0.6538	0.4406	0.6181	0.1416	0.5687

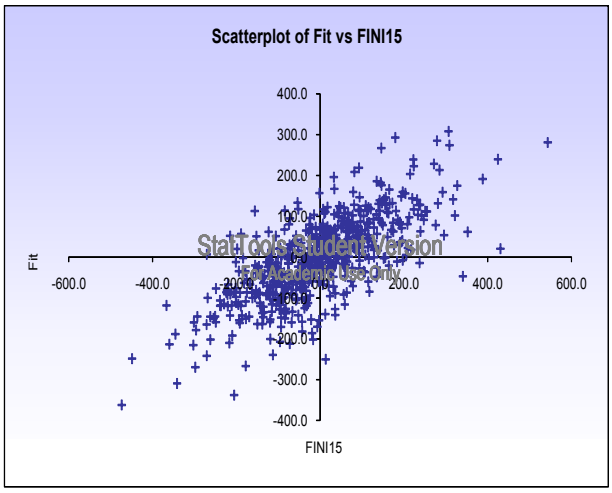
StatTools Full period, F

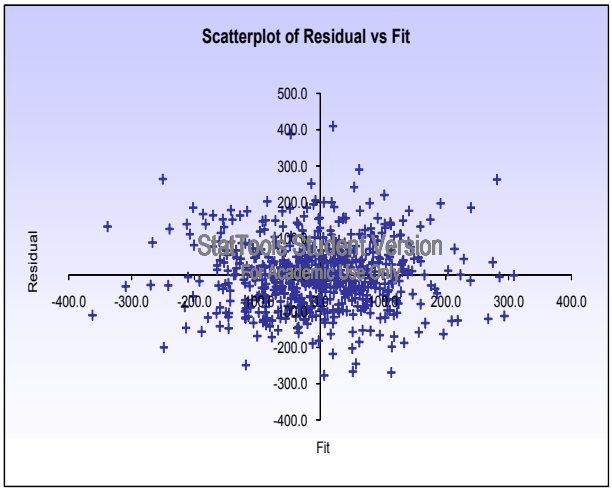
Analysis: Regression - Hypothesis 5 focus on impact on financial markets
Performed By: MPOFU Vusi
Date: 20-Feb-10
Updating: Static

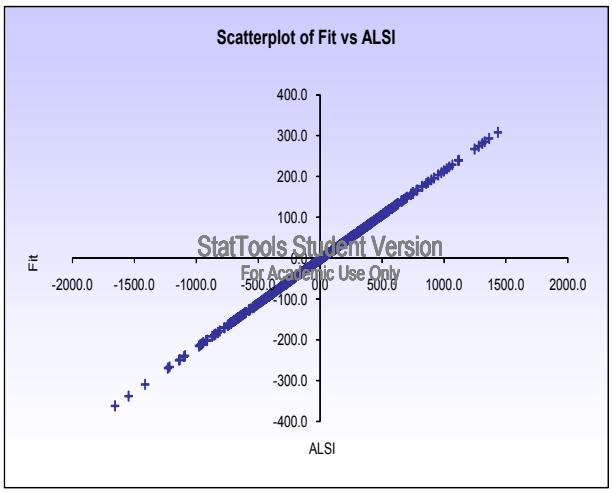
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.7268	0.5282	0.5274	92.73897946	1.8250

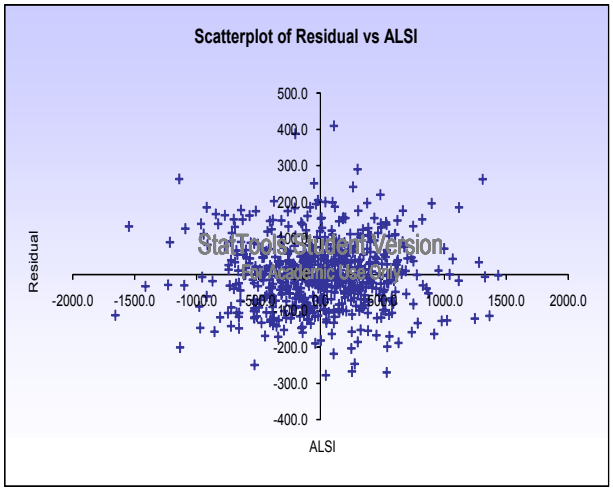
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	5699718.043	5699718.043	662.7180	< 0.0001
Unexplained	592	5091506.841	8600.518312		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	-2.946004902	3.805534418	-0.7741	0.4392	-10.41999559	4.527985789
ALSI	0.216962518	0.008427919	25.7433	< 0.0001	0.20041026	0.233514775









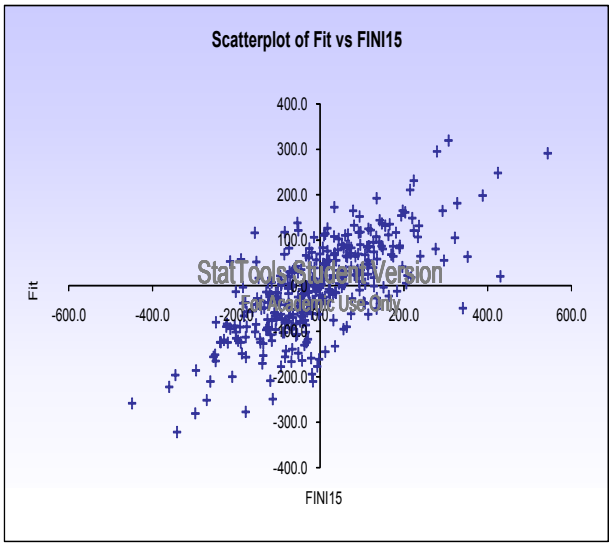
StatTools Stable period 1, S1

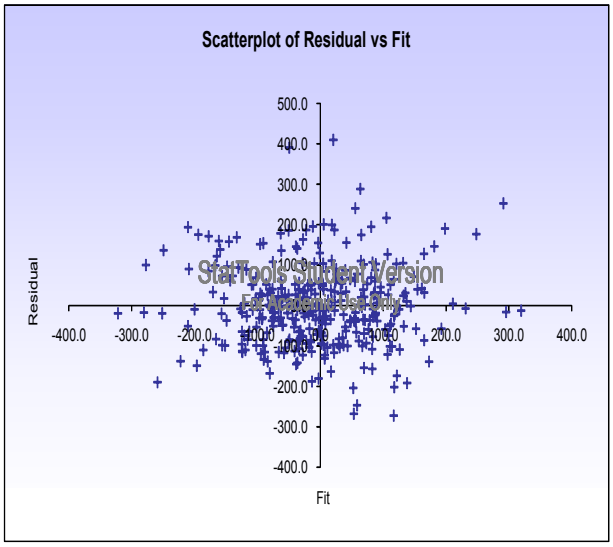
Analysis: Regression - Hypothesis 5 focus on impact on financial markets, ALSI FINI15
Performed By: MPOFU Vusi
Date: 20-Feb-10
Updating: Static

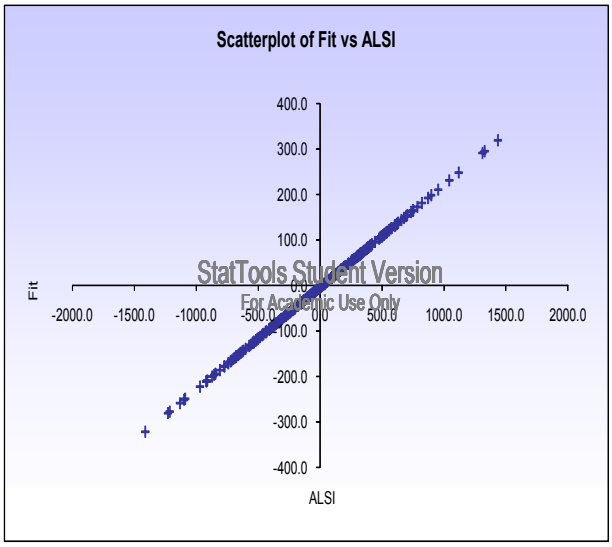
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.7143	0.5103	0.5088	98.20942718	1.6844

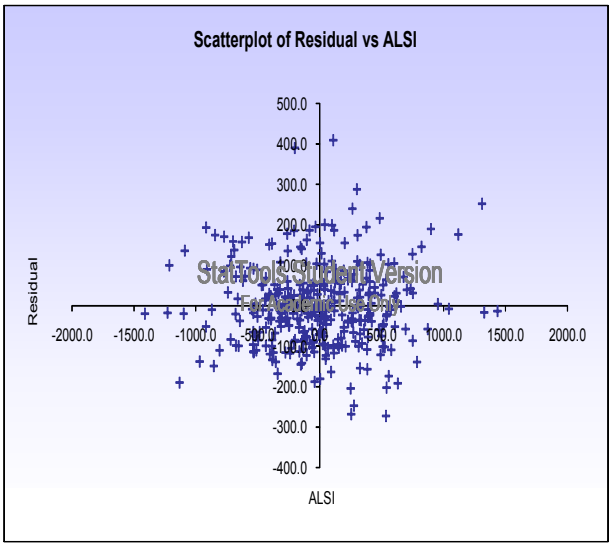
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	3376430.471	3376430.471	350.0672	< 0.0001
Unexplained	336	3240750.773	9645.091587		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	-3.840773049	5.346547445	-0.7184	0.4730	-14.35769591	6.676149809
ALSI	0.22526809	0.01203993	18.7101	< 0.0001	0.201584954	0.248951226









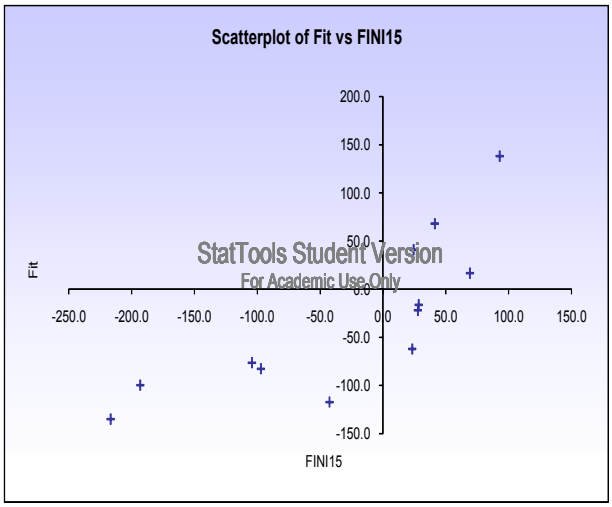
StatTools Stable period 2, S2

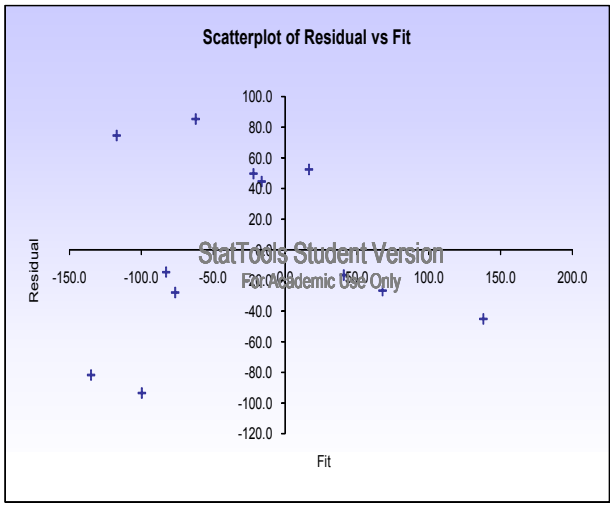
Analysis: Regression - Hypothesis 5 focus on impact on financial markets, ALSI FINI15
Performed By: MPOFU Vusi
Date: 20-Feb-10
Updating: Static

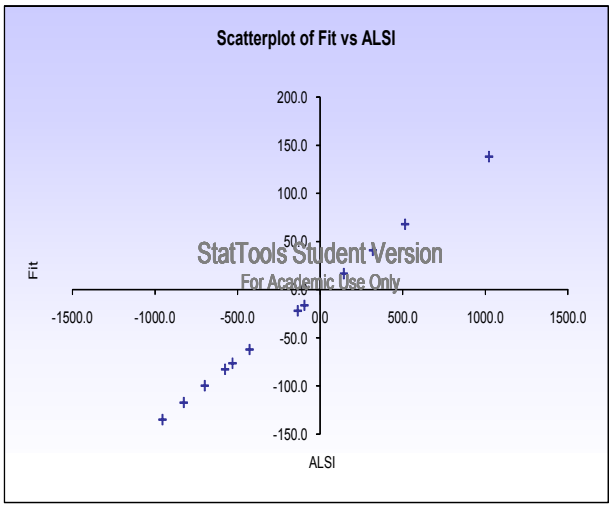
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.8086	0.6538	0.6191	62.88397617	2.3634

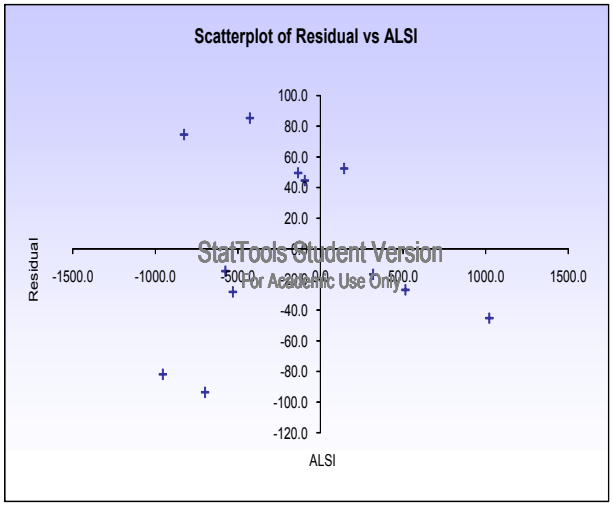
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	74667.37891	74667.37891	18.8821	0.0015
Unexplained	10	39543.94458	3954.394458		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	-3.114504511	19.10123667	-0.1631	0.8737	-45.67471206	39.44570304
ALSI	0.138074253	0.031775123	4.3454	0.0015	0.067274867	0.20887364









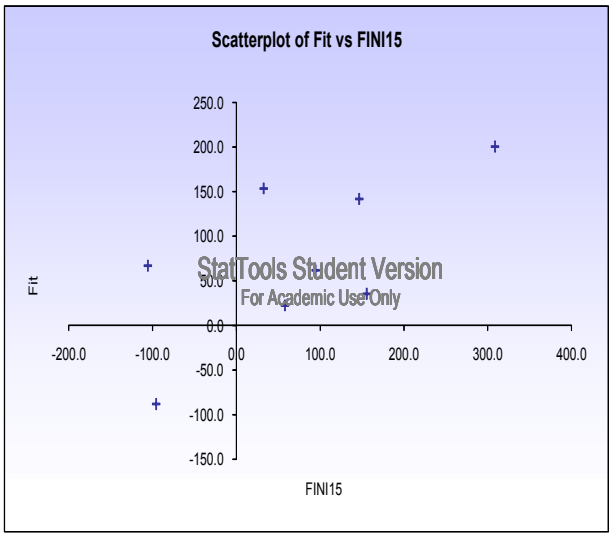
StatTools Turmoil period 2, T2

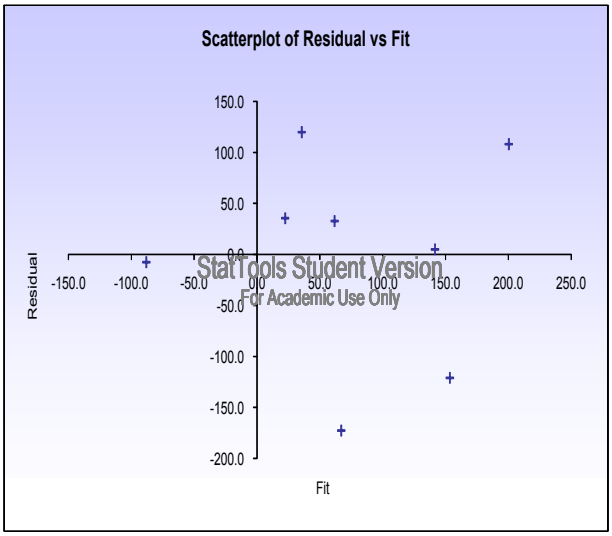
Analysis: Regression - Hypothesis 5 focus on impact on financial markets, ALSI FINI15
Performed By: MPOFU Vusi
Date: 11-Mar-10
Updating: Static

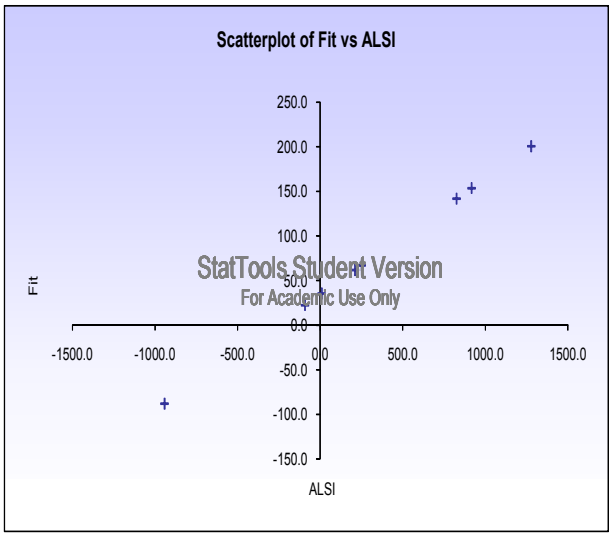
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.6638	0.4406	0.3474	110.2987864	1.4543

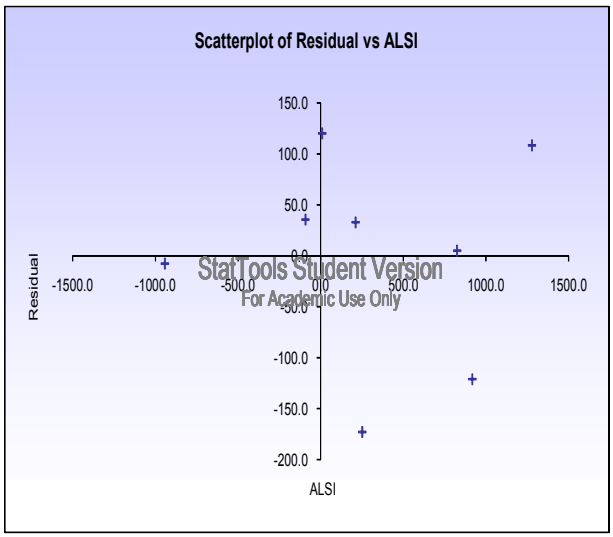
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	57491.87407	57491.87407	4.7257	0.0727
Unexplained	6	72994.93368	12165.82228		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	34.32709603	43.11578836	0.7962	0.4563	-71.17343739	139.8276294
ALSI	0.129894544	0.05975282	2.1739	0.0727	-0.016315341	0.276104428









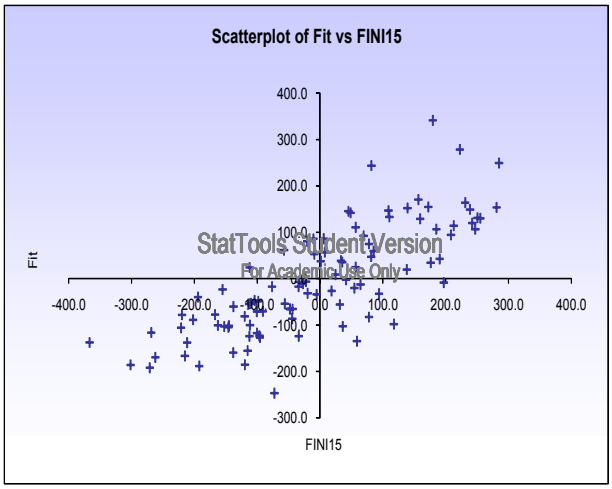
StatTools Stable period 3, S3

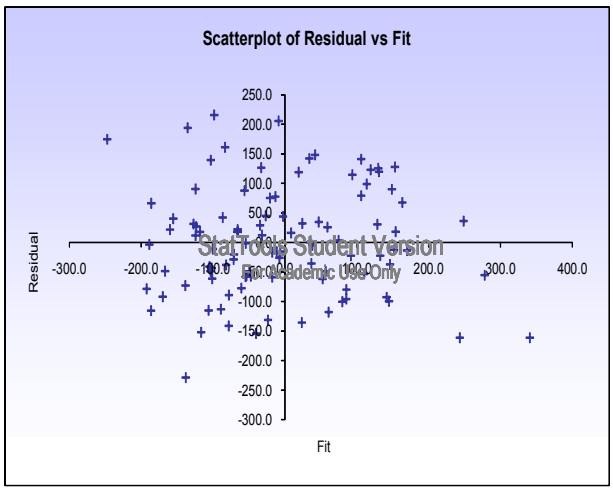
Analysis: Regression - Hypothesis 5 focus on impact on financial markets, ALSI FINI15
Performed By: MPOFU Vusi
Date: 20-Feb-10
Updating: Static

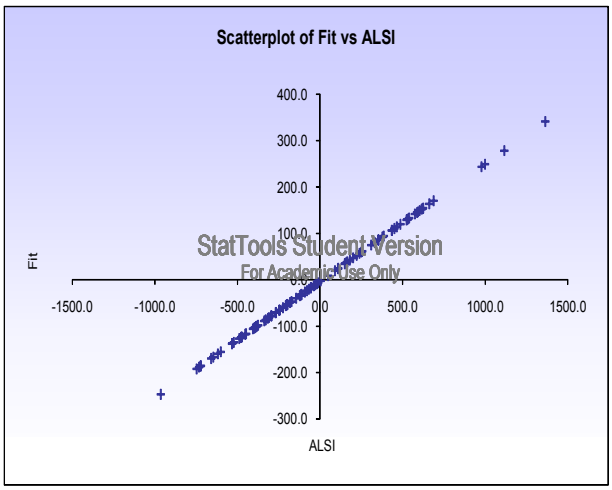
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.7862	0.6181	0.6143	91.85028107	1.9336

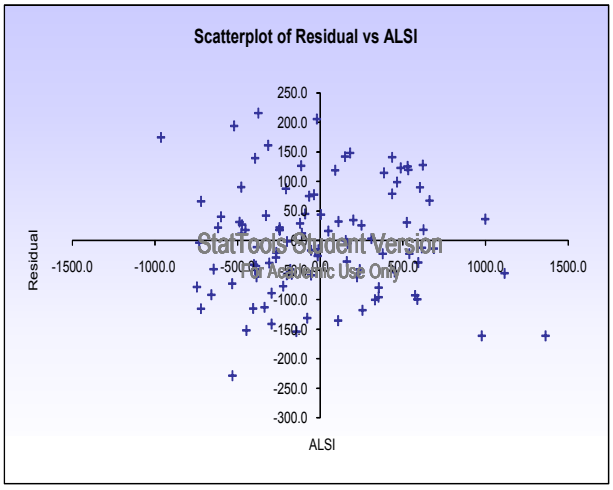
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	1352025.271	1352025.271	160.2595	< 0.0001
Unexplained	99	835210.9391	8436.474133		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	-3.556095913	9.140120208	-0.3891	0.6981	-21.69207737	14.57988554
ALSI	0.252630076	0.019955984	12.6594	< 0.0001	0.213033075	0.292227077









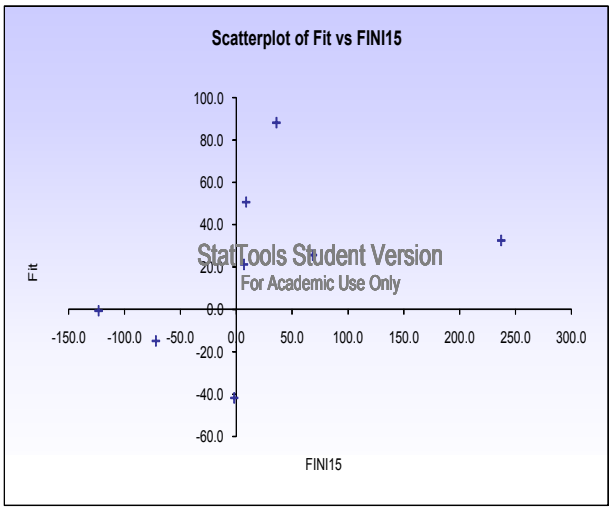
StatTools Turmoil period 3, T3

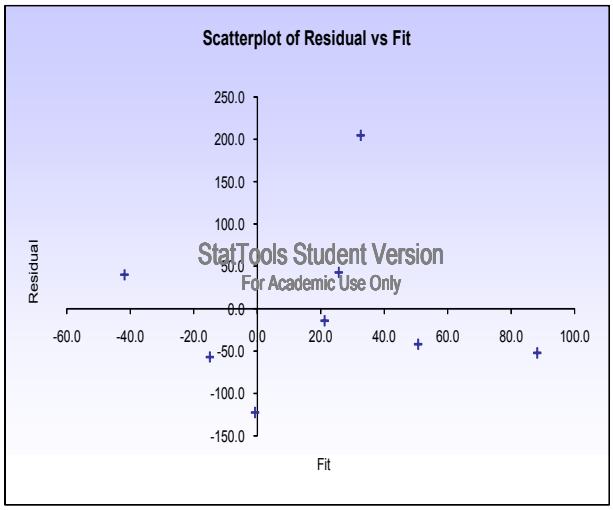
Analysis: Regression - Hypothesis 5 focus on impact on financial markets, ALSI FINI15
Performed By: MPOFU Vusi
Date: 20-Feb-10
Updating: Static

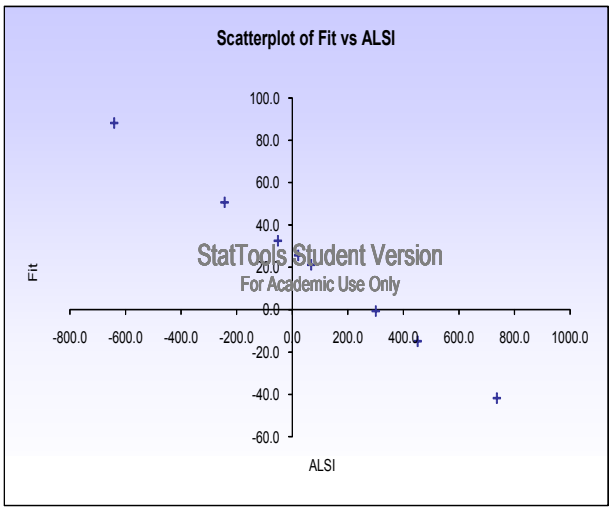
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.3762	0.1416	-0.0015	106.6753185	1.9681

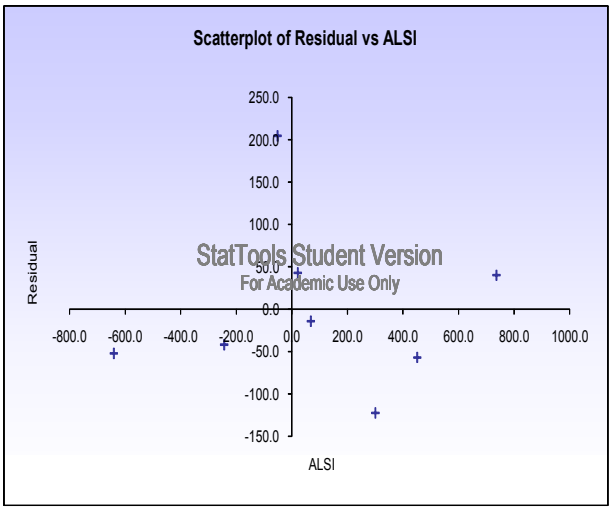
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	11259.36606	11259.36606	0.9894	0.3583
Unexplained	6	68277.74149	11379.62358		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	27.69278592	38.47861794	0.7197	0.4988	-66.46100025	121.8465721
ALSI	-0.094426564	0.094929494	-0.9947	0.3583	-0.326710669	0.13785754









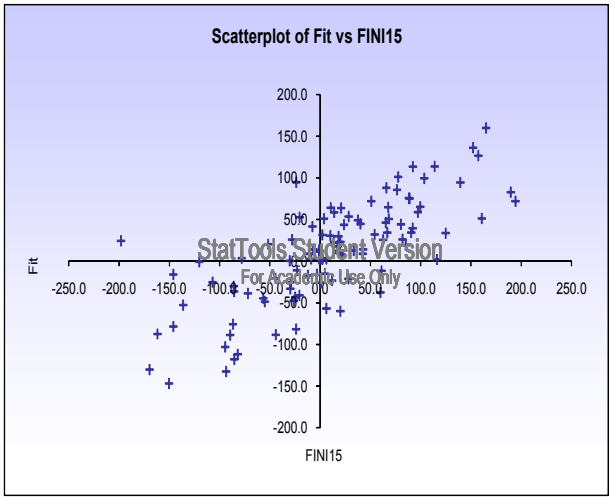
StatTools Stable period 4, S4

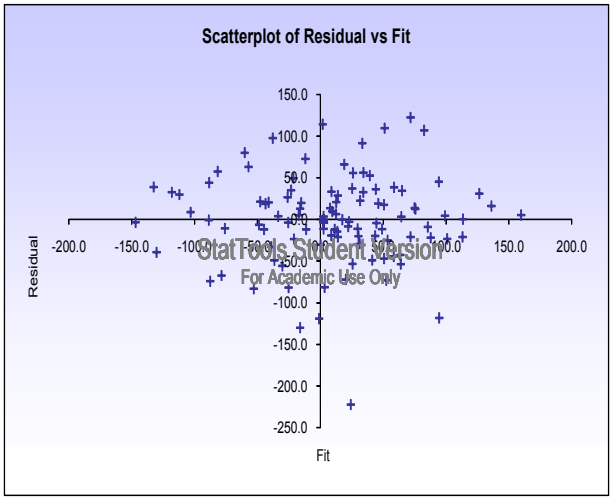
Analysis: Regression - Hypothesis 5 focus on impact on financial markets, ALSI FINI15
Performed By: MPOFU Vusi
Date: 20-Feb-10
Updating: Static

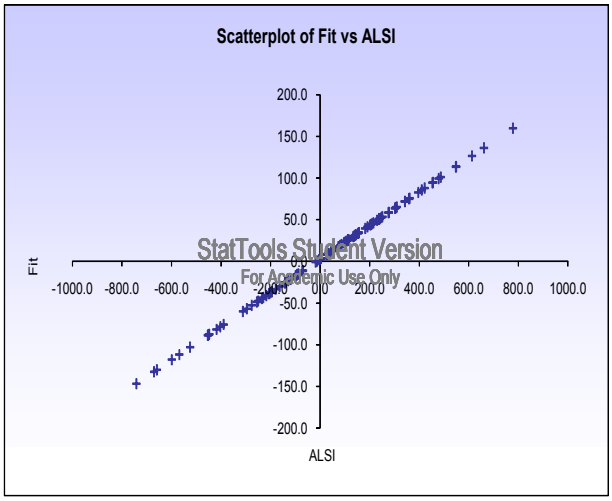
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.7541	0.5687	0.5646	52.85811228	1.7359

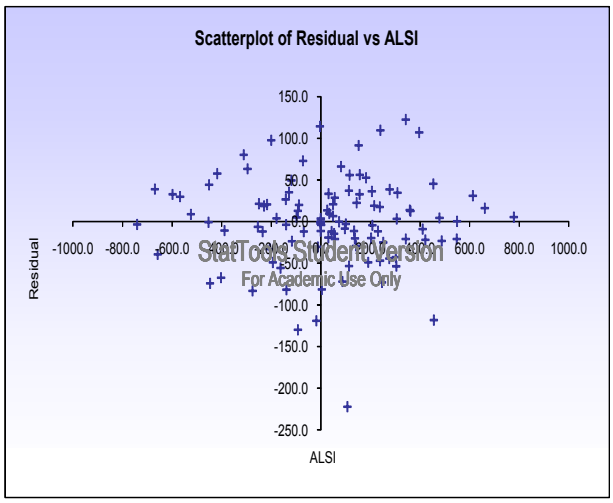
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	386797.8563	386797.8563	138.4397	< 0.0001
Unexplained	105	293367.9036	2793.980034		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	2.776298671	5.144779326	0.5396	0.5906	-7.424848356	12.9774457
ALSI	0.201843468	0.017154747	11.7660	< 0.0001	0.167828773	0.235858162









b. Intra-market analysis S & P 500_S5FINL

The Impact of the Global Financial Crisis on South African Markets
Hypothesis 5 - Focus on financial markets
S & P 500 and FINL daily returns data

StatTools	Summary parametrics
Analysis:	Regression
Performed By:	MPOFU Vusi
Date:	20-Feb-10
Updating:	Static

Period	F	S1	T1	S2	T2	S3	T3	S4
β - coefficient	0.4050	0.5142	0.4442	1.1709	0.7174	0.3553	4.4100	0.3962
Correlation	0.2096	0.1903	0.1965	0.3761	0.2338	0.2049	0.7749	0.2309
p-value	< 0.0001	0.0004	0.4063	0.2282	0.5773	0.0399	0.0239	0.0167
F-ratio	27.2057	12.6208	0.7230	1.6479	0.3470	4.3370	9.0203	5.9113
R-Square	0.0439	0.0362	0.0386	0.1415	0.0547	0.0420	0.6005	0.0533

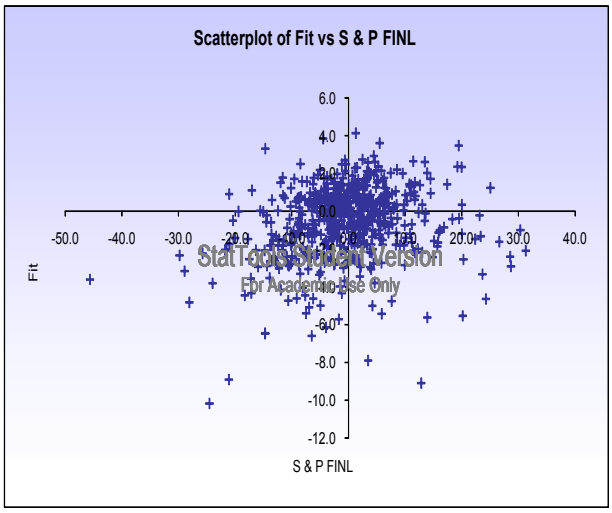
StatTools Full period, F

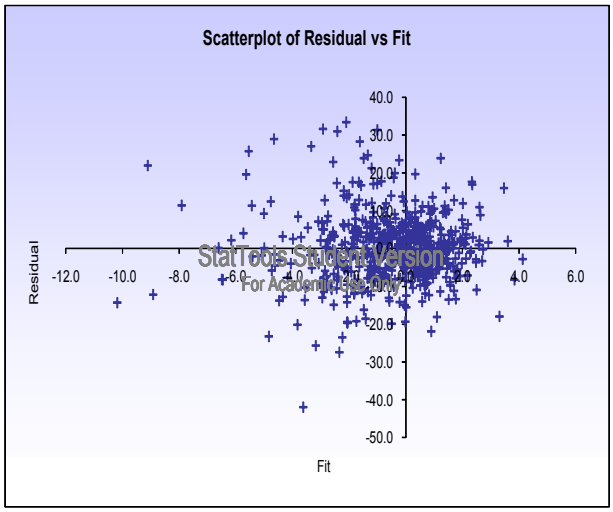
Analysis: Regression - Hypothesis 5 focus on impact on financial markets, S & P 500 _S5FINL
Performed By: RZA2961P
Date: 18-Feb-10
Updating: Static

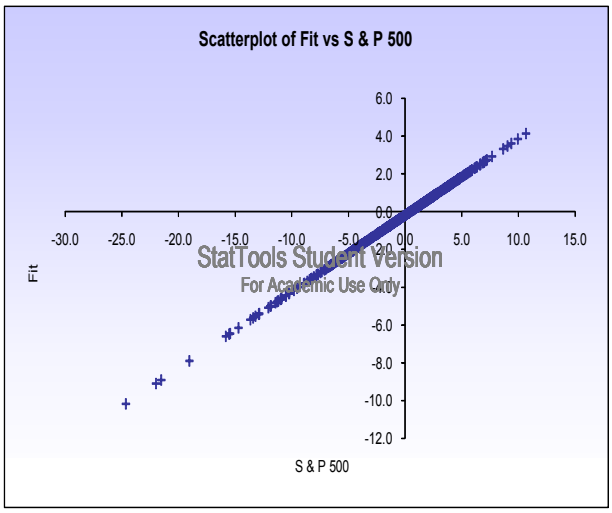
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.2096	0.0439	0.0423	8.743646628	2.2105

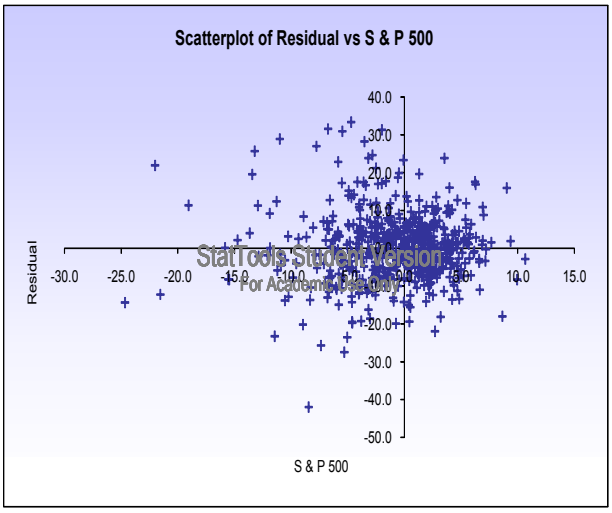
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	2079.909879	2079.909879	27.2057	< 0.0001
Unexplained	592	45259.20296	76.45135635		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	-0.197430517	0.363881583	-0.5426	0.5876	-0.9120864	0.517225367
S & P 500	0.405015823	0.077650155	5.2159	< 0.0001	0.252512528	0.557519118









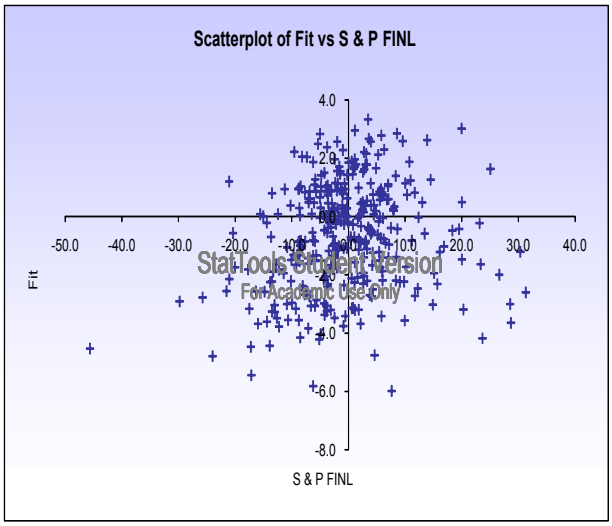
StatTools Stable period 1, S1

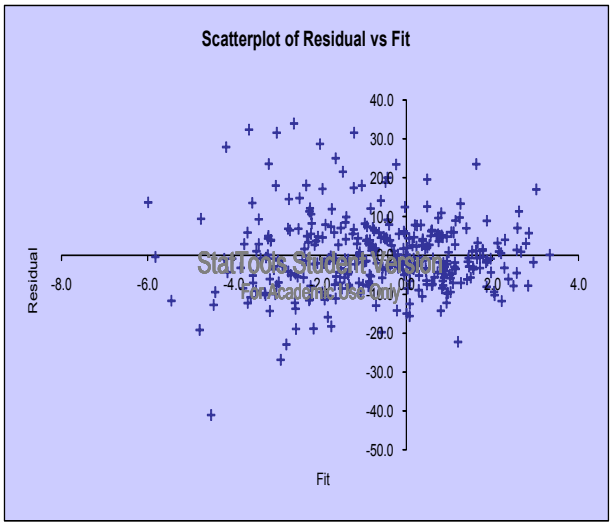
Analysis: Regression - Hypothesis 5 focus on impact on financial markets, S & P 500 _S5FINL
Performed By: RZA2961P
Date: 18-Feb-10
Updating: Static

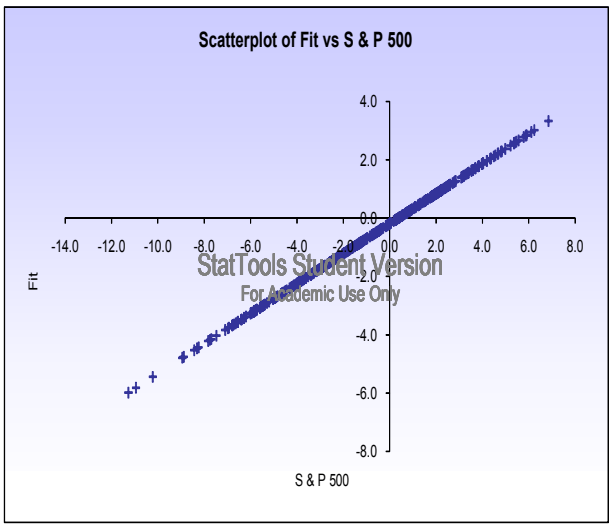
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.1903	0.0362	0.0333	9.439950066	2.2259

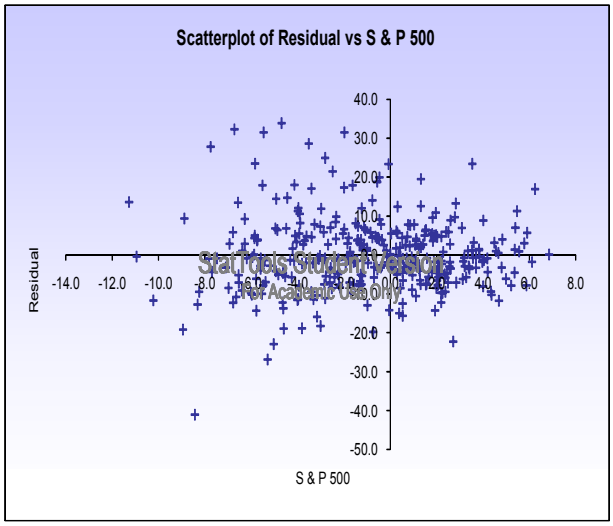
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	1124.670224	1124.670224	12.6208	0.0004
Unexplained	336	29941.85284	89.11265725		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	-0.192887256	0.532001109	-0.3626	0.7172	-1.23935971	0.853585199
S & P 500	0.514222008	0.144746396	3.5526	0.0004	0.229498699	0.798945316









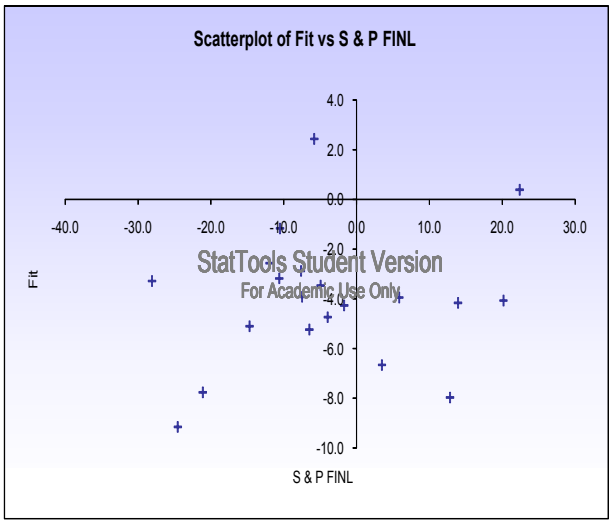
StatTools Turmoil period 1, T1

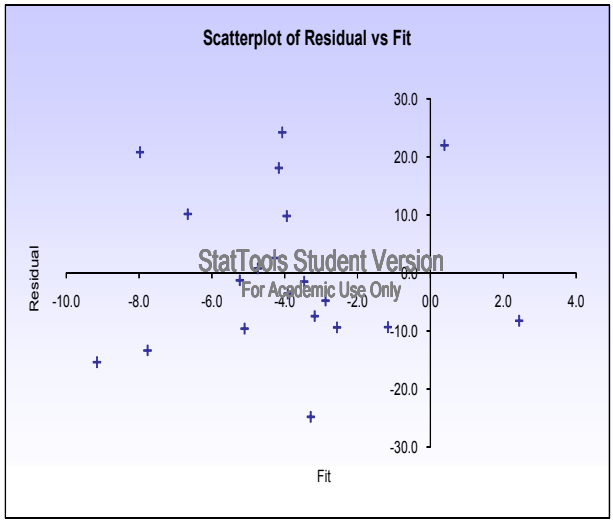
Analysis: Regression - Hypothesis 5 focus on impact on financial markets, S & P 500 _S5FINL
Performed By: RZA2961P
Date: 18-Feb-10
Updating: Static

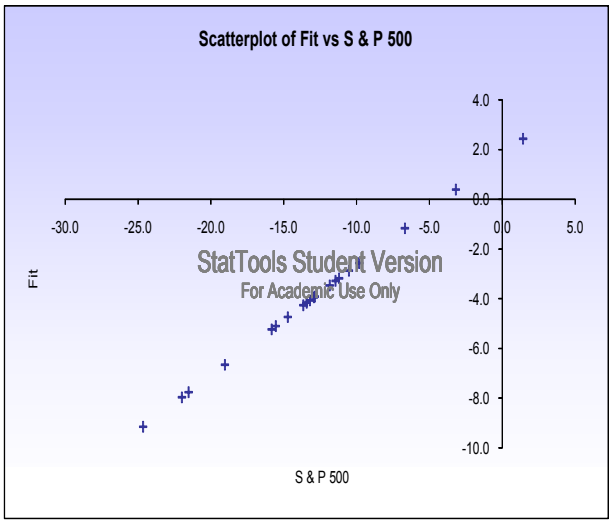
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.1965	0.0386	-0.0148	13.93897012	1.7807

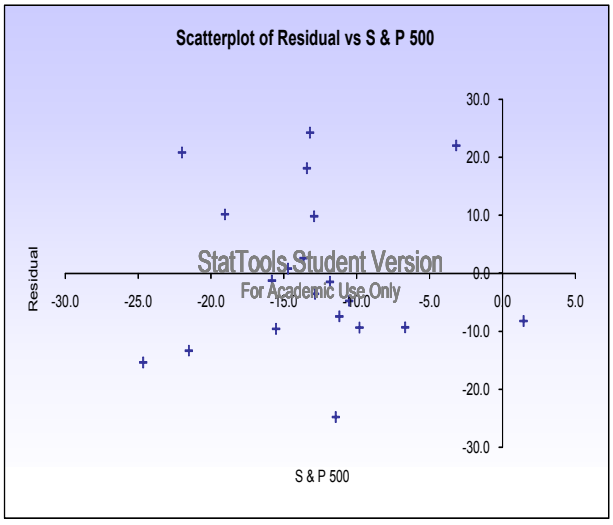
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	140.4762981	140.4762981	0.7230	0.4063
Unexplained	18	3497.307982	194.2948879		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	1.798076134	7.533843172	0.2387	0.8141	-14.02994103	17.6260933
S & P 500	0.444213294	0.522421103	0.8503	0.4063	-0.653352715	1.541779303









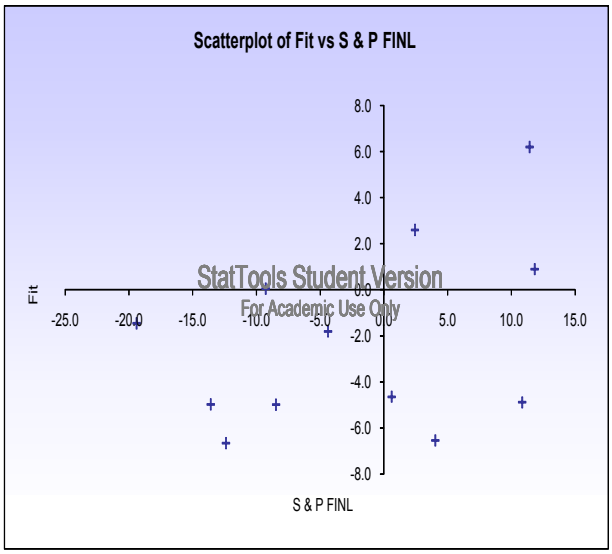
StatTools Stable period 2, S2

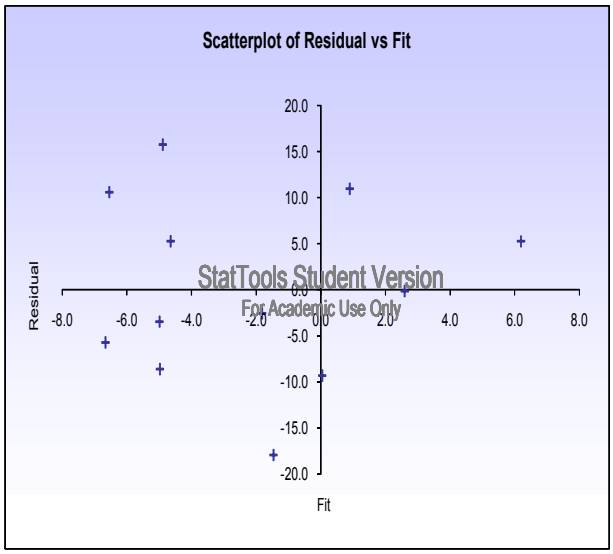
Analysis: Regression - Hypothesis 5 focus on impact on financial markets, S & P 500 _S5FINL
Performed By: RZA2961P
Date: 18-Feb-10
Updating: Static

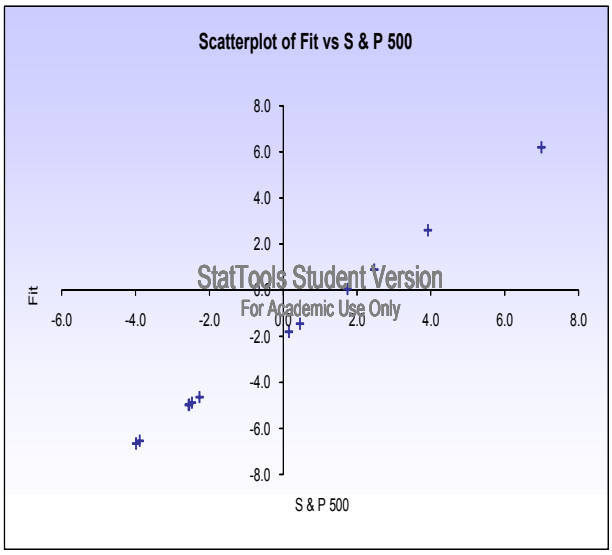
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.3761	0.1415	0.0556	10.34237953	2.1070

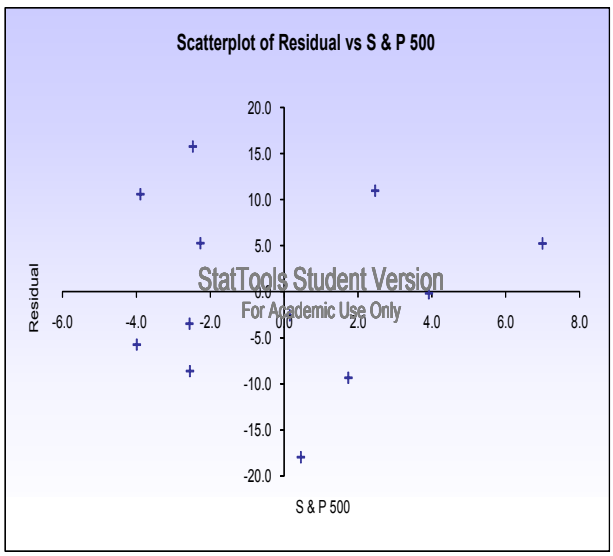
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	176.267456	176.267456	1.6479	0.2282
Unexplained	10	1069.648144	106.9648144		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	-1.995819181	2.989417313	-0.6676	0.5195	-8.656656042	4.665017679
S & P 500	1.170940226	0.912156019	1.2837	0.2282	-0.86147004	3.203350491









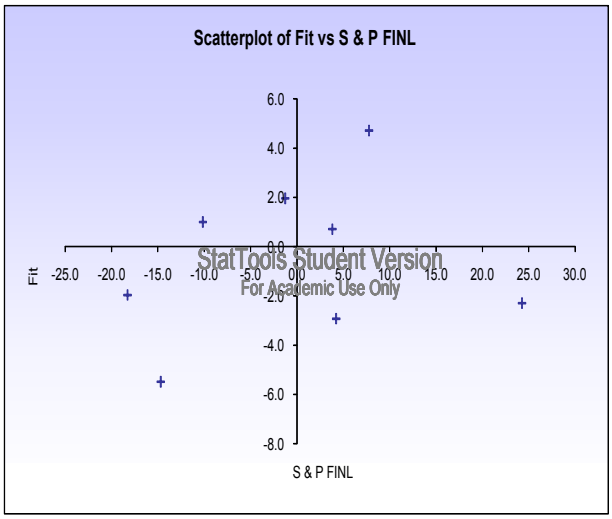
StatTools Turmoil period 2, T2

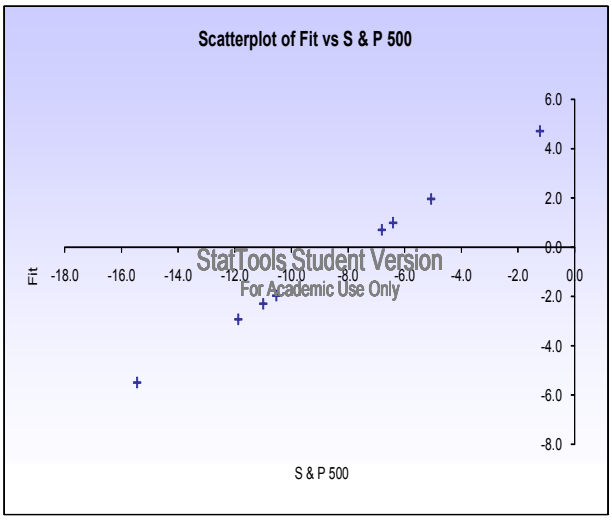
Analysis: Regression - Hypothesis 5 focus on impact on financial markets, S & P 500 _S5FINL
Performed By: RZA2961P
Date: 18-Feb-10
Updating: Static

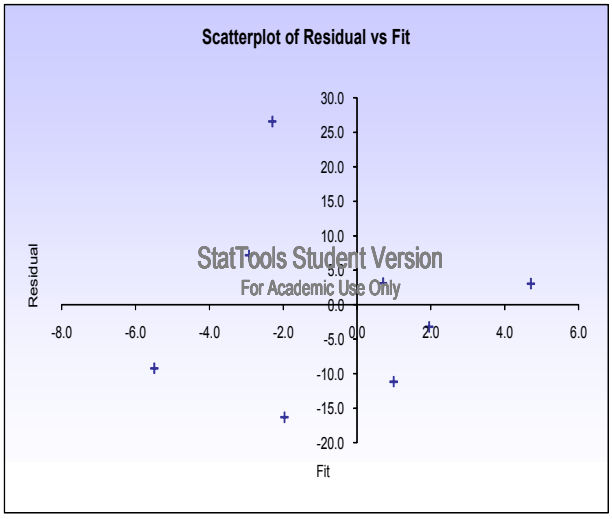
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.2338	0.0547	-0.1029	14.50708192	1.1728

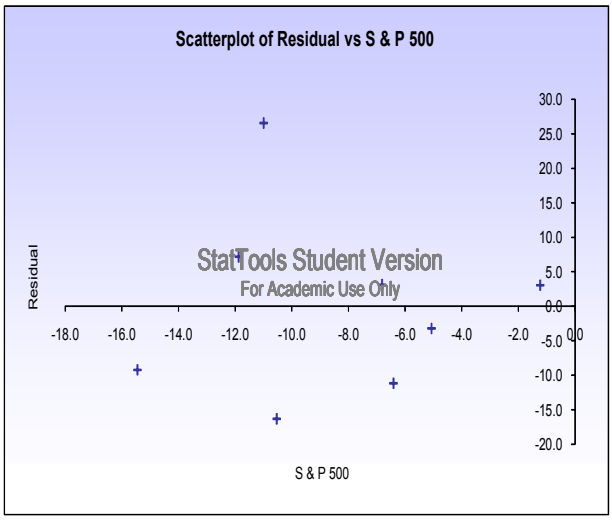
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	73.03264491	73.03264491	0.3470	0.5773
Unexplained	6	1262.732555	210.4554258		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	5.591710198	11.6039345	0.4819	0.6470	-22.80209462	33.98551502
S & P 500	0.717353838	1.21774113	0.5891	0.5773	-2.262351362	3.697059038









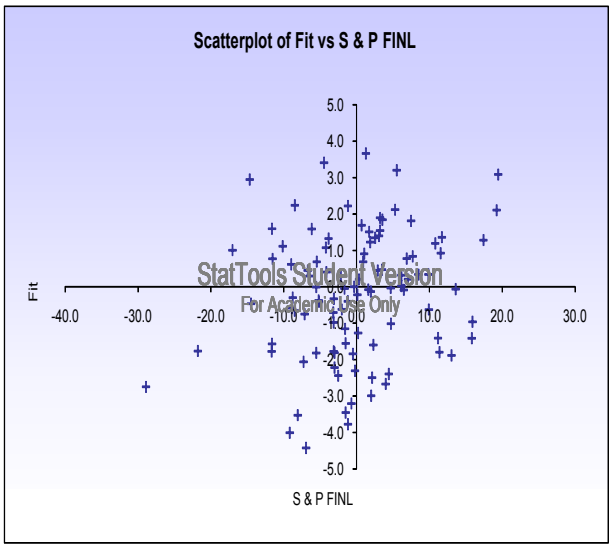
StatTools Stable period 3, S3

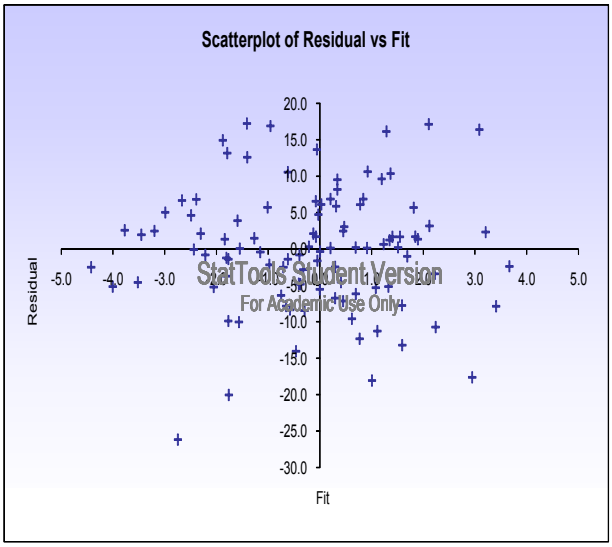
Analysis: Regression - Hypothesis 5 focus on impact on financial markets, S & P 500 _S5FINL
Performed By: RZA2961P
Date: 18-Feb-10
Updating: Static

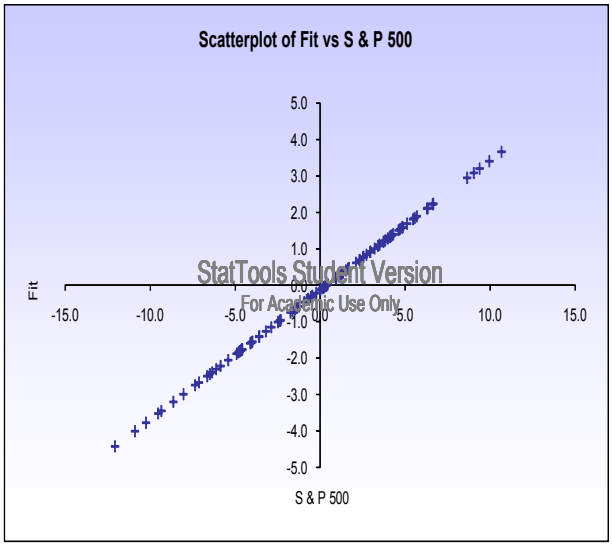
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.2049	0.0420	0.0323	8.325374414	2.3497

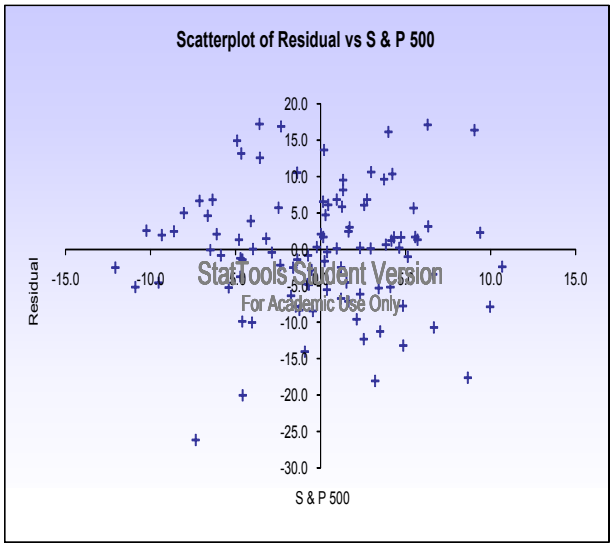
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	300.6028919	300.6028919	4.3370	0.0399
Unexplained	99	6861.874055	69.31185914		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	-0.131243151	0.828715345	-0.1584	0.8745	-1.775594187	1.513107885
S & P 500	0.355327775	0.17062252	2.0825	0.0399	0.016775677	0.693879872









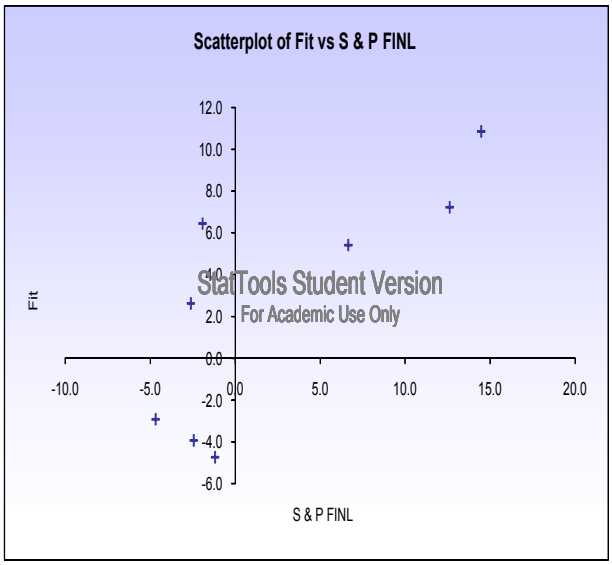
StatTools Turmoil period 3, T3

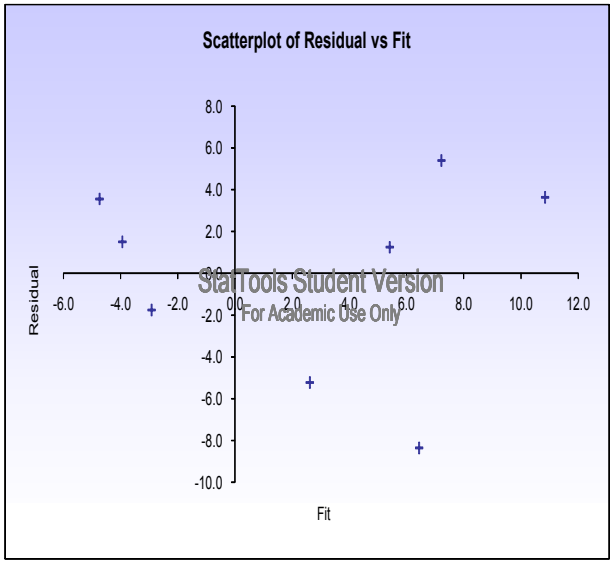
Analysis: Regression - Hypothesis 5 focus on impact on financial markets, S & P 500 _S5FINL
Performed By: RZA2961P
Date: 18-Feb-10
Updating: Static

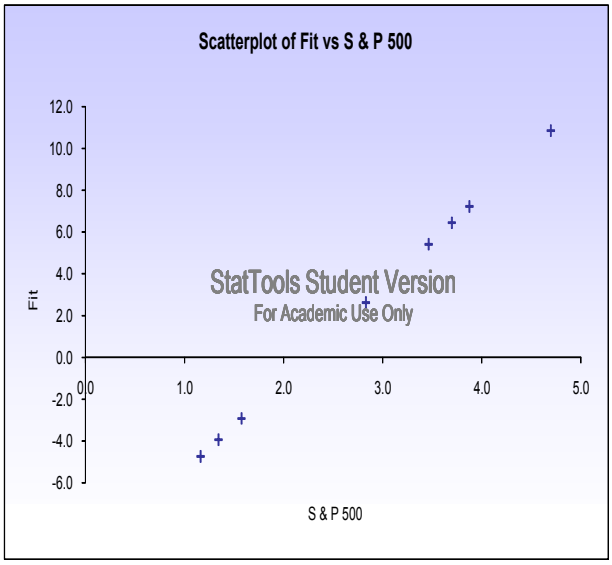
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.7749	0.6005	0.5340	5.149369497	2.5209

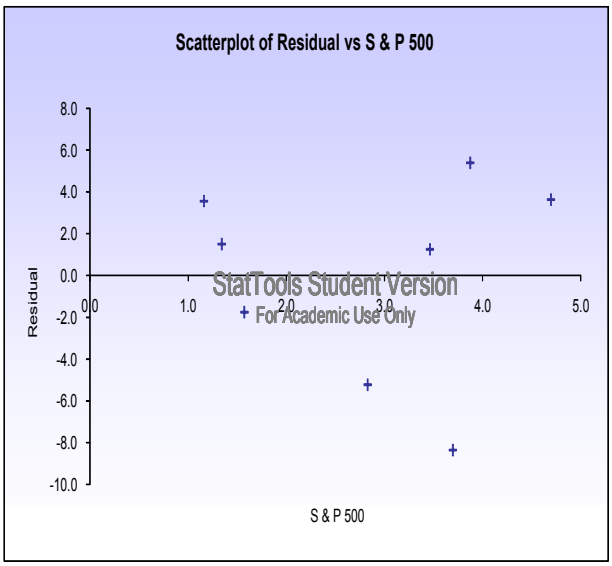
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	239.1831502	239.1831502	9.0203	0.0239
Unexplained	6	159.0960373	26.51600622		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	-9.860409789	4.535620611	-2.1740	0.0727	-20.9586736	1.237854027
S & P 500	4.409964274	1.468330556	3.0034	0.0239	0.817088839	8.002839709









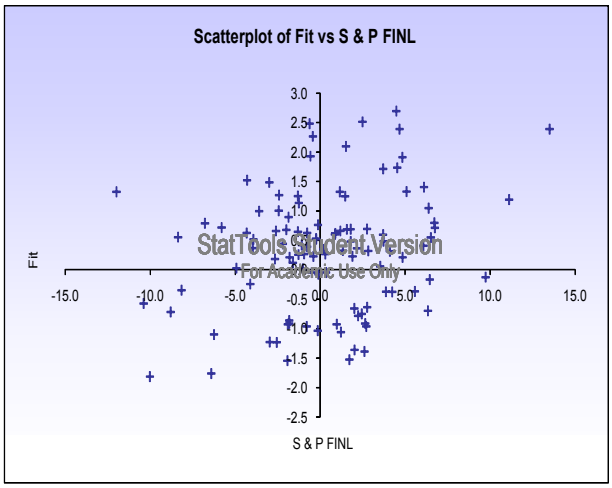
StatTools Stable period 4, S4

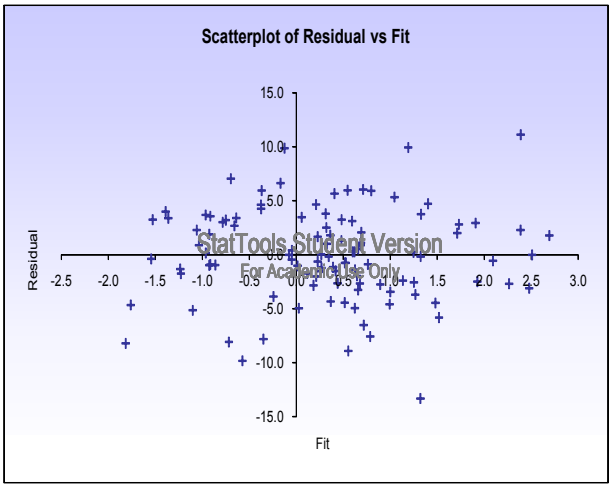
Analysis: Regression - Hypothesis 5 focus on impact on financial markets, S & P 500 _S5FINL
Performed By: RZA2961P
Date: 18-Feb-10
Updating: Static

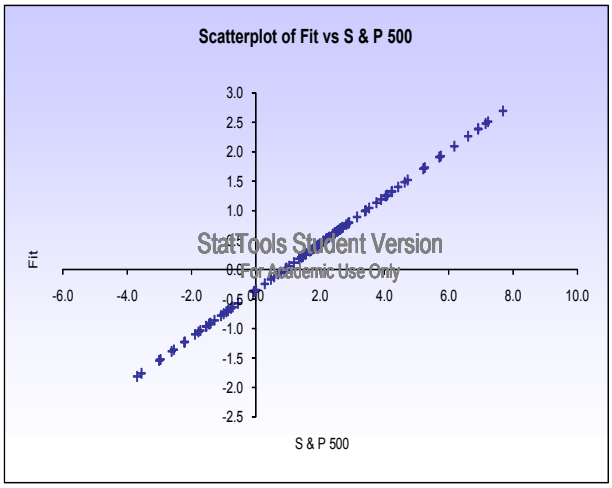
Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate	Durbin Watson
	0.2309	0.0533	0.0443	4.283884635	2.3787

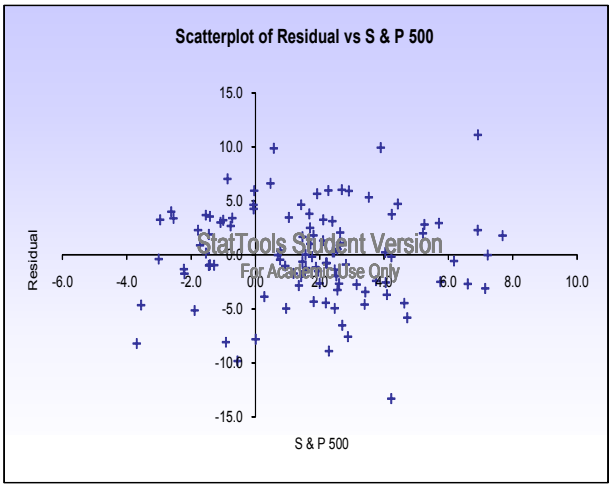
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	108.4822572	108.4822572	5.9113	0.0167
Unexplained	105	1926.925094	18.35166756		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	-0.35243128	0.499390239	-0.7057	0.4819	-1.342629874	0.637767313
S & P 500	0.396211783	0.162961794	2.4313	0.0167	0.073088649	0.719334917









Vusi Mpofu

Olivedale July 2010

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