RESEARCH MASTERS IN ECONOMICS

AN ANALYSIS OF RECENT GLOBAL ECONOMICS DEVELOPMENT AND GDP GROWTH USING STEIN'S PARADOX, AND SOUTH AFRICA'S MONETARY AND FISCAL POLICY RESPONSE

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DECLARATION

I Sharvania Pillai hereby declare that this thesis is an original piece of work, except where due reference has been made when the work of others has been used, and has not been submitted for a degree or diploma to any other university. This dissertation was undertaken at the University of KwaZulu- Natal under the direct supervision of Professor D. Mahadea and the late Dr Richard Simson.

Signature……………………….   Date…………………………..

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ABSTRACT

The economic crisis of 2007 has had debilitating effects on the global economy, affecting GDP growth, unemployment and trade to name a few. In response to these economic effects, numerous policy interventions were implemented. There are various existing time-series methods available to determine better estimates of GDP growth rates, one of which is Stein's Paradox which uses observed averages to estimate unobservable quantities which are closer to the true unknown GDP growth rates or theta (θ) in order to determine better growth rates post the economic crisis. The resulting James-Stein estimator (z) is said to be better than the arithmetic average, and thus a closer approximation to the true GDP growth rates which are unobservable.

This dissertation analyses the effects of the 2008 financial crisis on the global economy, with specific reference to South Africa and America, and their corresponding policy interventions to determine the growth trajectory after the crisis. The main objective is to determine if better estimates of GDP growth can be calculated using Stein's Paradox, across a sample of 30 countries, using quarterly GDP growth for the period 2005 to 2008. Annual GDP data was also used for the period 2009-2011, and future GDP growth rates were forecasted for the period 2012 to 2016. To reinforce the Stein's Paradox, the Monte Carlo study is undertaken. It is used to determine how the James-Stein estimates perform under different conditions using a *common c* or *unique c*, and to determine which condition will provide more accurate GDP growth rates (Muthen. 2002).

Analysis of time series data across a sample of 30 countries using Stein's Paradox provided better estimates of GDP growth rates than the individual average growth rates for each country

based on the lower standard deviation and total squared error of estimation achieved. This shows that the results are closer to theta and have a smaller amount of error, particularly when a *common c* was used. The Monte Carlo results indicate that better GDP growth rates are achieved when using a *common c* instead of a unique c given that a smaller standard deviation and variance is derived. Therefore the Monte Carlo study aims to reinforce or verify Stein's Paradox. The study also indicates that emerging and developing countries seem to be the driving forces of growth in the future, while developed countries seem to be lagging behind.

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CHAPTER ONE

INTRODUCTION

1.1 Introduction

The global economic crisis of 2008, which originated in the United States of America (USA), caused numerous countries around the world to enter a period of recession, thus contributing to a decline in economic growth. This economic turmoil began with a housing bubble which originated from an increase in credit which was easily attainable, thus fuelling the number of mortgages that were registered. This led to a decline in the price of houses, thus causing homeowners to default on their mortgages (Congleton, 2009: 289). As a result, various financial institutions faced bankruptcy. However, this had a domino effect, particularly in countries which had direct ties to USA, but also on a global scale in general.

However, some countries seemed to have escaped the recession, while others still seem to be in its grip. This dissertation aims to understand the crippling effects which the recession has had on the global economy, and to outline the current policy interventions implemented. The future trajectory of the global economy will also be analysed to determine if recovery is possible given the macroeconomic effects post the crisis. Stein's Paradox which enables one to determine better averages than the arithmetic mean will be used to determine if better estimates called James-Stein estimators of real GDP (Gross Domestic Product) growth rates can be calculated post the crisis during specific time periods across 30 selected countries which represented over half of global GDP in 2008 and 2009 (IMF, World Economic Outlook, 2012). By using the calculated James-Stein estimates, one hopes that these will produce better forecasted GDP growth rates for

the selected countries, thus allowing one to predict a more precise projected growth trajectory. The Monte Carlo study will also be applied to determine under which conditions one will achieve better GDP growth rates. Therefore the Monte Carlo study will aim to reinforce Stein's Paradox. Finally, policy interventions implemented in South Africa and USA in response to the crisis will be discussed. The South African economy is chosen to gain a domestic view of the effects and solutions to the crisis; and United States of America is chosen because the two countries are strong strategic trade partners and because the crisis originated here. In the next section, the origins and manifestations of the global crisis will be analysed.

1.2 Background to the 2008 Global Financial and Economic Crisis

The 2008 global and financial economic crisis, which originated in the United States of America has had a domino effect on the global economy, and has affected developed, emerging and developing countries. The credit crisis began with the intention of government to increase the value of homes and the demand for mortgages as a way to finance these homes. Certain policies were implemented to pursue these goals. Family income was also rising concurrently. Therefore more families were able to purchase homes, thus increasing the prices further, especially from 2004 to 2007. House prices, however, cannot constantly increase. In 2006-2007, they began to fall which represented the end of the housing bubble. When house prices began to fall, the number of households which defaulted on their mortgages began to rise because of easy credit conditions and because no background checks were conducted on these households. Therefore numerous financial institutions faced bankruptcy because the applicants of the mortgages could not be held accountable for defaults (Congleton, 2009: 289).

1.3 Research Objectives

The objective of this study is to determine the severity of the 2007/2008 financial crisis and its effects on the global economy during a specific time frame, and to analyse the corresponding policy interventions implemented in South Africa and the United States of America. Stein's Paradox will be used to determine if one can calculate better estimates of GDP growth rates than the individual average GDP growth rates for each of the thirty selected countries over a specified time period. This will also include forecasted GDP growth rates. If these James-Stein estimates are better than the individual averages, they are said to be closer to the true unknown GDP growth rates which will be called theta (θ). Theta is generally used to label unknown values. The Monte Carlo study will be used to support Stein's Paradox to determine which method produces better estimates of GDP growth; either using a *common c* or a *unique c*. A *common c* is the constant used in the equation used to calculate the James-Stein estimate (z) which is as follows:

$$z = c + (y_i - \ )^2 \tag{1}$$

where z = the James-Stein GDP estimator for a specific country, = grand average (average of countries averages) GDP for all countries in the sample, and y_i = average GDP for an individual country (Efron and Morris, 1977: 119). This constant will be calculated using a common variance. When a *unique c* is calculated, a separate variance will also have to be calculated. The main objectives are to determine if one can calculate better estimates of GDP growth post the crisis for each country using Stein's Paradox, and to determine under which condition will better estimates be achieved using the Monte Carlo study. The current policy interventions implemented in South Africa and USA will be elaborated as a way to determine if these policies are in fact working based on the effects of the crisis on certain macroeconomic indicators. The

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final objective is to determine the future trajectory of the global economy to determine if recovery is possible in the near future, or to determine when global recovery is likely to take place. In conclusion, this paper aims to analyse the effects and policy interventions of the crisis in South Africa and USA, and to determine if better estimates of GDP growth can be calculated in order to determine more accurate current and future growth trajectories of a sample of countries, and to determine the drivers of growth in the future.

This method using Stein's Paradox to calculate better estimates of GDP growth rates is an original piece of work and has never been attempted before, and is the first in its field used to calculate forecasts of a time series variable. It is a useful alternative to the traditional methods used in time series analysis, especially for verification purposes.

1.4 Research Method

Data for this research study comes from both primary and secondary sources. The secondary data is extracted mainly from journals. In order to obtain the primary data which consists of the James-Stein estimates, real GDP growth rates for thirty selected countries were extracted from IHS Global Insight, particularly from International Financial Statistics (IFS) and World Economic Outlook extracted from the International Monetary Fund (IMF). Real GDP growth rates are adjusted for inflation, and they depict a percent change from a year earlier. In order to determine the actual James-Stein estimates which are said to better than the average growth rates, Stein's formula will be used. The Monte Carlo study will also be applied to determine which method will provide better estimates of GDP growth. Here, the computer programme Shazam will be used whereby inputs related to the estimates will be generated to determine which method is better in calculating closer estimates to the true unknown values, theta.

1.5 Motivation for the Study and Economic Justification for why the James-Stein Estimator was used

The motivation for this topic is the interest in the global recession and its key contributions to the current economic climate, and also a significant interest in the future state of the global economy. The crisis is a current global issue, thus making it more challenging, and allows one to contribute significantly to current literature. There has always been an interest in determining if there was a way to calculate better estimates of GDP growth post the crisis to determine by how much current projections deviate from the calculated estimates which are closer to the true unknown growth rates, and to determine a way of calculating a more accurate future growth trajectory.

The James-Stein estimator is used to estimate unobservable quantities using observed averages in order to obtain better estimates. By using the James-Stein estimator, the average can be used to estimate values closer to the unobservable true mean theta (θ). The normal or Gaussian distribution, investigated by Gauss, can be used to explain this. The curve can be explained by looking at two parameters. They are the mean (θ) and the standard deviation (σ). A larger standard deviation indicates that the data are more widely distributed and are further away from (θ) which is the true unknown mean. Stein's Paradox therefore uses observed data to determine (θ) and the standard deviation. The grand average can be used to estimate values closer to the true unknown mean (Efron and Morris, 1977: 121).

Gauss proved that the average or grand average is the most probable estimate of the mean. In other words, the average is the best estimator of the unobservable mean, and it is an 'unbiased estimator' of the mean. This means that the average is viewed as unbiased because the expected

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observed averages will always equal the true mean (θ). Gauss also proved that the total squared error of estimation for the average $\overline{x}$ will be lower than the total squared error of estimation of the observed averages, thus making this is a useful method to calculate and analyse better GDP performance growth rates among the 30 countries pre-and-post crises periods (Efron and Morris, 1977: 121).

$$c = 1 - (k\text{-}3) * \sigma^2 / \Sigma\, (y\text{-}\ )^{\,2} \qquad\qquad\qquad (2)$$

In the above equation, c is the constant or the 'shrinking factor.' The James-Stein approach ultimately makes inferences that the unobservable means or (θ) are close to the grand average . If the observed averages are fairly closely distributed around , then the James-Stein estimates calculated are shrunk further towards the grand average, thus indicating a larger shrinking factor or constant c. On the other hand, if the observed averages lie quite far off from , then the estimates are not significantly shrunk towards (Efron and Morris, 1977: 123).

There are several explanations why Stein's Paradox may be a competent and useful alternative to other traditional time series methods. Many traditional time series methods have certain limitations which may inhibit the outcome or results. Generally, time series models are linear which means they may not have the ability to capture or interpret nonlinear data (Hill et al. 1996: 1086). Having said this, the James-Stein estimator is a nonlinear estimator. James and Stein developed an estimator with a smaller mean squared error, thus making it a better estimator as more accurate results will be derived.

A study was conducted by Hill, Connor and Remus in 1996 which compares the Neutral Network forecasting method to other traditional time series methods like Box-Jenkins,

Deseasonalized Exponential Smoothing, Deseasonalized Holts, Reference Average and the Naïve time series model to name a few across quarterly and monthly time periods as a way to determine the absolute percentage errors (APE) through each of these time series. The standard deviation of the APEs of the neutral network model was much lower than most of the other time series methods (Hill et al. 1996: 1088-1087). This indicates that the results obtained with most traditional time series are less accurate because a larger standard deviation is derived. Therefore when forecasting short and long term growth rates, the amount of uncertainty increases. Stein's Paradox generally produces a small standard deviation, thus indicating that the results derived are more accurate than the individual averages. Therefore, Stein's Paradox is once again a more efficient option when forecasting growth rates as a way to obtain more accurate results or predictions. In conclusion, the James-Stein estimator can be used efficiently in large sample size estimation forecasting, whereas others time series models may have certain limitations when it comes to sample size (Hausser and Strimmer, 2009: 1478).

1.6 Research Questions

- What are the economic effects of the financial crisis on the global economy, particularly in the United States of America and in South Africa?

- What are the policy interventions implemented in South Africa and in USA to counteract the crisis?

- Can better estimates of GDP growth rates be calculated across the sample of countries using Stein's Paradox across a specified time period?

- Does the Monte Carlo study produce better estimates of GDP growth throughout the sample

of countries when using a *unique c* or a *common c*? Does it support the results generated from Stein's Paradox?

- What is the possible future path of the global economy, with a particular focus on the American and South African economies? Is recovery possible in the future?

1.7 Significance of the Study

The significance of this study is that it provides a clear picture of the global economy post the recession, and it assesses the current and future path of the South African and American economies. Stein's Paradox will be used to determine if better forecasted GDP growth rates can be calculated in the 30 selected countries, thus allowing one to project a precise trajectory post the recession, therefore providing a firmer stance on the current situation across these countries in terms of GDP growth rates.

1.8 Study Outline

This dissertation consists of 7 chapters. Chapter 2, which forms the literature review, provides a concrete background to the economic crisis, and it examines in particular the effects of the crisis on the global economy. Chapter 3 illustrates the economic effects of the crisis on the American and South African economies. In chapter 2 and 3, the possible future path of the global economy and South Africa in particular are analysed given these economic effects, and the possibility of future recovery is determined. Chapters 4 and 5 look at the effects of the crisis on GDP growth using Stein's Paradox across a sample of 30 countries. Chapter 6 focuses on the Monte Carlo Study which will determine how the estimates calculated perform under different conditions, and which method will provide better estimates of GDP growth. Chapter 7 analyses policy

interventions implemented in South Africa and United States of America. This analysis will enable the determination of possible recovery given the current policy interventions. This dissertation is concluded in chapter 7.

1.9 Definition of Concepts

Gross Domestic Product (GDP) - The total final output of goods and services produced by a country's economy (Todaro and Smith, 2011: 777).

Purchasing Power Parity (PPP) - Calculation of gross national income (GNI) using standardized international prices for all goods and services (Todaro and Smith, 2011: 782).

Gross National Income (GNI) - The total output of a country which consists of both domestic and foreign GDP plus other forms of income which foreign residents earn minus the income of domestic residents (Todaro and Smith, 2011: 777).

Disposable Income - A household's gross income minus income taxes which is equal to the net income available for expenditure (Todaro and Smith, 2011: 775).

Securitization - When the mortgages are sold by the original lender to trusts who finance the purchase by selling the bonds (Levitin and Twormey, 2011:6).

Mortgage-backed securities - Bonds sold in the process of securitisation are called mortgage-backed securities as the debt from these bonds is supported by the cash generated from the mortgage loans (Levitin and Twormey, 2011:6).

Foreclosure - When a homeowner defaults on payment regarding their mortgages, therefore transferring the property back to the lender as this is more viable when the value of the home falls far below the amount of the mortgage (Apgar and Herbert, 2010).

International Monetary Fund - An international organisation which aims to facilitate and expanding international trade, boost economic growth, reduce poverty, and increase employment (International Monetary Fund, 2012).

SARB - The central bank of the Republic of South Africa with the main objective to obtain price stability as a way to sustain and enhance economic growth (SARB, 2012).

CHAPTER TWO

THE ECONOMIC CRISIS OF 2008, AND ITS IMPACT GLOBALLY

2.1 Introduction

This chapter focuses explicitly on the manifestations and consequences of the global financial crisis of 2008. The results obtained will enable valid conclusions on the possible future path of the global economy. A comparison will also be made between this recession and the Great Depression of the 1930s. This chapter is essential in determining the current and future trajectory of the global economy given the crisis.

A comprehensive set of key factors affected by the crisis are evaluated on a global scale; namely Gross Domestic Product (GDP), labour markets and trade. These are three major factors which could contribute to an unsustainable economy. The chapter will conclude by elaborating whether an extended recession is still possible given the effects of the crisis on the macroeconomic indicators emanating from the financial crisis. As a point of departure, before the effects on these macroeconomic indicators are analysed, the origins and the causes of the crisis will be focused on.

2.2 Origins and Causes of the 2008 Financial Crisis

From the mid-2000s, countries all over the world were experiencing strong economic growth and inflation was considerably low. There was an increase in international trade, strong economic growth in both developing and emerging countries, and unemployment and GDP growth rates were at a reasonable level. However, there has been a significant shift in this structure due to three contributing factors: a rise in real estate values in USA, high and increasing current account

deficits, and an increase in power or influence in many areas around the world, mainly among consumers in USA and Britain, and various financial sectors (Obstfeld and Rogoff, 2009:1). These three factors played a major part in the manifestation of the credit crisis of 2008.

The origins of the crisis can be explained by looking at two individual elements: the *Great Moderation* and the *Global Savings Glut*. During the Great Moderation in USA, inflation and nominal short-term interest rates were considerably low, thus contributing to steady growth. Low inflation and short-term interest rates have a direct impact on credit growth (Mizen, 2008: 533). The bursting of the housing bubble in the United States of America was the main cause of the financial crisis of late 2007. Banks in USA wanted to increase home ownership. Banks increased the number of loans that they issued for the purchase of houses. When interest rates were low, the number of loans taken increased to finance assets such as homes. Hence credit growth increased. Therefore, during 2004 to 2007, short-term interest rates grew at a constant rate. The purchase of houses increased which eventually drove up house prices dramatically from the beginning of 2004 to 2007. Real house prices increased 50 per cent from the first quarter of 2004 till the third quarter of 2007 when the crisis began (Congleton, 2009: 289). This fuelled economic growth and household consumption.

Against this background, the United States government used many tactics as a way to increase the value of homes across the country. One such policy was the income-tax deductibility policy. This policy comprised of income tax being deducted from interest paid on home mortgages, thus reducing the amount paid on the mortgage and increasing the demand for it. Another cause of an increase in the demand for mortgages was the lowering of lending rates and standards executed as a way to entice more people to purchase homes, thus shifting the liability away from the

homeowner onto the financial institutions providing the credit. Therefore, the homeowners would not be held accountable for any default on their mortgage (Congleton, 2009: 287-288). The main objective was to increase homeownership rates. Over the last couple of years, household incomes were also on a rise.

The lending standards regarding credit extensions were of a poor quality because individuals were encouraged to accept mortgages with high loan to value ratios. A high loan to value ratio means that even though legally the applicants are the owners of the property which they are purchasing, they do not have a real financial stake in the property. These types of loans, however, require high interest rates and high monthly premiums. To resolve this problem, banks offered Adjustable Rate Mortgages (ARMs)[1] whereby the applicant was required to pay low initial payments for a short period of time (Mizen, 2008: 539).

House prices, however, cannot increase forever. There will be a point where they will become too high, and will thus start declining due to what is called a housing bust as mentioned earlier. Based on this, house prices decreased by 17 per cent, and stocks decreased by 37 per cent towards the end of 2008 (Congleton, 2009: 288). When house and stock prices decreased, personal wealth also declined due to a decrease in an individual's disposable income, and also because the homes were worth far less than what the applicants paid. This caused a significant decline in real GDP growth rates towards the end of 2008, and it also fuelled the credit crisis. When house prices fell, numerous individuals defaulted on their mortgages, thus transferring this

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[1] Adjustable rate mortgages (ARMs) comprise of both fixed and adjustable loans. These are essentially hybrid ARMs. The first payment period is fixed and the remaining period is adjustable. During the 2000s, these types of mortgages were mainly taken out by households with an insufficient knowledge of finance and its operations (Bergstresser and Beshears, 2010).

debt on to the financial institutions who issued the mortgages. As a result, certain businesses were forced to retrench an increasing number of people due to financial constraints leading to bankruptcy. Therefore unemployment increased between 2007 and 2008 (Congleton, 2009: 289). All these events led to the credit crunch which began towards the end of 2007.

The current economic crisis cannot be fully explained without discussing mortgage-backed securities (MBS). Mortgages are held by banks and are issued to individuals. The residential mortgage market in the United States of America makes up approximately 30 per cent of the total credit market in the country. It is made up of a high credit quality market (prime) and a lower credit quality market (subprime). The prime market is composed of high risk consumers. The party selling RMBS has information that the buyer does not have any access to. Therefore the seller can persuade the buyer that the bonds are worth more than what they actually are (Gan and Riddiough. 2008: 2678). In the past few decades, a market for mortgage-backed securities had developed. When mortgage loans are issued, they are generally securitised. Securitisation is when the mortgages are sold by the original lender to trusts who finance the purchase by selling the bonds. These bonds are called mortgage-backed securities as the debt from these bonds is supported by the cash generated from the mortgage loans (Levitin and Twormey, 2011:6). Retail mortgage lenders can then either hold residential mortgages or securitise them by selling them to the secondary market which comprises of Fannie Mae and Freddie Mac, which are Government Sponsored Enterprises (GSEs) in USA (Gan and Riddiough. 2008: 2678). If mortgages are securitised, retail mortgage lenders have no concern over whether the mortgage defaults or not. They are only worried about payment of the loan. Therefore the bank lends recklessly regardless of the risk. This creates moral hazard in the financial market. Moral hazard in the current subprime crisis involved a large amount of risk taking as parties would not bear the brunt of the

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risk. This process would continue so long as the house prices continue to increase, and new entrants are continuously entering the market. It will seize to exist when interest rates increase and house prices fall (Dowd, 2009: 142-143).

MBS are supported by household income and household prices. When household income and prices fall, so do the prices of MBS. As a result, numerous companies lost a great amount of their capital. Approximately 25 per cent of sub-prime mortgages had been defaulted on towards the end of 2008 (Congleton, 2009: 300). House prices and economic growth declined between 2006 and 2007, thus making mortgages more risky. In 2006, outstanding mortgages stood at approximately $10.4 trillion (Congleton, 2009: 301). There were also high default rates in 2007. Based on this, mortgage-backed security insurers needed to pay insurance claims which homeowners were not paying due to the defaults. This led to the crisis in 2007. The crisis therefore had a global impact and it was no longer an American issue.

When loan originators securitised these mortgages or sold them in the secondary market, adverse selection concerns are generated for Fannie Mae and Freddie Mac. These GSEs have the ability to obtain large amounts of credit information at low cost in order to gain access to loan credit risk. As a result, they have developed sophisticated mechanisms to evaluate credit that other loan originators don't have access to (Gan and Riddiough, 2008: 2680-2681).

A credit default swap (CDS) market is used to insure financial institutions against default on mortgages or loans on repayments. When mortgage defaults occurred, a fixed premium would be swapped for payment. If a default is more likely to occur, then the premiums go up. Credit default swaps and the financial crisis. When subprime mortgages were securitised, the mortgages are set up as a trust, and notes will be issued against the trust. These notes are divided into three

levels. The super senior level had an AAA credit rating. The lowest levels however experience the greatest losses. If for example a super senior AAA credit rated debt is issued against a pool of mortgages, then a financial institution who wants to insure the debt which it holds could buy protection through a credit default swap. The credit default market accumulated to approximately $180bn by 1998. This however grew to $6 trillion in 2004 and to $41 trillion towards the end of 2008 (Stulz, 2010: 76-78).

Eventually a market for collateralised debt obligations (CDOs) which were made up of these notes mentioned above had developed. CDOs also had different levels of risk. The different levels were pooled and resold as CDOs-squared. These were also pooled and resold as CDOs-cubed. The process above involve credit risk taking being unbundled, repackaged, tiered, securitised, and distributed to final investors. Structured investment vehicles (SIVs) were some of these purchasers of the CDOs. SIVs are entities not shown on balance sheets which are developed by banks to hold these types of assets. They were set up by banks to undertake investments in Asset Backed Securities (ABS) Markets (Mizen, 2008: 538).

Another contributor of credit expansion was the global savings glut. The surplus of global savings particularly in Japan, China and Germany contributed to low long-term interest rates. Therefore these countries were not spending a great amount of money on imported goods from other countries. Therefore the amount of savings in these countries increased causing a decrease in interest rates. Large savings from emerging markets created deficits in industrialized countries. This created an imbalance between countries. This imbalance and low long-term interest rates contributed to credit growth (Mizen, 2008:533-534). In the next section, the global effects of the economic crisis will be discussed.

2.3 Economic Effects of the Crisis Globally

The current global financial crisis began towards the end of 2007. However, recovery only began around 2010 (Bordo and Landon-Lane, 2010). Numerous macroeconomic indicators like Gross Domestic Product, unemployment and trade were affected by this downturn. The effect on these factors will be discussed in detail below.

2.3.1 Gross Domestic Product (GDP)

A broad number of factors can be attributed to the decline in GDP growth which was exacerbated as a result of the crisis. Numerous organizations experienced severe losses, thus forcing them to retrench workers and reduce output. Different sectors of the economy tightened which subsequently contributed to an overall decline in GDP growth. This is exactly what materialised in the global economy.

Figure 1 below, shows global real GDP growth rates from 2004 to a projected 2013. Real global GDP growth increased by 3.5 per cent, 4.1 per cent and 4 per cent from 2005, 2006 and 2007, respectively. However in 2008 at the start of the crisis, GDP growth declined by 1.5 per cent (IMF, World Economic Outlook, 2012). During 2008, the global crisis was at its peak which caused a decrease in production owing to a decline in the demand for goods and services, which led to massive retrenchments because of insufficient funds. GDP growth rates declined by 2.3 per cent during 2009. It, however, increased by 4.2 per cent as of 31 December 2010. Growth, however, increased by 2.8 per cent in 2011. The blue bars in figure 1 below represent the actual growth rates from 2005 to 2011. The growth forecast is expected to only increase by 2.7 per cent in 2012. The GDP growth forecast for 2013 is set at about 3.3 per cent (IMF, World Economic

Outlook, 2012). The orange bars depict the forecasted growth rates in 2012 and 2013. These positive growth rates indicate that the global economy may be on the path to recovery as growth is expected to increase in 2013. However, it may take a considerable amount of time before the economy returns to pre-crisis conditions. As one can see, 2009 is the only year where GDP growth entered negative levels. In the next section, the global labour market will be analysed post the crisis.

Figure 1: Global Real GDP Growth from 2005 to a projected 2013
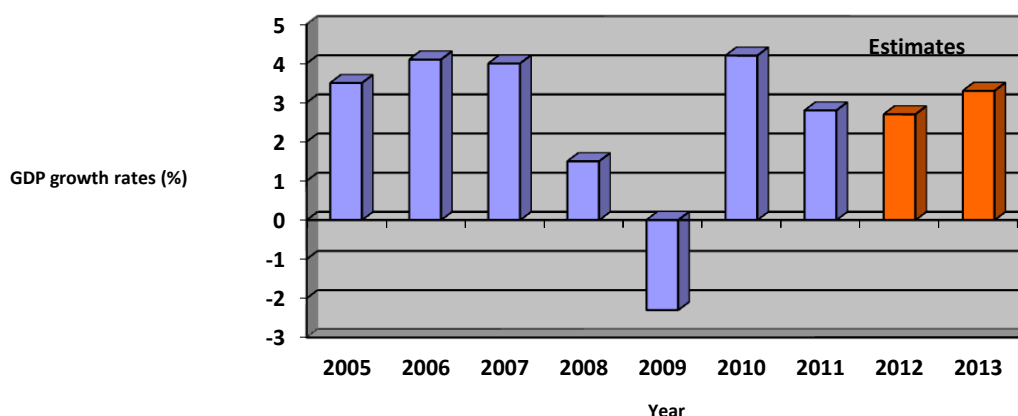
Source: IMF, World Economic outlook, 2012

2.3.2 Global Labour Markets

As a result of the economic crisis, numerous organisations around the globe had to retrench an increasing number of workers due to insufficient funds, and as a way to decrease costs. In China for example, approximately 3 per cent of the labour force had been retrenched, and the unemployment rate in Spain increased to 14.8 per cent in January 2009. Manpower, which is an

employment firm, said that companies are not keen on hiring due to the financial crisis. This recession has taken away more jobs than any other financial crises since 1957 (The Economist, 2009: 2-3). A rise in unemployment leads to a rise in poverty. These poverty and unemployment effects can be mitigated if the correct policy responses are implemented and executed. A financial crisis of this magnitude will impact significantly on unemployment. Unemployment levels are a key factor in determining the growth and success of an economy as unemployment will have a significant effect on income and production.

Figure 2, on page 21, below depicts global unemployment rates from 2005 to a projected 2012. Unemployment rates were 6.2 per cent, 5.8 per cent and 5.4 per cent from 2005 to 2007 respectively, thus depicting a gradual decline and recovery in unemployment levels. It, however, increased to 5.5 per cent in 2008 (International Labour Organisation, 2012). As a result of a decline in the demand for goods and services caused by the crisis, companies had to reduce production to limit costs by retrenching workers, thus representing the increase in the unemployment rate. It will be extremely complicated to recreate jobs once they are lost, and eventually fully recover. When the severity of the recession began to weaken, causing demand to increase once again, the composition of jobs visible in society will be altered. Workers who were retrenched might have to seek different areas of work from those previously acquired. The financial crisis has caused a rise in permanent-job losses which has exacerbated during the course of 2009 on a global scale. Unemployment levels accelerated to 6.2 per cent in 2009 before declining once again to 6.1 per cent in 2010. The unemployment rate stood at 6 per cent in 2011, and the rate is forecast at 6.1 per cent for 2012 (International Labour Organisation, 2012). The unemployment rate for 2012 is shown as an estimate. This shows that the unemployment rate has improved slightly between 2010 and 2011. However, it is likely to increase during 2013 if global

growth remains anaemic. Thus more jobs need to be created on a global scale to try and decrease the rate. In the next section, global trade will be analysed.

Figure 2: Global Unemployment Rates from 2005 to a Projected 2012
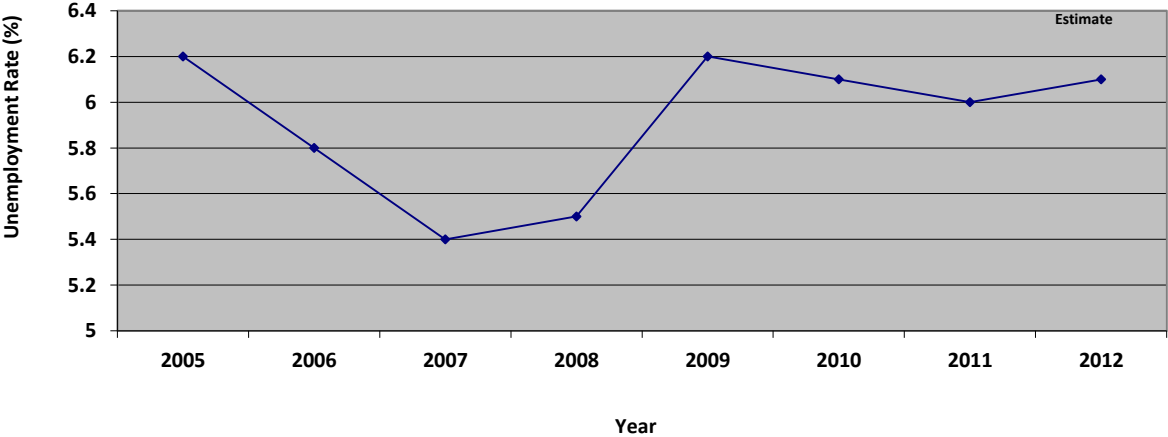
Source: International Labour Organisation, 2012

2.3.3 Global Trade

The demand for global commodities declined during 2008 and 2009. A main contributor to the decline during this period could be the 2008 financial crisis which peaked in 2009. Fuel and food prices increased in 2007 and 2008, thus increasing the cost of trade, therefore causing trade to decline (*Asmundson et al*, 2010). Trade declines because the demand for goods and services shrink, therefore causing imports and exports of a country to decline. When trade contracts, there is a slowdown in economic growth.

The percentage change of global trade volume of goods and services is depicted in figure 3 below. From December 2006 to December 2008, trade grew at 9.1 per cent, 7.7 per cent and 3

per cent respectively. However, in 2009, trade declined by 10.7 per cent. It, however, recovered by incr easing b y 12.8 per c ent in 2010. Tr ade at the end of 2011 grew at 7.5 per cent, thus representing a de cline of 5.3 pe r cent. Forecasted growth for 2012 stand at 5.5 per cent (IMF, World Economic Outlook, 2012). Therefore, trade is not at its peak given the occurrence of the economic c risis. However, one can a rgue that tr ade wa s on a de cline pr ior to the crisis. More needs to be done to increase trade between various countries across the globe, thus contributing to overall global economic growth. Figure 3, below, depicts the global trade volume percentage from 2006 to 2012. The blue bars represent actual trade volumes, and the orange bars represent the forecasted figure for 2012. The next section will conclude the chapter by determining if an extended g lobal re cession is possible given the e ffects of the crisis on the macroeconomic indicators mentioned above.

Figure 3: Global Trade Volumes: Year on Year Growth (Per cent Change)
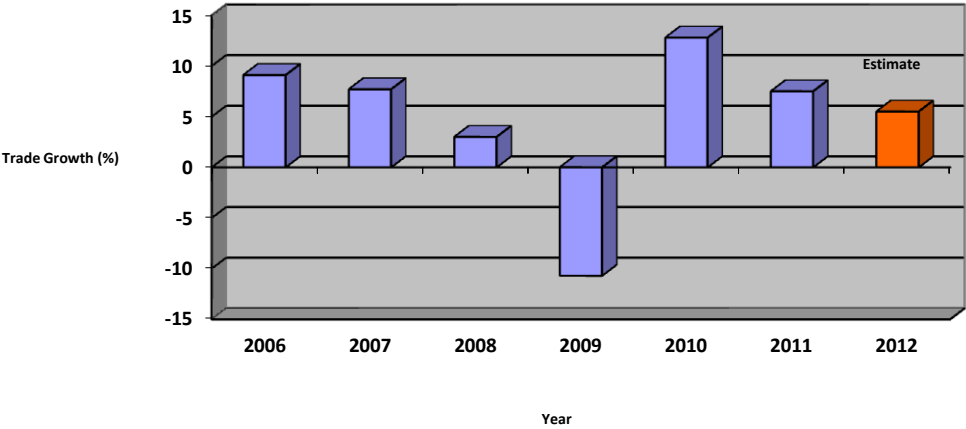
Source: IMF, World Economic Outlook, 2012

2.4 Possibility of an Extended Global Recession and Economic Collapse

The economic and financial crisis has continued to be extremely devastating across the global economy. The current recession could persevere for a long period of time due to the drop in house and stock prices. House prices dropped on average by 17 per cent, and stock prices dropped by 37 per cent by the end of 2008 (Congleton, 2009: 288). The major economic shocks brought about by the recession may prolong global recovery. The current crisis has since caused a significant amount of destruction based on the effects on the macroeconomic indicators analysed thus far. In the sections, below the possibility of an economic collapse will be focused on, and comparisons of the crisis will be made to the Great Depression of the 1930s.

The Great Depression was a financial crisis in the 1930s which was labelled as a stock market crash caused by a fall in the money stock. Income and production decreased after 1929. The quantity demanded of money and income is related. This means that if one falls, so does the other. When the quantity demanded of money decreased, the money supply also decreased. When the money supply decreased, banks entered a period of terror. Soon after, numerous banks failed during the 1930s, thus causing the stock market crash or the Great Depression (Temin, 1976: 41).

There are numerous similarities between the financial crisis of 2008 and the Great depression of 1929 which was the greatest recession the global economy has ever experienced until now. During 1929, there were massive credit extensions which fuelled consumption and expenditure. The financial system was also unstable. The stock market crash eventually led to high volumes of debt inflation, therefore resulting in decreased consumption and expenditure (Shibata, 2004: 88). Similarly, during the financial crisis, easy credit conditions encouraged people to borrow

more money from banks to finance the purchase of homes. This also led to the instability of the financial system. In both cases, the amount of debt in the economy increased.

In both recessions there was a resulting change in output, increased unemployment rates and a change in prices. During the Great Depression, unemployment increased from 3.2 per cent to 25.2 per cent, output declined by 26.7 per cent, and prices declined by 25.5 per cent. During the 2008 financial crisis, unemployment increased from 5 per cent to 9.5 per cent, output declined by 4.1 per cent, and prices declined by 2.5 per cent (Labonte, 2010).

The global recession of 2008 encompassed numerous downturns. In the short-term, the path of global recovery could look like a v-shaped recovery as numerous stimulus packages were implemented. A v-shaped recession is a recession which lasts for a few months followed by a sharp recovery in economic growth. This type of recession will only be possible if there had to be a significant increase in private domestic demand (Joshua, 2010: 33). However, a global recovery will not solely depend on government stimulus packages. Until employment, labour income and consumption are increased, a v-shaped recovery will not be possible in the long-run. As a result, a u-shaped recession (one where growth is stagnant for quite a significant amount of time before slowly returning to positive levels) is the most possible shape for the global economy over the next few years considering the current conditions emanating in the global economy and the decline in global growth from 2008 to 2009, followed by the increase in growth rates from 2010 to 2011 (Joshua, 2010: 33).

2.5 Conclusion

This chapter comprises of a comprehensive review of the 2008 financial crisis and its impact globally. The objective is to determine the current and possible future trajectory of the global economy post the economic recession. The crisis has had catastrophic effects on the global economy. The peak of the crisis occurred during 2009 when macroeconomic indicators entered negative levels. Unemployment has increased significantly since the start of the crisis. However, there has been a slight decrease in the rate between 2010 and 2011. Nevertheless, unemployment rates are expected to increase once again in 2012. It is uncertain as to when full recovery of employment will be achieved as the economy is currently very volatile. Global GDP growth has increased between 2005 and 2007 before only growing by 1.5 per cent in 2008 and entering negative levels in 2009 where it declined by -2.3 per cent. However, growth has increased by 2.8 per cent in 2011. Projected GDP growth in 2012 is fairly steady at 2.7 per cent, thus not showing a significant improvement (IMF, World Economic Outlook, 2012). The decline in trade has altered GDP growth in numerous countries around the world, thus hindering exports and imports. Trade is expected to decline further in 2012.

Based on the data above, the recession may continue for a prolonged period of time. However, the global economy seems to be on the path to recovery mainly based on the GDP growth statistics indicated above. Recovery may be slow, but it is, however, taking place which means that current global policies implemented may possibly be working. However, more needs to be accomplished in order for the global economy to operate at conditions before the financial crisis hit. The effects of this recession are similar to those experienced during the Great Depression of

the 1930s. The question is, 'How long would it take for the global economy to fully recover from the credit crisis if it ever will recover fully?'

Chapter 3 focuses on the economic effects of the financial crisis on the South African economy with a specific reference to United States of America as these two countries have a strong trade relationship. The consolidation of these two chapters will aid in understanding the current global economic climate post the recession, thus allowing one to make valid conclusions on the current and future global economic climate.

CHAPTER THREE

THE EFFECTS OF THE FINANCIAL CRISIS ON SOUTH AFRICA AND AMERICA, AND THEIR FISCAL AND MONETARY POLICY RESPONSE

3.1 Introduction

This chapter outlines the effects of the global economic crisis on certain macroeconomic indicators in the South African economy with a specific reference to United States of America as this is where the crisis originated. A reason for the choice of these two economies is that South Africa and USA have a strong bilateral trade relationship. Another reason is that it will be useful to compare the domestic market of South Africa with USA where the crisis originated pre and post crisis. This will allow one to unpack the economic effects from a local point of view, and from an international perspective, to determine how growth rates, unemployment and trade differ between the two countries. The macroeconomic indicators analysed include GDP growth, unemployment and trade which are the same indicators analysed globally. The chapter will conclude by elaborating on the possible future path of these two economies given the effects on these indicators as a result of the crisis, thus allowing one to comment on the future trajectories of these countries. The chapter begins by looking at GDP growth in South Africa.

3.2 GDP Growth

3.2.1 GDP Growth in South Africa

South Africa has registered an average growth rate of 3.1 per cent (per cent change from a year earlier) during the period 1994-2004 (SARB, 2012). However, growth increased by approximately 5 per cent between 2004 and 2007 (Bottini, Kowalski and Lattimore, 2009). Hence growth has improved significantly over the four year period. However, things changed in 2007 when the credit crisis began, thus causing South Africa to enter a period of recession.

From 2005 to 2007, real GDP growth rates in South Africa increased by 5.3 per cent, 5.6 per cent, and 5.6 per cent respectively. In 2008, the GDP growth rate only increased by 3.6 per cent. In 2009, at the peak of the recession, it declined by 1.7 per cent. In 2010, it increased by 2.9 per cent (World Bank, 2012). GDP growth rates began to improve in 2010 possibly as a result of reforms that were implemented, and also attributable to the soccer world cup hosted in the country in the same year which increased revenue, created jobs and increased production, thus boosting economic growth. The decline in GDP growth in 2009 can be accredited to the occurrence of the recession coupled with a decline in prices, a rise in unemployment and a decrease in demand. GDP growth increased by 3.1 per cent in 2011. Growth for 2012 is forecasted at 3.6 per cent (World Bank, 2012). South Africa's real GDP growth rates are depicted in figure 4 on page 24. The blue bars depict GDP growth rates for South Africa. Thus, this shows there has been considerable improvements in growth rates from 2010, and that South Africa has managed to escape the greatest downturn experienced in a very long time. Next, GDP growth in USA will be analysed.

3.2.2 GDP Growth in USA

In 1999, USA and South Africa signed a Trade and Investment Framework Agreement (TIFA). TIFA is an agreement between the two countries whereby they can solve trade and investment issues (Ploch, 2011). Therefore there is a direct link between U.S GDP and South African GDP and this will be explained further on in the chapter when focusing on trade between the two countries.

Real GDP growth in USA increased by 3.1 per cent, 2.7 per cent and 2.1 per cent in 2005, 2006 and 2007 respectively. Growth rates from 2008 to 2009 decreased by 0.4 and 2.5 per cent, respectively as also reflected in figure 4. The real GDP growth rate decreased substantially from 2007 to 2008, and decreased even further during 2009. This illustrates the severity of the crisis during 2009. Growth increased by 3 per cent in 2010. The GDP growth for 2011 was approximately 1.7 per cent, and growth is forecasted at approximately 1.8 per cent in 2012 (International Monetary Fund, 2012). Figure 4 below also depicts the real GDP growth rates of USA from 2004 to a projected 2012. The maroon bars depict GDP growth rates for USA. In both countries, there has been a significant decline in GDP growth post the crisis in 2009. However, rates have increased considerably during 2010, thus showing that policy interventions implemented by the two countries may be working. Growth is still positive in 2012. However, there has been a modest decline from 2011 growth. Combined policy interventions to be discussed in chapter 7, include the Expanded Public Works Programme, infrastructure investment, increase in social spending, lowering of the repurchase rate, stimulus packages and TARP. TARP is the Troubled Asset Relief Programme initiated by the U.S. government in 2008

as a way to increase credit growth and liquidity in the banking industry. In the next section, the effects of the recession on unemployment will be analysed.

Figure 4: Real GDP Growth Rates in South Africa and USA from 2005 to a Projected 2012
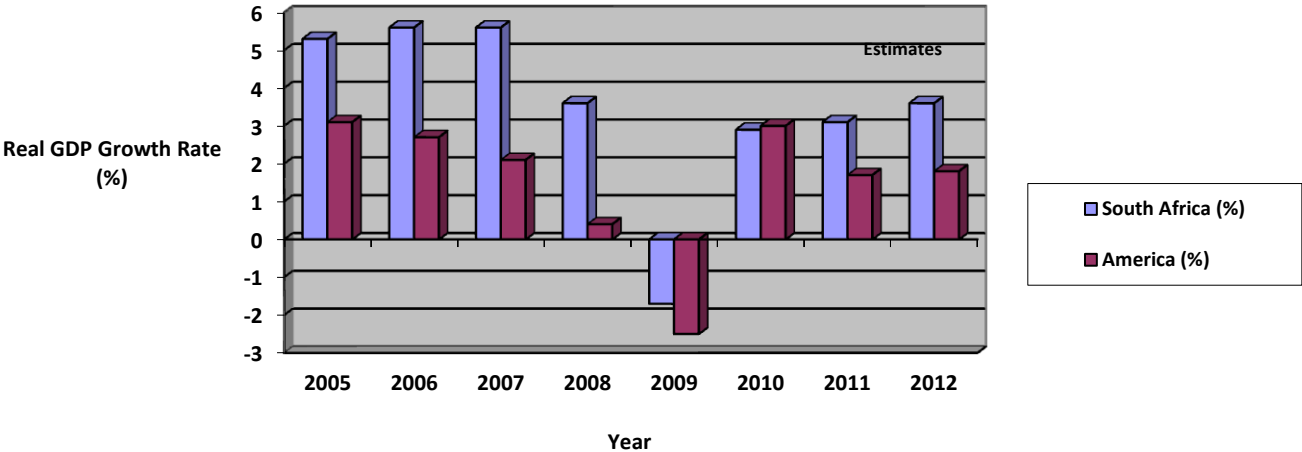
Source: IMF, International Financial Statistics, 2012

3.3 Unemployment

3.3.1 Unemployment in South Africa

Unemployment in South Africa is a priority and a key problem which South Africa faces, thus representing a major challenge. If not tackled efficiently, this will have a direct impact on economic growth and poverty. The 2011 State of the Nation address delivered by South African President, Jacob Zuma, emphasised the issue of job creation related to the issue of high unemployment rates. He stated that 2011 will be the year in which countless jobs will be created,

and he also included ways in which to grapple this problem (Zuma, 2011). This included the Expanded Public Works Programme (EPWP) and the R846bn infrastructure investment. These initiatives will be discussed in chapter 7.

Figure 5 on page 32 below shows unemployment rates in South Africa as a percentage of the total labour force from 2006 to a projected 2012. The unemployment rate in 2006 prior to the crisis stood at approximately 25.5 per cent. However, unemployment levels decreased to 22.1 per cent in 2007 (IMF, World Economic Outlook, 2012). As a result of the crisis, it increased between 2008 and 2010. Unemployment rates increased from 22.9 to 23.9 and to 24.9 per cent in 2008, 2009 and 2010 respectively. During the first three quarters of 2009 throughout the peak of the crisis, approximately 336 000 jobs in the formal sector were lost as numerous companies were retrenching based on a limited budget (SARB, 2012). Unemployment, however, dropped to 24.5 per cent in 2011, thus showing a slight recovery as also evidenced by improvement in GDP growth rate from -1.5 per cent in 2009 to 3.1 per cent in 2011 (SARB, 2012). The forecasted figure for 2012 is approximately 23.8 per cent (IMF, World Economic Outlook, 2012). Nevertheless the actual rate in the second quarter of 2012 is almost 25 per cent (SARB, 2012). The unemployment rate for 2012 is shown as an estimate. This is an indication that there has been no major improvement in unemployment rates. Steps have been initiated to address the unemployment problem. One initiative includes the Expanded Public Works Programme (EPWP) which will be analysed in chapter 7 as part of the policy interventions implemented. Now that domestic unemployment has been reviewed, unemployment in USA will be evaluated.

Figure 5: Unemployment Rates in South Africa as a Percentage of the Total Labour Force from 2006 to a Projected 2012
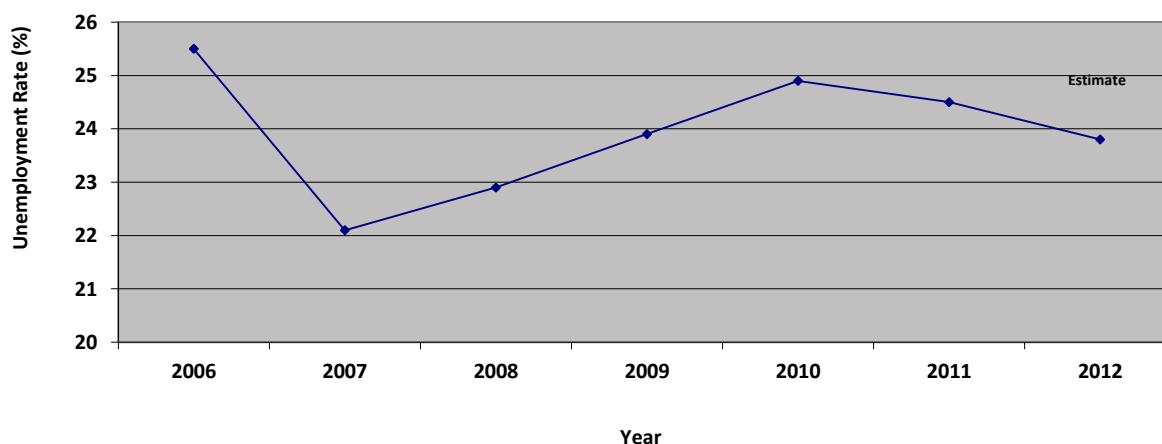
Source: IMF, World Economic Outlook, 2012

3.3.2 Unemployment in USA

Unemployment rates in USA have been quite volatile over the last couple of years. The unemployment rate in USA in 2011 was 9 per cent which is considerably lower compared to that of South Africa which remained at 24.5 per cent in 2011 (IMF, World Economic Outlook, 2012). As a result of the crisis, millions of people have been laid off due to the inability of employers to retain their workers owing to financial constraints and bankruptcy faced by numerous financial institutions. Figure 6 below shows unemployment rates as a percentage of the total labour force between 2005 and a projected 2012. The annual unemployment rate in USA from 2005 to 2007 was 5.1 per cent, 4.6 per cent and 4.6 per cent respectively (International Monetary Fund, 2012). Hence, unemployment was on a general decline. However, as a result of the crisis, unemployment increased to 5.8 per cent in 2008. It increased further in 2009 and 2010 to 9.3 per

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cent and 9.6 per cent respectively. The rate nearly doubled from 2008 to 2010. The rate in 2011 stood at approximately 9 per cent (International Monetary Fund, 2012). Unemployment is forecasted at 8.2 per cent for 2012 and this is shown as an estimate in figure 6 below (IMF, World Economic Outlook, 2012). A similar trend is present in United States of America; unemployment rates seem to be declining, and will decline further during 2012. Thus more policy action is required.

Figure 6: Unemployment Rates in United States of America as a Percentage of the Total Labour Force from 2005 to a Projected 2012
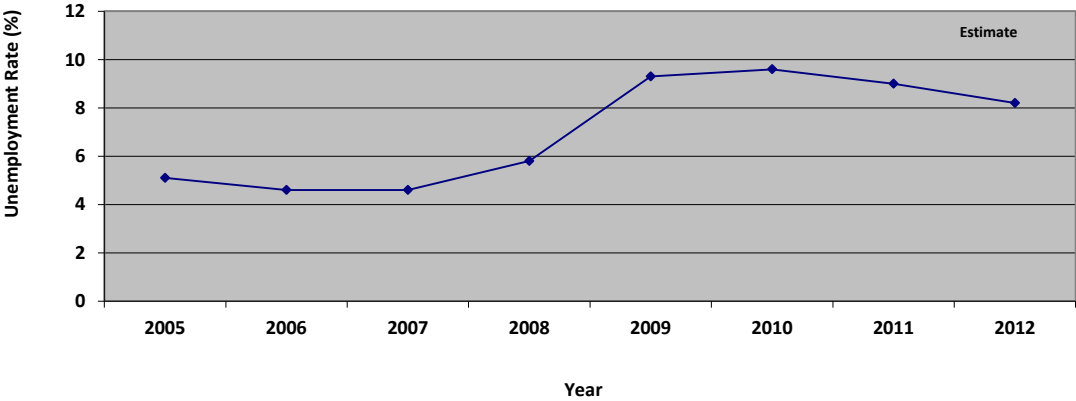
Source: IMF, World Economic Outlook, 2012

When comparing unemployment rates in South Africa and USA, it can be observed that unemployment rates in South Africa are extremely high. The unemployment rate in South Africa stood at approximately 24.5 per cent in 2011, whereas it was approximately 9 per cent in USA (IMF, World Economic Outlook, 2012). Taking the geographical size into consideration, South Africa is significantly smaller than USA but it has a much higher unemployment rate.

Unemployment rates have worsened in South Africa as a result of the crisis, but not at an excessive rate. Unemployment increased from 3.9 million during the fourth quarter of 2008 to 4.4 million in the first quarter of 2010. Approximately 75 000 jobs were lost by the first quarter of 2012 (Statistics South Africa, 2012). Thus more is required in terms of creating jobs and reducing this unemployment rate. The next section will analyse how the crisis has altered trade in both of these countries.

3.4 Trade in South Africa and United States of America

As previously mentioned, South Africa and USA have a powerful trade relationship. Due to this relationship, what happens in one of the countries will most definitely affect the other. Therefore the origins of the crisis in USA had a direct effect on South Africa. Both countries signed a Trade and Investment Framework Agreement (TIFA) in 1999 as already mentioned above (Ploch, 2011). South Africa's second main export merchandise trading partner is USA. It exported approximately 7.6 per cent of total goods to United States of America in 2010 for example. Its main exports to the country include metals, minerals and transportation equipment. However, South Africa's third main importer is USA with a share of 7 per cent of total goods (Southern African Customs Union, 2010). Its main imports from the country include transportation equipment, chemicals and electronic products. As one can see, exports increased significantly during this year partly due to increased economic growth, as already mentioned, earlier on occurring as a result of the recovery of the domestic economy post the crisis. In the section below, trade between the two countries will be analysed from 2007 to a projected 2012.

Total imports and exports to and from South Africa have altered significantly over the past few years. In 2007, South Africa imported approximately $5.5bn worth of goods from USA, and it

exported $9bn in goods to USA, and in 2008, exports increased to R9.9bn, and imports increased to R6.4bn. Therefore they had a trade surplus of $3.5bn in 2007 and 2008. However in 2009 during the peak of the crisis, South Africa only imported $4.5bn worth of goods, and it exported $5.9bn, thus reducing the surplus to $1.4bn. In 2010, South Africa's imports increased to $5.6bn, and its exports increased to $8.2bn producing a trade surplus of $2.6 bn. In 2011, exports increased again to $9.5bn, and South Africa's imports increased to $7.3bn, therefore decreasing the surplus again to $2.2bn. Forecasted imports for 2012 amount to R4.2bn, and exports amount to R5bn which decreased the trade surplus to R0.8bn. This shows a gradual decline from the previous year (United States Census Bureau, 2012). Figure 7 below outlines the trade balances in South Africa comprising of exports and imports to and from USA from 2007 to a forecasted 2012. Trade figures for 2012 are shown as estimates. The blue bars represent South Africa's exports to USA; the maroon bars represent its imports from USA; and the yellow bars represent the resulting trade surplus.

Figure 7: South Africa's Exports and Imports to and from United States of America from 2007 to a Projected 2012 (Billions of Rands)
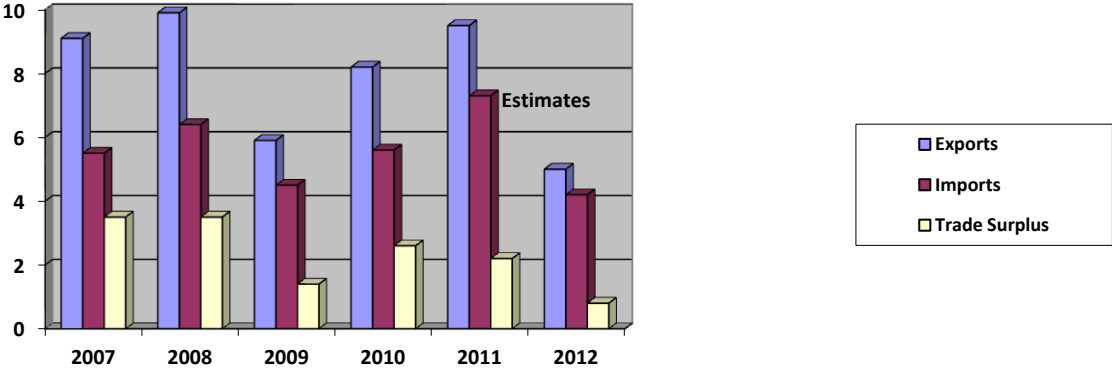
Source: (United States Census Bureau, 2012).

The current financial and economic crisis has had disastrous effects on the global economy. However, conditions have improved significantly in the past two years from 2010 to 2011 based on economic data presented in chapter 2. This chapter also briefly analyses policy interventions implemented in South Africa and in the United States of America in response to the crisis, and depicts their progress thus far, and also aligns this with the future growth trajectory to determine if recovery is possible in the future.

Policy interventions need to be implemented as a way to boost the economic environment of an economy and promote growth and job creation, and are needed to respond timely to financial crises (National Treasury, 2011). In this regard, the appropriate monetary and fiscal policies are necessary to ensure the country is on the road to recovery and out of the midst of a recession. South Africa's monetary and fiscal policy response will be analysed first.

3.5 South Africa's Policy Interventions

3.5.1 Fiscal Policy Response

The main objective of fiscal stimulus packages is to enhance economic activity during periods of recessions or depressions, increase the amount of money in an economy, lower taxes, increase spending and implement interest rate reductions (Walker, 2008).

South Africa experienced significant growth between 2002 and 2007. Therefore when the crisis hit in 2007, South Africa already had low levels of debt and adequate finances which cushioned the effects of the financial crisis on the economy (National Treasury, 2011). Therefore a flexible fiscal policy was implemented in response to the crisis.

Government debt increased from approximately R480bn in 2007/08 to R880bn in 2010/11. During this period, there was a decline in national government revenue. Government revenue decreased from 27 per cent of GDP in 2007 to 26 per cent of GDP in 2008/09 before decreasing to 24 per cent of GDP in 2009/10. However, revenue picked up in 2010 and 2011 when it increased to approximately 24.5 per cent and 27.5 per cent of GDP respectively (SARB, 2012). Therefore, the South African government had to borrow more in order to continue with fixed spending on social grants, infrastructure, education and health during 2008 and 2009 during the peak of the crisis (Nene, 2012). This led to a rise in government expenditure. Expenditure increased between 2007/08 to 2009/10 from 26 per cent of GDP to 29 per cent of GDP. However, expenditure declined to 28 per cent of GDP in 2010 before increasing again to 32 per cent of GDP in 2011 (SARB, 2012). Expenditure is expected to decrease in the future. The increase in expenditure is directly linked to the current budget deficit in South Africa. The only year which South Africa experienced a budget surplus was in 2007/08 when it accumulated to approximately 0.9 per cent of GDP. When the crisis hit, the budget deficit increased from 1.2 per cent of GDP in 2008/09 to 6.6 per cent of GDP in 2009/10 during the peak of the crisis (National Treasury, 2011). It, however, decreased to 4 per cent of GDP in 2010/11 before increasing once again to 4.5 per cent of GDP in 2011 (SARB, 2012).

During the recession, a vast number of workers were laid off. Therefore, the Expanded Public Works Programme (EPWP) implemented in 2009 played a major role in creating jobs and increasing unemployment insurance from 6 to 9 months, thus giving people additional time to find work (Nene, 2012). Governments' target was to create approximately half a million jobs by the end of 2009. Approximately 97 per cent of that target has been achieved by 2010 (Derek and

Steytler, 2010). However, the unemployment level still remains at extremely high levels. This fiscal policy response helped stabilize and facilitate economic growth.

Another fiscal policy intervention implemented was the R846bn infrastructure investment mentioned above which was initiated in order to strengthen growth and employment up until 2013. Unemployment rates increased and economic growth rates decreased as a result of the economic crisis based on economic data illustrated in chapter 3. Accordingly there was an urgent need for infrastructure investment as a way to improve these two macroeconomic indicators (Derek and Steytler, 2010).

Owing to the economic crisis of 2009 and the increase in expenditure, a large amount of this had to be funded through debt. This led to an increase in government borrowings. Therefore, the fiscal policy intervention for 2012 is aiming to transform current government expenditure to investment infrastructure as a way to increase the assets in South Africa and reduce its liability, thus enhancing economic growth (National Treasury, 2011).

The fiscal policy response initiated by the South African government helped stabilise the economy. The plus side was that taxes were not increased (Nene, 2012). Therefore, this did not have an adverse impact on the people of the country, especially during an economic crisis when the disposable income of individuals has already been reduced. In order to achieve constant growth and a stable economy, spending growth needs to be moderately maintained, and investment needs to dominate consumption.

3.5.2 Monetary Policy Response

Monetary policy aims to manage inflationary pressures through an inflationary targeting framework. An economy generally aims to achieve low, stable inflation. High inflation can be detrimental to an economy because it increases interest rates and has an adverse effect on economic growth. South Africa has tightened its monetary policy stance since the start of the crisis (National Treasury, 2011). This tightening is evident in the monetary policy interventions analysed below.

The South African Reserve Bank (SARB) has an inflation targeting framework to manage inflationary pressures. This framework was implemented in 2000 and was used to effectively manage inflation during the 2008 economic crisis. When inflation is too high, the inflation targeting framework raises interest rates as a way to deal with these inflationary pressures. When interest rates are raised, the demand for credit, for example, decreases, and, therefore, the demand for certain items will decrease, thus reducing prices. This will control inflation and bring it down to acceptable levels. Inflation was on the rise during 2007 and 2008 when the crisis hit. As a result, interest rates dropped from 9 per cent in May 2007 to 12 per cent in April 2008 (Barnard and Lysenko, 2010). Owing to the drop in interest rates, the inflation targeting framework will have to raise interest rates. However, for the next year and a half, the framework was unable to get inflation within the target range of 3 to 6 per cent. As a result, the SARB came under scrutiny for inefficient monetary policy tightening regarding inflationary pressures.

The SARB has a Monetary Policy Committee (MPC) with the main objective of implementing monetary policy within a flexible inflation targeting framework (South African Reserve Bank, 2012). The MPC lowered the repo rate by 50 basis points to 11.5 per cent in December 2008 due

to high interest rates since the start of the crisis (Kahn. 2009). The repo rate is the interest rate at which the commercial banks in the country borrow money from the South African Reserve Bank (South African Reserve Bank, 2012). When the rates are cut, banks will tend to borrow more money due to less interest paid. This drop in interest rates will be transferred to consumers who will also be offered credit/loans at lower interest rates, thus fuelling consumption and economic growth. However, the increase in the uptake of loans by consumers can also be used to pay off their debts, thus lowering the debt to disposable-income ratio. The Reserve Bank cut the repo rate by 6.5 percentage points on average between 2008 and 2010. Interest rates decreased again by 50 basis points to 5 per cent in July 2012.

The Reserve Bank revised down GDP growth from 2.9 per cent to 2.7 per cent in 2012. However, it is forecasted to grow by 3.8 per cent in 2013. The National Treasury has stated that when interest rates decline by a half percentage point, economic growth increases by 0.6 percentage points in one year (Nene, 2012). However, if households and businesses charge higher prices in response to the decline in interest rates, then economic growth will not exist. The Reserve Bank cut the repo rate from 10.2 per cent in July 2008 to 7.5 per cent by January 2009. The Repo rate was approximately the same in April 2010.

Figure 8 below shows the cut in the repo rate from the first quarter of 2010 to the third quarter of 2012. The Reserve Bank cut the rate from 5.8 per cent in the first quarter of 2010 to 5.5 per cent in the first quarter of 2011. However, from this point on, the rate has remained constant at 5.5 per cent up till the first quarter of 2012 (South African Reserve Bank, 2012).

Figure 8: Repo Rates in South Africa from the Fourth Quarter of 2010 to the First Quarter of 2012
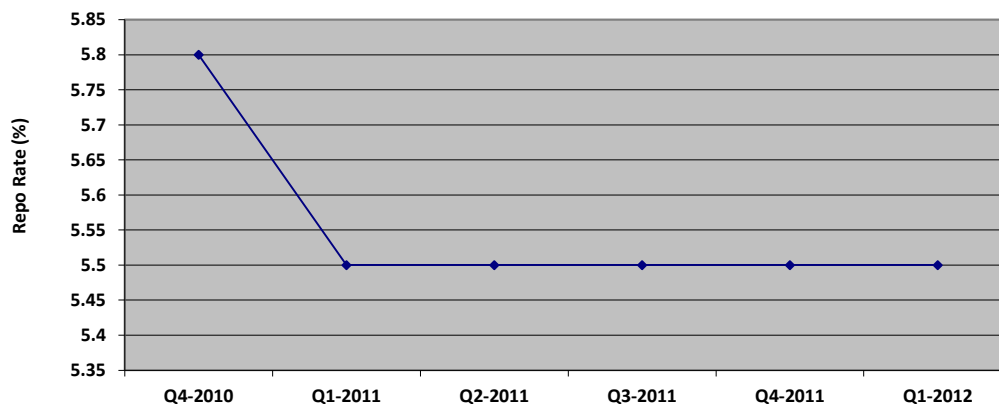
Source: SARB, 2012

South African banks were not severely impacted by the crisis since they had limited credit exposure. This was partly due to the National Credit Act (NCA) of 2007 which helped limit the effects of the crisis on South African banks. The NCA aimed to limit reckless lending by imposing certain restraints on credit extension, thus reducing risk and enhancing growth (Moody's Investors Service, 2011). The implementation of this Act was essential because increased credit extensions with very little constraints were the main cause of the financial crisis, thus causing individuals to default. Therefore, this Act aimed to control the credit environment. In the next section, GDP growth rates in South Africa will be reviewed once again to determine if these policy interventions have made a significant difference to the overall economic well-being of the country.

Consumer credit extensions to the private sector decreased from 23.6 per cent in 2007 to 16.6 per cent in 2008, before decreasing substantially to -0.6 per cent in 2009. This occurred during the peak of the crisis which depicted the unwillingness of banks to extend credit. A decrease in the extension of credit causes a direct decrease in the money supply. This is due to tighter credit controls which were put in place in 2007. However credit extensions increased to 4.3 per cent in 2010, thus showing significant improvement, and an increase in business confidence. Credit extensions increased further to 5.1 per cent in 2011 (South African Reserve Bank, 2012). This is depicted in figure 9 below.

Figure 9: Credit Extensions to the Private Sector
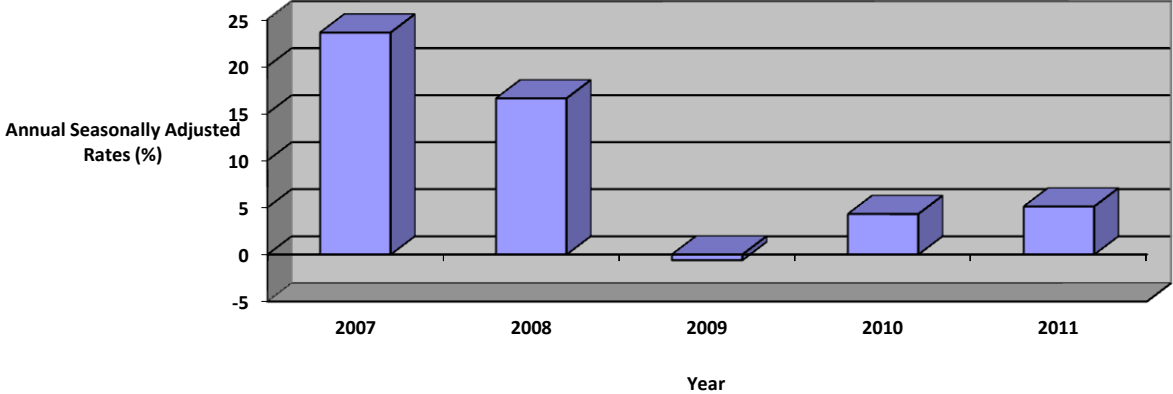
Source: SARB, 2012

During 2010, the money supply began to increase. The money supply increased by 6.8 per cent in 2011 (SARB, 2012). South Africa's real GDP growth rate declined from 5.6 per cent in 2007 when the crisis began to -1.5 per cent in 2009 at the peak of the crisis. Growth rates, however,

recovered in 2010 when it increased to 2.9 per cent. Growth increased by 3.4 per cent in 2011 (IMF, International Financial Statistics, 2012). The cause for the increase in growth rates was due to the flexible stance on monetary policy. South Africa's GDP growth rates from 2012 till 2016 are projected at 3.6, 4, 3.8, 3.6 and 3.6 per cent respectively showing a projected increase up till 2014 (IMF, World Economic Outlook, 2012).

Various organizations in South Africa entered a period of financial difficulty due to the 2008 recession. Therefore a bailout strategy was required. The Industrial Development Corporation (IDC) undertook this bailout strategy by setting up a fund of approximately R6.1 billion to help companies in need of a bailout as a result of the crisis. The IDC is a national finance organization which aims to promote economic growth and industrial development (Industrial Development Corporation, 2012). These companies in distress will apply for funds and based on their application, money will be allocated to them. Approximately R500 million had been allocated to 15 companies which applied for financial bailout. This amount was allocated in 2009 (South African Government Online, 2009).

According to the IMF, South Africa's recovery from the crisis has been comparatively low compared to that of other emerging markets. This is depicted in figure 10 below. The green line represents South Africa and the blue line represents other emerging markets. South Africa's recovery is way below that of other emerging markets especially from 2009 till 2011. One of the reasons for this slow recovery could be the substantial increase in unemployment post the crisis (Selassie, 2011).

Figure 10: South Africa's Recovery from the Global Economic Crisis

Chart 1
Halting and incomplete
South Africa's recovery has lagged that of other emerging markets.
(real GDP index; first quarter 2007 = 100)
— South Africa
— Emerging markets (median)
Source: IMF, World Economic Outlook.
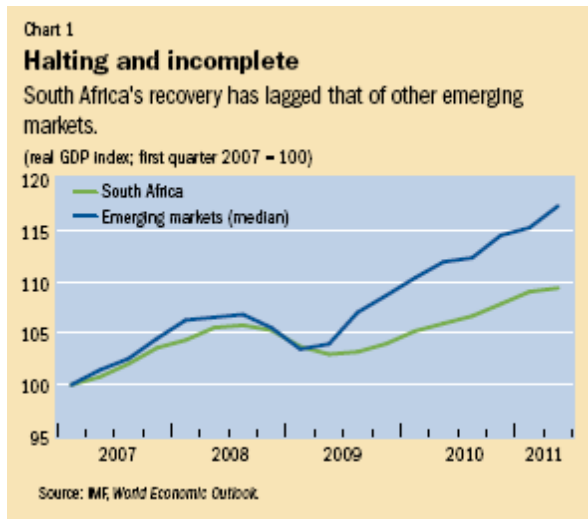
Source: IMF, World Economic Outlook, 2012

In the next section, the USA's main policy interventions initiated to combat the crisis will be discussed. It is crucial to include the USA's policies as the crisis originated in the USA to provide more insight into their policy strategy in response to the financial crisis.

3.6 The United States of America's Policy Interventions

3.6.1 Bailouts for the Banking Sector

The financial crisis has had devastating effects on the world economy, and as a result, some of the world's largest financial institutions faced bankruptcy while others have been bailed out either by other financial institutions or their governments. In October 2009, global credit loss accumulated to $2.8 trillion. An increase in credit loss means an increase in bailout packages.

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The USA's bailout package in particular accumulated to approximately $9.7 trillion in 2009 (Shah, 2009).

The attention will now be turned to one significant bailout package known as TARP (Troubled Asset Relief Programme) which was initiated by the U.S. government in 2008. A $700 billion plan was initiated which enabled the government to purchase illiquid MBS and ABS. The objective of such a scheme was mainly to increase credit growth and liquidity in the banking sector. The U.S. Treasury would give major banks in the USA money, and these banks would in turn have the obligation of lending it out to customers or other banks as a way to help banks and markets in distress. This is a form of a bailout strategy. However, no restrictions were placed on the money given to banks (Ghosh and Mohamed, 2010:125).

The authority of TARP came to an end on October 3, 2010. Approximately $474.8bn has been promised to 13 programmes as a form of a bailout strategy. Approximately $410.5bn of this total has been spent as of March 31, 2011. The remaining $58.9bn is yet to be spent (Burrows, 2011). There has, however, been much controversy over the effectiveness and efficiency of TARP. Some economists and policymakers say that it helped prevent a Great Depression similar to the one in the 1930s, while others say that it could have exacerbated the situation. TARP has failed in mitigating foreclosures which occurred from January 2009. The large number of foreclosures in the U.S. drove down house prices. The main aim of TARP is to enhance the amount of liquidity in the credit sector. However, it has transformed into a package aimed at rescuing banks which were in trouble, thus inducing them to take substantial cost capital injections (Ghosh and Mohamed, 2010:130).

The aim of the Treasury's bailout plan was to enhance bank's balance sheets. It has been argued that TARP was not a feasible policy intervention because the failure of banks is inevitable and should have continued (Miron, 2009: 13). This is according to the free-market assumption which states that a market without any government regulation operates more efficiently than a market with government regulation (Todaro and Smith, 2011: 777). The bailout may have exacerbated the crisis as banks may now fully depend on these types of bailouts without taking the initiative to survive the crunch independently. As a result, U.S. President Barack Obama's $787bn stimulus package which will be discussed in the next section was implemented as a way to fill the gaps which TARP could not.

3.6.2 USA's $787bn Stimulus Package

In order to limit the debilitating effects of the credit crisis on the global economy, Democrats in the United States Congress passed a $787 billion stimulus bill in February 2009. The main objective of implementation was to speed up economic growth and reduce the unemployment rate to below 8 per cent (Amadeo, 2011). It will aid to serve victims of the financial meltdown through an increase in tax cuts, a rise in unemployment benefits, assistance to workers in terms of retaining health insurance, as well as providing financial assistance to its state government in terms of Medicaid and education.

The final package comprised of $288 billion in tax cuts, $224 billion increased unemployment benefits, education and health care, and $275 billion allocated for creating jobs. Approximately 91.5 per cent of the total stimulus package was budgeted for three years from 2009 to 2011. Approximately $185 billion of the total amount allocated was budgeted for 2009, $400 billion was budgeted for 2010, and $135 billion was budgeted for 2011(Amadeo, 2011).

It has however been concluded that the stimulus package has been ineffective in achieving economic growth and reducing unemployment (Amadeo. 2011). One of its aims was to ensure that the unemployment rate is below a desirable level. However, the unemployment rate increased from 5.8 per cent in 2008 to 9.6 per cent in 2010 before decreasing to 9 per cent in 2011 (IMF, International Financial Statistics, 2012). Therefore the unemployment rate is still not below the desired rate of 8 per cent.

3.7 Relation of the James-Stein Estimates to Policy Interventions

The James-Stein estimates calculated can be used to guide policy interventions. If more accurate GDP growth rates are calculated, then a more accurate account of the economic environment can be projected, thus leading to more precise and efficient policy interventions being developed and implemented as the economic environment is more accurately accounted for. In each time period mentioned above in the study, more accurate GDP growth rates were calculated post the crisis, and more accurate growth rates are projected for the future. Therefore, these calculated GDP growth rates can be used to develop more successful polices, and can also be used to calculate other macroeconomic indicators more accurately which have a direct link to GDP growth rates. These James-Stein estimates will be calculated in chapter 5.

3.8 Conclusion

The trade surplus in South Africa of goods exported to and imported from United States of America is forecasted to decline in 2012. A reduction in exports will cause economic growth to contract. Nonetheless, real GDP growth is expected to increase in 2012. Growth has improved significantly for both economies in 2010. However, growth declined in USA in 2011, only increasing by 1.7 per cent; whereas it increased by 3.1 per cent in South Africa (International

Monetary Fund, 2012). Unemployment in both countries has decreased since 2009, and the unemployment rate is expected to decline further in 2012. Both economies, therefore, seem to be in a process of recovery, however, at a sluggish pace. It will take an ample amount of time before substantial growth and recovery is realized, but based on the data above, these two economies appear to be on the road to recovery and have improved somewhat since the peak of the crisis in 2009. However, it is uncertain to conclude whether full recovery will ever be accomplished.

This chapter also analysed the policy interventions undertaken by South Africa and America. A flexible fiscal policy was implemented in South Africa in response to the crisis. Even though recovery from the crisis has been slow, South Africa has still managed to sustain social spending and boost infrastructure investment. However, government expenditure and the budget deficit have increased. The government hopes to reduce the budget deficit to approximately 3.8 per cent of GDP by 2013 (National Treasury, 2011). In the United States of America, various policy measures like TARP and the $787bn stimulus package had been implemented to combat the effects of the crisis. However, the stimulus package did not produce the desired results as growth rates, unemployment and trade expansions did not improve as anticipated.

In the next chapter, the research methodology of the study will be discussed. Here, Stein's Paradox will be used to determine if one can calculate better estimates of GDP growth across the sample of 30 countries. This will also include calculations of future GDP growth rates as a way to determine a more desirable growth trajectory of the selected countries taking into account the effects of the financial crisis.

CHAPTER FOUR

RESEARCH METHODOLOGY AND STEIN'S PARADOX

4.1 Introduction

This chapter will outline the impact of the crisis on real GDP growth rates across thirty randomly selected countries post the recession of 2008 using Stein's Paradox. Stein's Paradox allows one to use observed averages of any parameter to estimate unobservable quantities of that parameter which are better than the arithmetic average (Efron and Morris, 1977:119). The objective is to determine if one can calculate better real GDP growth estimates than what actual data suggests, i.e. GDP growth estimates which are closer to the unobservable true GDP growth rate, theta (θ), for each country across different time periods of the crisis. If this Paradox does in fact allow one to calculate better estimates, then these figures can be used to more accurately depict the future trajectory of the sample of countries by calculating more accurate future GDP growth rates. These estimates will be used to determine how much more accurate the estimates are than the actual GDP growth rates if they are more accurate at all. They will also give an indication of how much the estimates deviate from the individual average GDP growth rates for each country.

This chapter will first outline Stein's Paradox and the corresponding James-Stein estimators, and how they will be used in this particular study. An example will then be derived using the Paradox to explain its workings. The chapter will end by focusing on data collection and limitations with regards to the impact on GDP growth rates after the crisis using this Paradox.

The reason for the choice of Stein's Paradox to be included as part of this study is to determine if there is a way to determine better GDP growth rates post the crisis which will include forecasted

GDP growth rates. In addition to this, the study uses the Monte Carlo study to determine under which conditions (either using a *unique c* or *common c*) will produce better or more accurate results. This will aim to reinforce Stein's Paradox. In the next section, Stein's Paradox will be explained.

4.2 Stein's Paradox and the James-Stein Estimator

Based on statistical theory, it can be proved that no form of estimation rule is better or more accurate than the observed average obtained. This however contradicts what Stein proved whereby the estimates are shown to be better than the observed averages. For this reason, this process of estimation is referred to as a Paradox, namely Stein's Paradox because it is a proposition or statement contrary to commonly accepted belief. In this particular study, Stein's Paradox combines a country's data with other countries in the sample to obtain better predictions in the form of lower variances and standard deviations than the individual country's average which produces wider variances (Efron and Morris, 1977: 119). For example, the wealth-happiness paradox indicates that even though the wealth of Americans increased over the last few decades, their happiness did not increase (Fisher, 2007: 219). One can either agree or disagree with such a paradox, and measures can be taken to support the justification. With that being said, Stein's Paradox in particular was discovered in 1955 by Charles Stein. This paradox uses observed averages of the sample mean to estimate unobservable quantities of certain parameters called theta (θ) (Efron and Morris, 1977:119). In this particular study, theta would be the true unknown GDP growth rates. In other words, the paradox defines situations where the estimators calculated are better than the arithmetic average, and thus are a closer approximation to the true unknown values called theta. These estimators are referred to as the James-Stein

estimators. James and Stein developed this estimator in 1961. This estimator is said to have a smaller degree of risk than the sample mean, and it also generates a smaller mean squared error (MSE) (Hoffmann, 1998:128). The MSE or total squared error of estimation is the sum of the differences between the grand average and the observed averages or the average GDP growth rates in this particular study all squared, and also the sum of the differences between the estimates and the grand average all squared (Efron and Morris, 1977: 121). Therefore they are much closer to theta, and are therefore more accurate than the observed averages. Therefore, Stein's Paradox allows one to calculate closer estimates to these true unknown values, and also allows one to calculate better forecasted estimators. The result is improved estimators.

The James-Stein estimator is referred to as a shrinkage estimator. It is called a shrinkage estimator because it shrinks the individual or observed averages called the vector (X) towards the parameter vector (theta) which is the true unknown parameter. When these individual averages shrink, they become closer to the true unknown values theta, thus making them more accurate with a smaller amount of risk. The optimal estimate thus lies between these two values (Hoffmann, 1998:130).

For example, if there are three or more baseball players, and one wants to predict the future batting averages for each individual, then instead of deriving the three separate averages, the future batting averages can be calculated in a more precise way. If a baseball player has 7 hits in 20 times, then the average would be 0.35 which is equal to 7/20. The objective is to determine how well the player will do in his next 100 times at bat. One can assume that the baseball player may have 35 more hits if we are assuming that they will bat at a constant rate. By using Stein's Paradox, if the mean or average µ represents the batting averages of individuals, it is possible to

determine if there are better estimates of μ. The first step in this procedure is to calculate the average of the averages. This grand average is denoted by the symbol   . This means that the optimal estimate of the individual batting averages is neither the individual averages nor the overall grand average; it is in fact the James-Stein estimate which will be the closest to the true unobservable value theta (Efron and Morris, 1977: 119).

If a baseball player's individual hitting record is better or higher than this grand average, then his average hitting record has to be reduced. If his hitting record is lower than the grand average, then his average hitting record has to be increased. The amount that it has to be increased or decreased by is the shrunken value for each individual player which is denoted by z. This figure is called the James-Stein estimate of that player's batting ability (Efron. and Morris, 1977:119). Stein's Paradox states that the James-Stein estimates provide better estimates than the individual batting averages or observed averages. In other words, by using Stein's Paradox in this scenario, one is able to more accurately predict an individual's true batting ability.

Stein's method involves calculating a variance and a corresponding standard deviation. A large standard deviation and variance means that the data are widely dispersed, i.e. it lies far from the mean. Similarly, a small standard deviation and variance means that the data are closer to the mean and that the results are therefore more accurate. If the James-Stein estimators calculated are more accurate than the individual observed averages, then a smaller standard deviation and MSE will be achieved than those achieved when using the individual averages. Higher variances of the individual country averages imply that more weight will be put on the grand average, and hence the shrinkage factor c will be close to zero. On the other hand, if the variations across various countries GDPs are large, then we should rely more on individual country averages (i.e. c

is close to 1). The number of times the more accurate the estimates are than the individual average growth rates for each country can be calculated by dividing the MSE of the individual growth rates by the MSE of the James-Stein estimators if the estimators are in fact more accurate than the individual growth rates (Efron and Morris, 1977: 121). Therefore, this will prove that the estimators are closer to the true unknown valued theta. The mean and standard deviation will therefore be used to calculate better estimates of real GDP growth. Therefore in this study, the objective is to determine if Stein's Paradox produces more accurate real GDP growth estimates than the observed average GDP growth rates for each selected country. The James-Stein estimates are an estimate of true GDP growth rates in each country which are unobservable. The formula for the calculation of the constant (c) is as follows:

$$c = 1 - (k\text{-}3) * \sigma^2 / MSE \tag{1}$$

where k is the sample size, σ^2 is the variance, and MSE is the mean squared error or total squared error of estimation. The variance is calculated as follows:

$$\sigma^2 = (y\text{-} \quad)^2 / k \tag{2}$$

where σ^2 = the variance of individual country's average GDP from the grand average

The MSE is calculated as follows:

$$MSE = \Sigma (y_i\text{-} \quad)^2 \tag{3}$$

where the MSE is the sum of the individual averages minus the grand average all squared

The James-Stein estimators are calculated as follows:

$$z = \; + c\,(y_i\text{-}\;)\tag{4}$$

In the next section, the James-Stein estimator will be explained and its link to the Monte Carlo study.

4.3 Stein Paradox's Link to the Monte Carlo Study

The Monte Carlo Study will be used to generate real life scenarios through a computer programme called Shazam. It is used for forecasting and for deriving certain sets of data (Whiteside, 2008:1). It will determine how the calculated estimates perform under different conditions. The estimator will be analysed in terms of its standard deviation. A smaller standard deviation achieved means that the estimates are more accurate than the individual observed average (Muthen and Muthen, 2002: 600). Therefore the Monte Carlo simulation aims to support Stein's Paradox. Instead of using a *common c* (the constant in the equation used to calculate the James-Stein Estimator), a *unique c* for each country will have to be calculated in order to calculate the corresponding new James-Stein estimators. When a *common c* is calculated, the same c will be used for each country and a common variance will be used as well. However, when a *unique c* is calculated, a variance for each country will first have to be calculated and then substituted into the formula above to calculate the *unique c*.

The Monte Carlo study tries to determine if using a *common c* and variance or using a *unique c* and unique variance for each country will produce better estimates of GDP growth, and will thus be closer to the true unknown value theta. Stein's Paradox will also be used to determine under which condition better estimates of GDP growth can be calculated; either using a *unique c* or a

common c in order to determine which condition provides better estimates. If Stein's Paradox does prove that one can calculate better estimates of GDP growth than the individual GDP growth rates, then the Monte Carlo study will also be applied to determine under which condition will better estimates be achieved, and whether this supports what Stein's Paradox tells us. The results of the Monte Carlo study will be further analysed and discussed in chapter 6. In the next section, a previous study using Stein's Paradox will be studied to explain the operations of this paradox in relation to the study at hand.

4.4 Previous Work in the Field

In this section, a previous study in the field will be analysed which applies Stein's Paradox and its James-Stein estimators to obtain better estimates. The study was conducted by Bradly Efron and Carl Morris, and it is an extension of the baseball batting averages previously touched on earlier in the chapter. The paper is termed 'Data Analysis using Stein's estimator and its Generalizations (Efron and Morris. 1974).' The objective of this paper is to analyse a set of data related to baseball batting averages in order to illustrate ways of enhancing or improving estimates of actual data used.

The study uses the batting averages of 18 baseball players through their first 45 times at bat during the 1970 batting season. The objective is to predict better estimates of each player's batting average. When applying Stein's Paradox, equal variances are required. In this example, Y is the batting average of each player after 45 times at bat, and n would be the number of times at bat which will be 45. Therefore Y1 would be the batting average of player 1 for the first 45 times at bat. P1 would be the true season batting average, and $\overline{Y}$ would be the sample mean. The equal variances will be calculated from the sample mean. All Yi which will be the individual

55

batting averages will be shrunk towards $\overline{Y}$ or the sample mean (Efron and Morris, 1974:312). The constant c in the equation to calculate the James-Stein estimate is the following as already mentioned above:

$$c = 1 - (k-3) * \sigma^2 / MSE$$

Having said that, the mean squared error of the sample mean is calculated as follows:

$$MSE \text{ of } Y = \Sigma (y_i - \quad)^2$$

Therefore the equation to calculate the James-Stein estimate is as follows:

$$z = \quad + c (y_i - \quad)$$

The sample mean will be equal to the individual batting averages of each player Y_i minus the grand average $\overline{Y}$ all squared. This will be done for each country, and the total amount summed up will be equal to the mean squared error (MSE) of the sample mean $\overline{Y}$. This amount equals 17.56. This figure is the total squared error of estimation or the mean squared error. The James-Stein estimates total squared error of estimation is 5.01 (Efron and Morris, 1974:313). This amount is equal to the James-Stein estimate of each player minus the grand average all squared, and this amount will be summed up. Therefore 5.01 is smaller than 17.56 which means that the James-Stein estimates total squared prediction error is far less than the sample mean of all the countries. Therefore the estimates' MSE is far closer to the true unknown value theta than the MSE of the individual batting averages because the degree of error is less. In order to determine the number of times more accurate the estimates are than the individual averages, the MSE of the individual averages is divided by the MSE of the estimates. Therefore we have the following:

MSE of individual averages/MSE of James-Stein Estimates = 17.56/5.01

$$= 3.50$$

Therefore the estimates are approximately 3 times more accurate than the individual observed averages (Efron and Morris, 1974:313). Therefore the estimates would be closer than Y_i to theta (θ) for every batter. Thus it is proven that the estimates calculated do in fact produce better estimates than the batting averages of each player, and thus provides one with closer values to the true unknown values theta. The same concept will be applied to the study on GDP growth rates in the next chapter using Stein's Paradox.

4.5 Data Collection and Limitations

Now that the workings of Stein's Paradox have been analysed, the study on GDP growth using this Paradox can begin. The data used will consist of quarterly and annual real average GDP growth rates across thirty selected countries across various time periods post the 2008 crisis. Real GDP growth rates are growth rates which are adjusted for inflation, and it is a measure from one period to the next which is conveyed as a percentage. These time periods will include quarterly growth rates from the first quarter of 2000 till the third quarter of 2008 (this time period will be classified as 2008), annual 2009 GDP growth rates, 2010 annual GDP growth rates, and forecasted GDP growth rates from 2012 till 2016. The thirty selected countries are as follows: United States, Australia, South Africa, South Korea, United Kingdom, France, Brazil, Russia, Zambia, Nigeria, Kenya, Japan, Uganda, Italy, Spain, Mexico, New Zealand, Switzerland, Israel, Ghana, Honduras, Slovenia, Gabon, Netherlands, Cameroon, Senegal, Oman, Canada, Sweden and Saudi Arabia. These countries comprise developed, emerging and

developing countries as a way to provide a fair estimate of the impact of the crisis on various types of countries representative of the world.

Based on the fact that the global recession is a current one, and data regarding the effects of the crisis alternate regularly, all data up until the study is completed cannot be factored into the study. Therefore, a cutoff date will be used. Financial events and data occurring after this date will not be taken into account. Only data from 2005 up until the end of 2011 will be used. All data for 2012 and beyond will be regarded as forecasted.

Another limitation of the study which will be further discussed in chapter 5 is that a sample of 30 countries was chosen as this was the sample which comprised over half of global GDP and meets the normal statistical requirement.

4.6 Conclusion

This chapter outlines the research methodology. The workings of Stein's Paradox, the James-Stein estimator and the Monte Carlo Study are analysed in order to gain more insight as to whether one can calculate better estimates of real GDP growth rates of the selected countries using Stein's Paradox, and under which conditions will one achieve better estimates using the Monte Carlo study. The example of the baseball players and their corresponding batting averages is chosen to provide a clear understanding of this paradox and the way it works, and this will be a foundation for the work to follow in the next two chapters. Stein's Paradox can and will be used to determine if better GDP growth rates can be calculated which will be beneficial in determining a more precise future growth trajectory of the selected countries.

CHAPTER 5

INTERPRETATION AND DISCUSSION OF RESULTS

5.1 Introduction

In this chapter, Stein's Paradox will be used to determine if better estimates of GDP growth can be calculated for the selected countries mentioned in the study post the crisis. The James-Stein estimators are generally said to be better than their corresponding individual observed averages. If the James-Stein estimates are more accurate than the individual average growth rate for each selected country across various time periods since the start of the crisis, then they are said to be closer to the true unknown GDP growth rates theta (θ) for each country. The closer the estimates are to the grand average or the mean, the more accurate the estimates are as to when they deviate quite substantially from the mean. Quarterly real GDP growth rates from the first quarter of 2005 to the third quarter of 2008 are used; which represents part of the start of the crisis. This time period will be referred to as the 2008 time period. Annual growth rates during 2009 were also used when growth rates entered negative values; and annual rates in 2010 were used when the global economy began to recover. The study will also use forecasted GDP growth rates from 2012 till 2016 as a way to calculate more accurate projected growth rates. Growth rates in 2011 however were not used because growth rates on a global scale recovered in both 2010 and 2011. Therefore 2010 annual growth rates will only be used but will be reflective of both time periods. Therefore, generally all time periods of the crisis are covered, with the objective of determining better estimates for all periods.

Thirty countries were randomly selected. The countries make up a fair representation of the global economy. The future trajectory of the group of countries will be analysed, and assumptions will be made as to whether each group has managed to escape the grips of the recession.

5.2 Method and Data Collection

Based on the fact that every country in the world cannot be used in this study, thirty countries have been randomly selected. They comprise developed, emerging and developing economies in order to gain a fair and unbiased insight into the effects of the crisis on different categories of countries, and also to determine which type of countries will ultimately be the drivers of growth in the future. A limitation of the study as previously mentioned is that only thirty countries were chosen as this is an adequate number in order to get a fair representation of the global economy post the crisis as these countries made up approximately 56.69 per cent and 55.18 per cent of real world GDP in 2008 and 2009 respectively, therefore representing a fair proportion of global GDP as will be calculated before. Fewer than 30 countries could not be chosen as this will limit the amount of data in the study. If more than thirty countries were chosen, then the sample size will be too large, and will thus make it more difficult to analyse and interpret data; thus making the choice of sample size 30 the most viable and efficient option. The data or variables included in the study follow a normal distribution according to the Central Limit Theorem. This theorem states that the mean of a large number of independent variables, which each has a mean and variance, will be normally distributed. Stein's Paradox efficiently obtains optimum estimates of the rate of convergence towards this normal distribution (Barbour, 1989: 125-126). For this reason, Stein's estimation is preferred over other methods.

In order to determine exactly what share of global GDP these countries accumulate to, global GDP growth in 2008 and 2009 will have to be determined, as this was when the recession began, and when it was at its peak. Columns 2 and 3 in Table 1 on page 63, below, show real GDP growth figures in 2008 and 2009 respectively using the purchasing power parity (PPP) in trillions of dollars (IMF, World Economic Outlook, 2012). The purchasing power parity is the calculation of gross national income (GNI) using standardized international prices for all goods and services (Todaro and Smith, 2011: 782). The GNI is the total output of a country which consists of both domestic and foreign GDP plus other forms of income which foreign residents earn minus the income of domestic residents (Todaro and Smith, 2011: 777). The individual real GDP growth rates for each country in 2008 are shown in column 2 (Table 1, Pg63), and the sum of this is equal to $37.32 trillion. World real GDP in 2008 using PPP equals $65.82 trillion (IMF, World Economic Outlook, 2012). These figures are shown at the bottom of column 2. The sum of the individual real GDP growth rates for each country in 2008 is therefore divided by the total global GDP in 2008. This is multiplied by a hundred to get a percentage of total global GDP. Therefore the following is obtained:

Percentage of Total Global GDP in 2008 = sum of individual growth rates in 2008/total global GDP in 2008 = (37.32/65.82) *100 = 56.69 per cent

Therefore the sample of countries made up approximately 56.69 per cent of global GDP in 2008 shown at the bottom of column 2. Similarly, real GDP growth in 2009 using the PPP for each country is shown in column 3. This is summed up and the total amount is $38.34 trillion. Real world GDP in 2009 accumulates to $69.49 trillion. The sum of the sample of countries' GDP is divided by the world GDP in 2009. Similarly, the following is derived:

Percentage of total global GDP in 2009 = (38.34/69.49) * 100 = 55.18 per cent

This means that the selected countries made up 55.18 per cent of total GDP in 2009 which translates into more than half of total GDP. These figures are shown at the bottom of column 3 (Table 1, Pg63). The information above shows that the sample of countries makes up over half of global GDP both in 2008 and 2009, therefore representing a fair portion of the global economy, and will allow one to accurately determine if better estimates of GDP growth can be calculated using a fair proportion of the global economy. In the next section, growth rates from the first quarter of 2005 till the third quarter of 2008 will be used to determine if better estimates of GDP growth can be calculated across the sample of countries post the crisis using Stein's Paradox.

Table 1: The selected Countries' World Share of Real GDP

	1	2	3
Countries		**Real GDP (PPP-2008) (Trillions of $)**	**Real GDP (PPP-2009) (Trillions of $)**
Australia		0.77	0.82
Canada		1.27	1.29
France		2.07	2.11
Netherlands		0.64	0.66
Italy		1.8	1.76
Japan		4.31	4.14
South Korea		1.21	1.36
Mexico		1.35	1.48
New Zealand		0.11	0.12
Spain		1.36	1.37
Sweden		0.33	0.33
Switzerland		0.3	0.32
United Kingdom		2.15	2.15
United States		13.86	14.26
South Africa		0.47	0.5
Brazil		1.84	2.03
Oman		0.06	0.07
Russia		2.08	2.12
Zambia		0.02	0.02
Israel		0.18	0.21
Nigeria		0.29	0.36
Kenya		0.06	0.06
Uganda		0.03	0.04
Ghana		0.03	0.04
Honduras		0.02	0.03
Senegal		0.02	0.02
Cameroon		0.04	0.04
Gabon		0.02	0.02
Slovenia		0.05	0.06
Saudi Arabia		0.57	0.59
Sum of Real GDP		**37.32**	**38.34**
World GDP (PPP-Trillions of %)		**65.82**	**69.49**
Share of Real World GDP (%)		**56.69**	**55.18**

Source: IMF, World Economic Outlook, 2012

5.3 Calculation of James-Stein Estimates using Growth Rates from the First Quarter of 2005 to the Third Quarter of 2008

In this section, observed individual average GDP growth rates will be used to calculate James-Stein estimators to determine if these estimators are better than the individual averages. The data used comprise quarterly average real GDP growth rates for each of the 30 countries as mentioned earlier, beginning from the first quarter of 2005 to the third quarter of 2008. This time period is chosen because it represents part of the crisis which began in 2007, and it will be referred to as the 2008 time period. Therefore the objective is to determine if the James-Stein estimates calculated are more accurate than the given individual GDP growth rates for each country, and is therefore closer to the true unobservable GDP growth rates, theta, for each country.

The thirty selected countries as mentioned earlier are as follows: United States, Australia, South Africa, South Korea, United Kingdom, France, Brazil, Russia, Zambia, Nigeria, Kenya, Japan, Uganda, Italy, Spain, Mexico, New Zealand, Switzerland, Israel, Ghana, Honduras, Slovenia, Gabon, Netherlands, Cameroon, Senegal, Oman, Canada, Sweden and Saudi Arabia. These countries comprise developing, developed and emerging economies. The countries are ranked according to their Gross National Income (GNI) per capita. These economies will be classified as low-income countries or developing economies (LICs), lower middle-income countries (LMCs), upper middle-income countries (UMCs), and high-income countries or developed economies (HICs). LMCs and UMCs will be classified as middle income countries or emerging countries. Low-income countries are countries which had a GNI of $975 or less in 2008. Lower-income countries had a GNI of between $975 and $3855, and upper-middle-income countries had a GNI

of between $3856 and $11 906. High-income countries had a GNI of more than $11 907 in 2008 (Todaro and Smith, 2011: 39).

The real quarterly GDP growth figures from the first quarter of 2005 till the third quarter of 2008 are shown in Table 2 in the appendix. They depict a percent change from a year earlier, and they are adjusted for inflation. To begin the calculation of the James-Stein estimates, the average GDP growth rates for each country across the various quarters need to be calculated. This is shown in column 2 in Table 3a below on page 66. These average GDP growth rates for the selected countries are arranged in ascending order. The figures are calculated by summing up the individual average growth rates for each country throughout the 15 quarters from 2005 to the third quarter of 2008 shown in table 2 in the appendix and dividing this figure by 15. South Africa for example has an average individual growth rate of 4.53 per cent, and USA has an individual growth rate of 2.33 per cent as highlighted in red below. Each average individual growth rate of each country will then be summed up and divided by the number of countries, which is 30, in order to obtain the grand average   which is shown at the bottom of column 2. This grand average accumulates to 4.16 per cent. This grand average will be used to calculate the James-Stein estimates.

Table 3a: Calculation of James-Stein Estimates using Real GDP Growth Rates from the first Quarter of 2005 to the third Quarter of 2008 using a *common c* and a *unique c*

	1	2	3	4	5
Countries	**Average GDP Growth (y)**	**(y-)²**	**James-Stein Estimates (z)**	**(z-)²**
Italy	1.01	9.92	3.94	0.05
Japan	1.65	6.29	3.98	0.03
France	1.96	4.82	4	0.02
New Zealand	2	4.65	4.01	0.02
United Kingdom	2.31	3.39	4.03	0.02
United States	2.33	3.32	4.03	0.02
Canada	2.43	2.99	4.04	0.01
Netherlands	3.01	1.3	4.08	0.01
Sweden	3.03	1.26	4.08	0.01
Gabon	3.13	1.04	4.09	0.01
Switzerland	3.14	1.03	4.09	0.01
Cameroon	3.2	0.91	4.09	0.01
Spain	3.31	0.72	4.1	0
Australia	**3.37**	**0.61**	**4.1**	0
Mexico	**3.53**	**0.39**	**4.11**	0
Senegal	3.94	0.05	4.14	0
Saudi Arabia	4.15	0	4.16	0
South Africa	4.53	0.14	4.18	0
South Korea	4.64	0.23	4.19	0
Brazil	4.68	0.28	4.19	0
Israel	5.18	1.05	4.23	0.01
Kenya	5.56	1.97	4.25	0.01
Slovenia	5.63	2.16	4.26	0.01
Honduras	5.91	3.09	4.28	0.01
Zambia	5.92	3.11	4.28	0.01
Nigeria	6.03	3.5	4.28	0.02
Ghana	6.27	4.48	4.3	0.02
Oman	6.7	6.47	4.33	0.03
Russia	7.37	10.31	4.38	0.05
Uganda	8.74	21.02	4.47	0.1
Grand Average	**4.16**			
Mean squared Error (MSE)	**100.53**		**0.48**	
Variance	**3.4**		**0.02**	
Standard Deviation	**1.84**		**0.14**	
Constant (c)	**0.07**			

In order to calculate the variance of the individual growth rates which is needed to calculate the estimates, $(y-\bar{y})^2$ for each country needs to be calculated as shown in column 3 (Table 3a, Pg66). This is equal to the average growth rate of each country minus the grand average all squared. For example for South Africa, the following is obtained:

$(y-\bar{y})^2 = (4.53-4.16)^2 = 0.14$

Similarly, for USA, the following is obtained:

$(y-\bar{y})^2 = (2.33-4.16)^2 = 3.32$

The same procedure is repeated for the rest of the countries. Thereafter, $(y-\bar{y})^2$ for each country will be summed up and this equals 100.53. The amount of 100.53 is the total squared error of estimation or the mean squared error (MSE) for the individual average GDP growth rates. In other words, this is the amount of error associated with the individual growth rates. This once again indicates that the growth rates are far off from the true unknown growth rates theta.

Next, the variance of the individual growth used to calculate the James-Stein estimates will be calculated as follows:

$\sigma^2 = \Sigma (y-\bar{y})^2 / k$

  = MSE of individual growth rates/30

  = 100.53/30

  = 3.4

Therefore the variance equals 3.4. In the next column, the standard deviation of 1.84 is shown (Table 3a, Pg66). This is equal to the squared root of the variance. The standard deviation indicates how far the individual average GDP growth rates deviate from the true unknown growth rates theta or the James-Stein estimates calculated. The smaller the standard deviation, the more accurate the growth rates are, and the closer the estimates are to the true growth rates theta.

Next, the constant c of 0.07 is calculated using the following standard formula:

$$c = 1 - (k-3)\ \sigma^2 / \Sigma\ (y-\ )^2$$

$$c = 1 - (30-3) * 3.4/100.53\ (variance/MSE)$$

$$c = 0.07$$

The MSE, variance and standard deviation of the individual growth rates are shown at the bottom of column 2 (Table 3a, Pg66). The c calculated above is the *common c* used to calculate the James-Stein estimates. The formula for the estimator is as follows:

$$z =\ \ + c\ (y-\ )$$

Therefore the James-Stein estimate (z) for each country is equal to the grand average ( ) plus the constant (c) times by the average GDP growth rate for each country minus the grand average (Efron and Morris, 1977: 119). For example the estimator for South Africa is as follows:

James Stein Estimator (z) for South Africa = + c (y-)

$$= 4.16 + 0.07\ (4.53 - 4.16)$$

$$= 4.18 \text{ per cent}$$

The estimator for USA is calculated as follows:

James-Stein Estimator (z) for USA = 4.16 + 0.07 (2.33-4.16)

$$= 4.03 \text{ per cent}$$

These estimates are shown in column 4 (Table 3a, Pg66) and are highlighted. The same procedure is repeated for the rest of the countries. Now we will calculate the variance and the MSE of the estimates in order to compare it to the variance and MSE of the individual growth rates to determine which set of indicators are more accurate, thus representing a variance, standard deviation and MSE.

In order to calculate the variance of the James-Stein estimates, $(z-\ )^2$ for each country needs to be calculated as shown in column 5 in table 3a. This is the James-Stein estimate of each country minus the grand average all squared. For example for South Africa, this is equal to $(4.18\text{-}4.16)^2$ = 0.0004. Similarly for USA, this is equal to $(4.03\text{-}4.16)^2$ = 0.02. The sum of this column is equal to the MSE which is equal to 0.48. Therefore the variance of the estimates is calculated as follows:

$$\sigma^2 = \Sigma (z-\ )^2 / 30 = MSE/30$$

$$= 0.48/30 = 0.02$$

The corresponding standard deviation will be the square root of the variance which is 0.14. The MSE, variance and standard deviation of the James-Stein estimates are shown at the bottom of column 4 (Table 3a, Pg66). When comparing the data, the James-Stein estimates calculated have

a lower MSE of 0.48 and standard deviation of 0.14 than the MSE of 100.53 and a standard deviation of 1.84 for the individual average GDP growth rates. This proves that the James-Stein estimates are more accurate than the individual GDP growth averages, and are therefore much closer to the true unknown growth rates theta because a lower standard deviation and MSE is achieved. Therefore Stein's Paradox does in fact provide closer estimates to the true GDP growth rates for each country, and the estimates obtained for each country are more accurate than their corresponding individual average GDP growth rates. In order to determine the level of accuracy of the James-Stein estimates when compared to the individual average GDP growth rates, the MSE of the individual average growth rates is divided by the MSE of the James-Stein estimates when using a *common c*. This is equal to the following:

MSE of Individual average growth rates/ MSE of the James-Stein Estimates = 100.53/0.48= 210.25

This means that the estimates calculated for the selected countries are approximately 210 times more accurate than their corresponding individual average growth rates. Now the individual average GDP growth rates will be compared to the corresponding James-Stein estimates. So for example, when a *common c* is used, the estimate of 4.18 per cent obtained for South Africa in column 4 in Table 3a (Pg66) is a better estimate than the individual average growth rate of 4.53 per cent shown in column 2 during the period from the first quarter of 2005 till the third quarter of 2008. Similarly, the estimate of 4.03 per cent for USA in column 4 is better than the corresponding individual average of 2.33 per cent in column 2. This proves that Stein's Paradox does provide better estimates of GDP growth rates than the individual average GDP growth rates for each country.

Figure 11, on page 72 below, shows the average GDP growth rates against the corresponding James-Stein estimates using a *common c* using real average GDP growth rates from the first quarter of 2005 up until the third quarter of 2008. Axis A below shows the average GDP growth rates, and Axis B shows the James-Stein estimates. The average GDP growth rates on Axis A for the selected countries are arranged in ascending order from left to right according to column 2 in Table 3a, on page 66. In the diagram, South Africa for example has an average growth rate of 4.53 per cent shown on Axis A, and a corresponding estimate of 4.18 shown on Axis B. The growth rate and the estimate are joined by a connecting line. The USA's average GDP growth rate of 2.33 per cent on Axis A is joined to the corresponding estimate of 4.03 per cent shown on Axis B.

The grand average of 4.16 is shown as the red vertical line. Countries with individual average growth rates on Axis A which are less than the grand average will have their averages increased towards this grand average, and countries with individual average growth rates greater than the grand average will have their average growth rates reduced towards this grand average. This is called shrinkage whereby the individual average GDP growth rates are shrunk towards the grand average. The value that these individual growth rates are shrunk by is the resulting James-Stein estimates (Efron and Morris, 1977: 119). The individual average GDP growth rates are shrunk towards the grand average to get them closer to the true unknown GDP growth rates theta, which means they are more accurate than the individual average growth rates. The individual average GDP growth rates however do not entirely converge towards the grand average of 4.16 per cent.

Figure 11: Average GDP Growth Rates against the James-Stein Estimates from the First Quarter of 2005 to the Third Quarter of 2008 using a *common c*
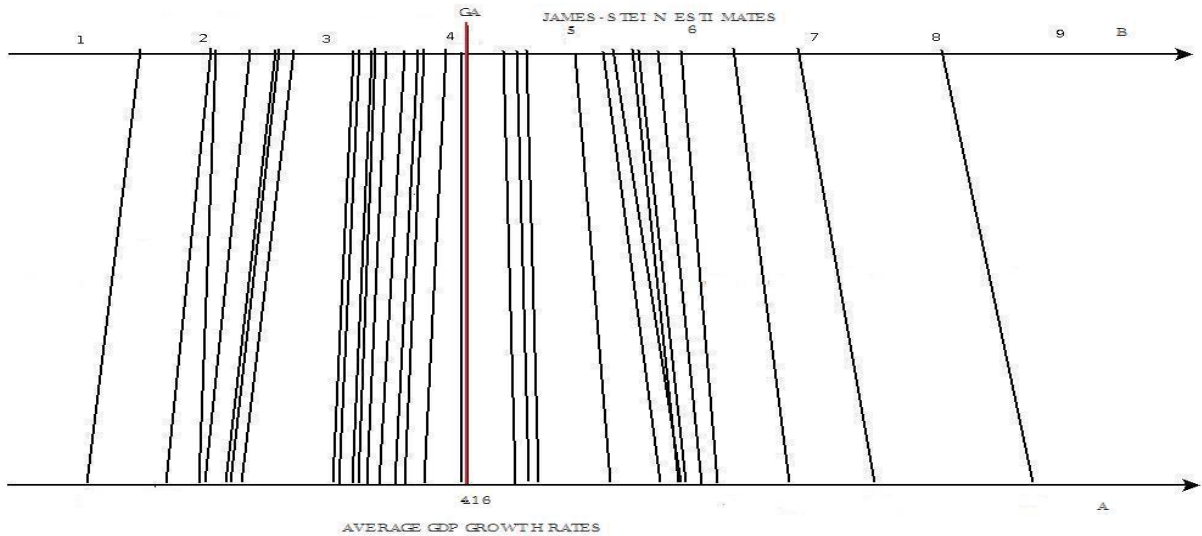
Figure 12 below, shows the difference between the average GDP growth rates from the first quarter of 2005 till the third quarter of 2008 and their corresponding James-Stein estimates calculated for each country when a *common c* is used. The yellow line of James-Stein estimates is in fact more accurate than the pink line of average GDP growth rates for each country. The estimates are not far off from the individual average GDP growth rates. However, the yellow line of estimates represents a more accurate growth trajectory of the economic crisis of 2008 across the selected countries post the recession than the pink line of individual growth rates. This means that the estimates for each country are said to be better than their corresponding individual average growth rates. Therefore the James-Stein estimates for each country is closer to their corresponding true unknown GDP growth rates theta.

Figure 12: Difference between the 2008 Average GDP Growth Rates and the James-Stein Estimates using a *Common c*
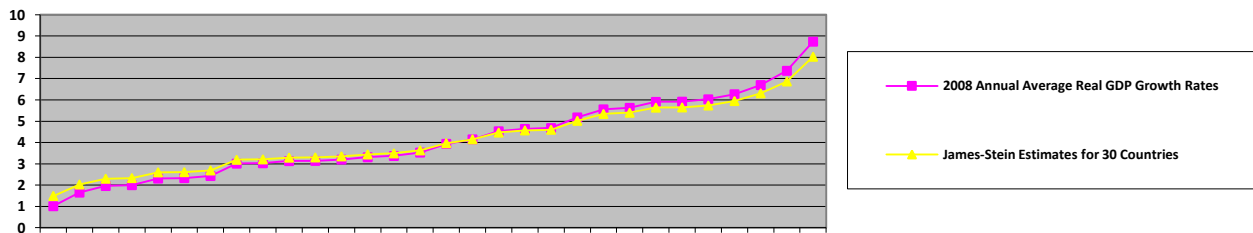
Now new James-Stein estimates will be calculated using a *unique c*. Thus the variance for each country will have to be calculated. Using a *unique c* and a *common c* can be linked to the Monte Carlo Study in chapter 6. The reason for calculating a *unique c* in addition to a *common c* would be to test under which conditions one will achieve better estimates of GDP growth, thus deriving a lower standard deviation and a lower MSE. Therefore, the Monte Carlo study aims to reinforce Stein's Paradox. In order to calculate a unique variance and a *unique c* for each country, Σ (y-)^2 will be calculated for each country. Firstly, the quarterly individual growth rates from the first quarter of 2005 to the third quarter of 2008 minus the grand average all squared divided by the number of quarters which is 15 will be calculated for each country. This will be equal to the unique variance. So for example for South Africa, the variance is equal to 2.78 shown in column 7 (Table 3b, Pg 73) which is highlighted in red and is calculated as follows:

σ^2 for South Africa $= \Sigma$ (y-)^2 / 15 = 2.78

Similarly, the unique c for South Africa shown in column 8 is equal to the following:

Unique c for South Africa = 1- (k-3)* σ^2/MSE of the individual average growth rate = 1- (30-3)* 2.78/100.5 = 0.25

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Table 3b: Calculation of James-Stein Estimates using Real GDP Growth Rates from the First Quarter of 2005 to the Third Quarter of 2008 using a *common c* and a *unique c*

	6	7	8	9	10
Countries	Variance of each Country	Unique c of each Country	New James-Stein Estimates (z)	-)2
Italy	1.37	0.63	2.17	3.95
Japan	1.39	0.6	2.59	2.47
France	0.45	0.88	2.23	3.72
New Zealand	1.9	0.49	3.1	1.11
United Kingdom	0.5	0.87	2.56	2.55
United States	0.76	0.8	2.71	2.1
Canada	0.96	0.74	2.87	1.65
Netherlands	0.79	0.79	3.26	0.81
Sweden	1.78	0.52	3.57	0.34
Gabon	3.24	0.13	4.02	0.02
Switzerland	0.85	0.77	3.37	0.61
Cameroon	0.51	0.86	3.33	0.68
Spain	1.02	0.72	3.54	0.38
Australia	0.94	0.75	3.57	0.34
Mexico	1.63	0.56	3.81	0.12
Senegal	2.31	0.38	4.07	0.01
Saudi Arabia	1.28	0.66	4.15	0
South Africa	2.78	0.25	4.25	0,01
South Korea	0.89	0.76	4.52	0.14
Brazil	2.06	0.45	4.39	0.05
Israel	0.38	0.9	5.05	0.84
Kenya	3.92	-0.05	4.08	0.01
Slovenia	1.62	0.56	4.99	0.69
Honduras	0.93	0.75	5.48	1.74
Zambia	0.32	0.91	5.77	2.6
Nigeria	0.26	0.93	5.9	3.03
Ghana	0.11	0.97	6.21	4.22
Oman	2.37	0.36	5.08	0.86
Russia	1.01	0.73	6.5	5.48
Uganda	3.25	0.13	4.76	0.37
Sum of Column 10 (MSE)	40.9			
Variance of New James-Stein Estimates	1.4			
Standard Deviation of New James-Stein Estimates	1.18			

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The *unique c* for each country will be used to calculate the corresponding new James-Stein estimates. For example for South Africa, the estimate obtained using an individual growth rate of 4.53 per cent is derived using the following equation:

$$= \ + c \ (y- \ )$$

$$= 4.16 + 0.25 \ (4.53\text{-}4.16) = 4.25 \ \text{per cent}$$

Therefore the James-Stein estimate calculated using a *unique c* for South Africa is 4.25 per cent for the individual growth rate of 4.53 per cent. Similarly the variance for USA is equal to the following:

$$\sigma^2 \ \text{for USA} = \Sigma \ (y- \ )^2 / \ 15$$

$$= 0.76$$

This is shown in column 7 (Table 3b, Pg74). Now the unique c will be calculated as follows:

$$c = 1 - (30\text{-}3) * 0.76/100.53$$

$$= 0.80$$

This is shown in column 8 (Table 3b, Pg74). The corresponding James-Stein estimate for the United States of America using the individual average growth rate of 2.33 is calculated as follows:

$$= \ + c \ (y- \ )$$

$$= 4.16 + 0.80 \ (2.33\text{-}4.16) = 2.71$$

The new James-Stein estimates are depicted in column 9. In order to determine the MSE and standard deviation of the new James-Stein estimates, $(z-\bar{z})^2$ will have to be calculated for each country shown in column 10 in table 3b on page 74. For South Africa for example, it will be the James-Stein estimate minus the grand average all squared. This will equal to $(4.25-4.16)^2 = 0.01$. The same procedure is repeated for the rest of the countries. The sum of this column is shown at the bottom of column 7, and this accumulates to 40.90. The variance of the new James-Stein estimates equals the following:

$$\sigma^2 = \Sigma (z-\bar{z})^2 / 30$$

$$= \text{MSE of the new estimates}/30 = 40.90/30 = 1.4$$

The standard deviation for the new estimates which is the square root of the variance of 1.4 is equal to 1.18. The variance and standard deviation are shown at the bottom of column 7 Table 3b, Pg74). In this case, the James-Stein estimates calculated when using a *common c* are better estimates than the ones calculated when a *unique c* is used. This is because the resulting standard deviation of 0.14 and MSE of 0.48 using the *common c* are lower than the standard deviation of 1.18 and the MSE of 40.90 of the James-Stein estimates when a *unique c* is used. Thus one can conclude that using a *common c* will give better estimates than when using a *unique c* as the estimates will be much closer to the true unknown GDP growth rates because a smaller standard deviation and MSE is derived. The results obtained with the new James-Stein estimates are approximately 2 times more accurate than the individual average GDP growth rates derived as follows:

MSE of the individual average GDP growth rates/MSE of the new James-Stein estimates

$=100.53/40.90 = 2.46$

The original James-Stein estimates using a *common c* are approximately 85 times more accurate than the new James-stein estimates calculated using a *unique c* (40.90/0.48) which is equal to the MSE of the new James-Stein estimates divided by the MSE of the original James-Stein estimates. Thus it is proven that using a *common c* produces more accurate GDP growth rate estimates than when using a *unique c*. The Monte Carlo study will be used in chapter 6 to test these results, thus supporting Stein's Paradox.

Figure 13 on page 78 shows the average GDP growth rates for each country against the new estimates calculated when a *unique c* is used. Average GDP growth rates are depicted on Axis A, and the estimates are shown on Axis B. The average GDP growth rates on Axis A are once again arranged in ascending order from left to right according to Table 3a on page 47. The grand average of 4.16 is shown as the red vertical line in the diagram below. South Africa has an average GDP growth rate of 4.53 per cent with a corresponding new estimate of 4.25 per cent, and USA has an average GDP growth rate of 2.33 with a corresponding estimate of 2.71 per cent. However, the same concept of shrinkage is applied whereby the observed averages less than the grand average will have their averages increased towards the grand average, and countries with observed averages greater than the grand average will have their averages decreased towards this grand average. The resulting amounts are the James-Stein estimates. All the averages converge around this grand average. However, better estimates are derived when using *common c* because a lower standard deviation and MSE is obtained.

Figure 13: Average GDP Growth Rates against New James-Stein Estimates from the First Quarter of 2005 to the Third Quarter of 2008 using a *unique c*
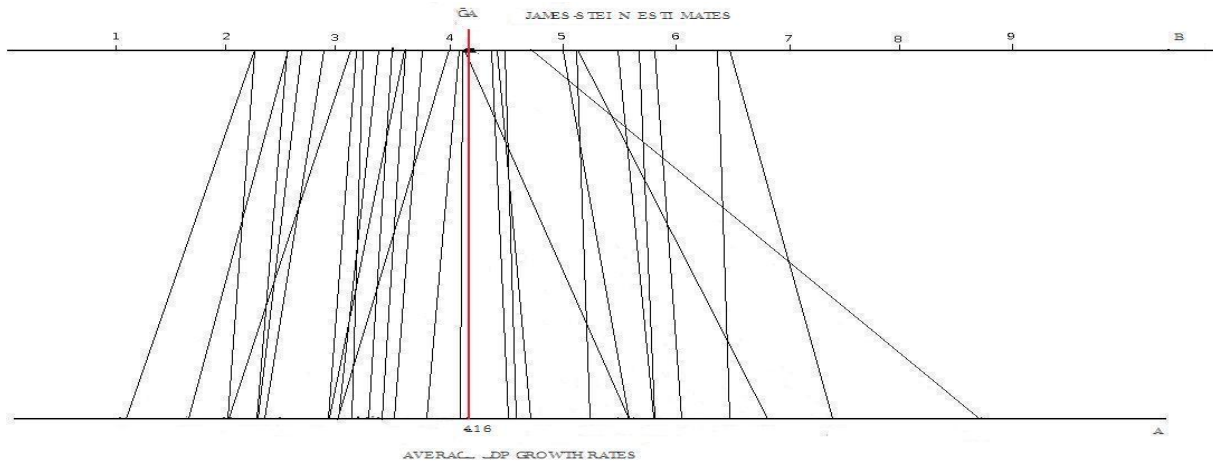
Figure 14 below shows the difference between the individual growth rates from the first quarter of 2005 till the third quarter of 2008 and the James-Stein estimates for each country using a *unique c*. The yellow line of new estimates calculated is more accurate than the pink line representing the individual average GDP growth rates based on the smaller standard deviation and MSE obtained. The main objective is to use these growth rates to calculate better estimates of GDP growth rates taking into account part of the crisis. The estimates produced are a better reflection of growth rates during this time period.

Figure 14: Difference between the 2008 Average Annual GDP Growth Rates and the James-Stein Estimates using a *unique c*
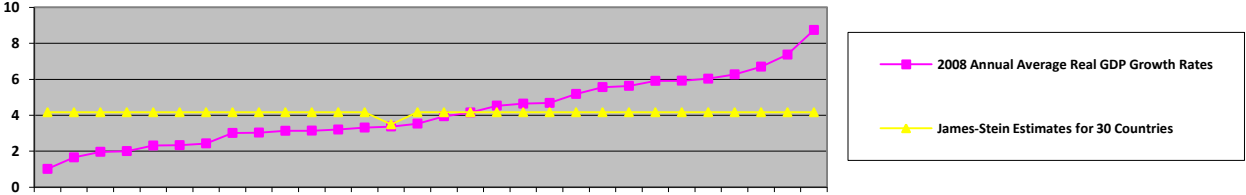
In the next section, the observed averages for each country from the first quarter of 2005 up until the third quarter of 2008 is linked up to the 2009 given average GDP growth figures as depicted in figure 15 on page 81. The 2009 annual average GDP growth rates for each country are depicted in Table 4a, in column 2 on page 80. The 2008 annual growth rates are once again arranged in ascending order from left to right on Axis A according to the growth rates in column 2 in Table 3a, on page 47. South Africa for example had a GDP growth rate of -1.5 per cent in 2009, and USA had a GDP growth of -3.5 per cent as highlighted below. The grand average accumulates to -1.09 per cent. This is derived by adding up the individual GDP growth rates across each country in column 2 and dividing this by 30 which is the number of countries analysed. On Axis A, the 2008 observed averages of the 30 countries is plotted, and on Axis B, the 2009 GDP growth figures are plotted. The GDP growth rates for the selected countries on Axis A are arranged in ascending order from left to right according to column 2 (Table 3a, Pg47). The observed average of each country on Axis A is linked to their corresponding average 2009 GDP growth rate as shown in figure 9. The diagram shows that growth rates were all positive in 2008. However in 2009 during the peak of the crisis, growth rates entered negative values. Therefore, growth rates project to the left from positive to negative values in figure 12, thus depicting the growth trajectory of the selected countries during the peak of the crisis. In the next section, the James-Stein estimators will be calculated using 2009 average annual real GDP growth rates.

Table 4a: 2009 Annual Average GDP Growth Rates

Countries	Average Annual Real 2009 GDP Growth rates (%)
Slovenia	-8
Russia	-7.8
Mexico	-6.3
Italy	-5.5
Japan	-5.5
Sweden	-4.9
United Kingdom	-4.4
Spain	-3.7
Netherlands	-3.5
United States	-3.5
Canada	-2.8
France	-2.6
New Zealand	-2.1
Honduras	-2.1
Switzerland	-1.9
South Africa	-1.5
Gabon	-1.4
Brazil	-0.3
Saudi Arabia	0.1
South Korea	0.3
Israel	0.8
Oman	1.1
Australia	1.4
Cameroon	2
Senegal	2.1
Kenya	2.7
Ghana	4
Zambia	6.4
Nigeria	7
Uganda	7.3
Grand Average	**-1.09**

Source: IMF, World Economic Outlook, 2012

Figure 15: 2008 Average GDP Growth Rates against 2009 Average GDP Growth Rates
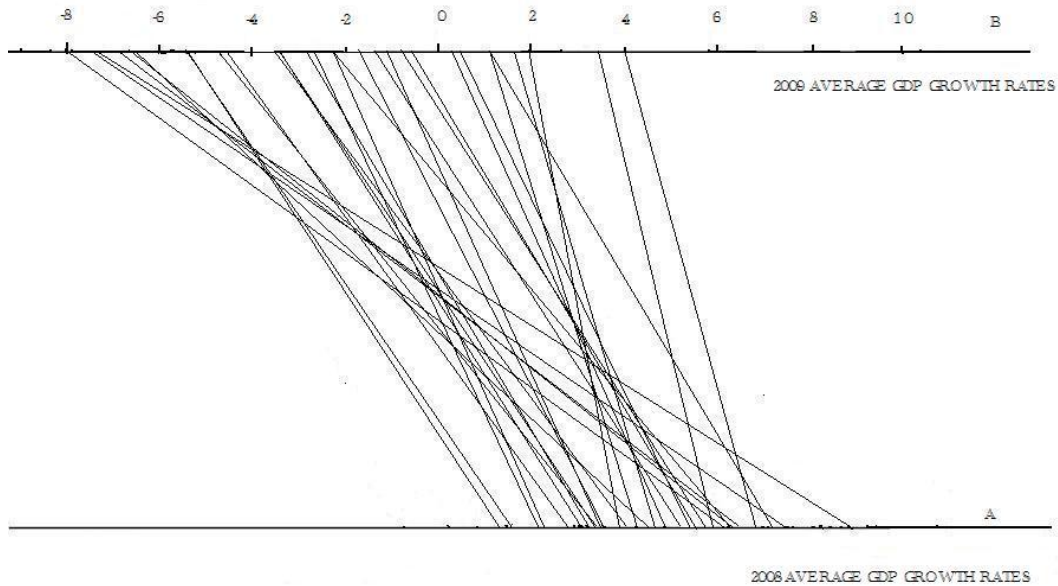
5.4 Calculation of James-Stein Estimates using 2009 Annual GDP Growth Rates

In this section, 2009 annual GDP growth figures will be used to calculate James-Stein estimates. This time period was chosen because it was at this point when growth rates entered negative values as a result of the crisis. Therefore the crisis was at its peak. Thus the objective is to determine better estimates of GDP growth rates during the worst period or the peak of the crisis in 2009.

The data calculated is shown in Table 4b on page 83 below. The GDP growth rates for the selected countries are arranged in ascending order as shown in the table. The grand average of the individual growth rates was previously calculated, and this amounts to -1.09. Next $(y-)^2$ for each country is calculated which is needed to calculate the MSE. For South Africa, we have the following:

$(y-)^2 = [-1.5-(-1.09)]^2 = 0.17$

This is highlighted in red in column 3 in Table 4b on page 83, below. If USA is considered, the following is derived:

$$(y-)^2 = [-3.5- (-1.09)]^2 = 5.82$$

The same procedure is followed for the rest of the countries whereby the average individual growth rates y for each country will be the only factor altered. These individual amounts are summed up to give the figure in column 5 (Table 4b, Pg 83) which equates to 481.35. This is the MSE of the individual average GDP growth rates. The MSE divided by the number of countries which is 30 is equal to the variance of 16.05. The corresponding standard deviation is 4.01 which is the square root of the variance of 16.05. These figures are shown at the bottom of column 2. Next, the constant *common c* for South Africa will be calculated as follows:

$$c = 1- (30-3) * \sigma^2 /MSE$$

$$= 1 - (27) * 16.05/481.35 = 0.10$$

This amount is then substituted into the James-Stein estimator equation to calculate the estimates. Thus the following is obtained for South Africa for example:

James-Stein Estimate (z) for South Africa = -1.09 + 0.10 [-1.5- (-1.09)] = -1.13 per cent

Similarly, the following is obtained for United States of America:

James-Stein Estimate (z) for USA = -1.09 + 0.10 [(-3.5- (-1.09)] = -1.33 per cent

These estimates are depicted in column 4 (Table 4b, Pg 83). The same procedure is applied when calculating the estimates for the rest of the countries. The only variable that will change will be individual average GDP growth rates y for each country.

Table 4b: Calculation of James-Stein Estimates using Annual 2009 Real GDP Growth Rates

1	2	3	4	5
Countries	Average Annual Real 2009 GDP Growth Rates (%)	$(y-)^2$	James-Stein Estimators (z)	$(-)^2$
Slovenia	-8	47.49	-1.78	0.48
Russia	-7.8	45.07	-1.76	0.45
Mexico	-6.3	27.18	-1.61	0.27
Italy	-5.5	19.48	-1.53	0.19
Japan	-5.5	19.48	-1.53	0.19
Sweden	-4.9	14.54	-1.47	0.15
United Kingdom	-4.4	10.98	-1.42	0.11
Spain	-3.7	6.83	-1.35	0.07
Netherlands	-3.5	5.82	-1.33	0.06
United States	-3.5	5.82	-1.33	0.06
Canada	-2.8	2.94	-1.26	0.03
France	-2.6	2.29	-1.24	0.02
New Zealand	-2.1	1.03	-1.19	0.01
Honduras	-2.1	1.03	-1.19	0.01
Switzerland	-1.9	0.66	-1.17	0.01
South Africa	-1.5	0.17	-1.13	0.0016
Gabon	-1.4	0.1	-1.12	0
Brazil	-0.3	0.62	-1.01	0.01
Saudi Arabia	0.1	1.41	-0.97	0.01
South Korea	0.3	1.92	-0.95	0.02
Israel	0.8	3.56	-0.9	0.04
Oman	1.1	4.78	-0.87	0.05
Australia	1.4	6.18	-0.84	0.06
Cameroon	2	9.53	-0.78	0.10
Senegal	2.1	10.15	-0.77	0.10
Kenya	2.7	14.34	-0.71	0.14
Ghana	4	25.87	-0.58	0.26
Zambia	6.4	56.05	-0.34	0.56
Nigeria	7	65.39	-0.28	0.65
Uganda	7.3	70.34	-0.25	0.70
Grand Average	**-1.09**			
Mean Squared Error (MSE)	**481.35**		**4.81**	
Variance	**16.05**		**0.16**	
Standard Deviation	**4.01**		**0.4**	
Constant (c)	**0.1**			

Source: IMF, World Economic Outlook, 2012

In order to calculate the MSE, variance and standard deviation of the James-Stein estimates, (-)^2 for each country will have to be calculated. This is shown in column 5 (Table 4b, Pg83). For South Africa, this would be the following:

$[-1.13-(-1.09)]^2 = 0.0016$

For USA, it would equal the following:

$[-1.33-(-1.09)]^2 = 0.06$

The same procedure is applied to the rest of the countries. The sum of column 5 equals 4.81. This is the MSE of the James-Stein estimates. The variance of the estimates is equal to 0.16, and the corresponding standard deviation is 0.4. The variance is equal to the following:

$\sigma^2 = \Sigma\,(y-\quad)^2 / 30$

$= MSE/30$

$= 4.81/30$

$= 0.16$

These figures are shown at the bottom of column 4 (Table 4b, Pg83). The standard deviation of 4.01 and MSE of 0.4 for the James-Stein estimates are lower than the standard deviation of 4.81 and MSE of 481.35 for the individual average GDP growth rates. A smaller standard deviation and MSE means that the results are more accurate with a smaller risk. Having said that, the James-Stein estimates is approximately 100 times more accurate than the individual average growth rates. It is calculated in the following way:

Level of Accuracy of the James-Stein Estimates = MSE of the individual average GDP growth rates/MSE of the James-Stein estimates = 481.35/4.81= 100

This proves that Stein's Paradox does provide better estimates of GDP growth rates. This means that for all the selected countries, the estimates calculated are more accurate than the individual average annual growth rates. So for South Africa, the James-Stein estimate of -1.13 per cent is more accurate than the individual average growth rate of -1.5 per cent, and the James-Stein estimate of -1.33 per cent for USA is more accurate than the individual average growth rate of -3.5 per cent. The estimates calculated are therefore much closer to the true unknown GDP growth rates theta.

In figure 16 on page 86 below, the 2009 GDP growth rates are depicted for all 30 countries on Axis A, and on Axis B, the calculated James-Stein estimates are depicted. The GDP growth rates on Axis A are arranged in ascending order from left to right according to Table 4b on page 64. The grand average is depicted as the red vertical line which equates to approximately -1.09 per cent. Diagonal lines connect the 2009 GDP growth rates for each country to their corresponding James-Stein estimates. Countries with observed individual average growth rates less than the grand average of -1.09 per cent will have their individual averages increased towards this grand average, and countries with observed average growth rates greater than the grand average will have their averages reduced towards this grand average. The resulting figures are the James-Stein estimates.

Figure 16: 2009 Average GDP Growth Rates against James-Stein Estimates
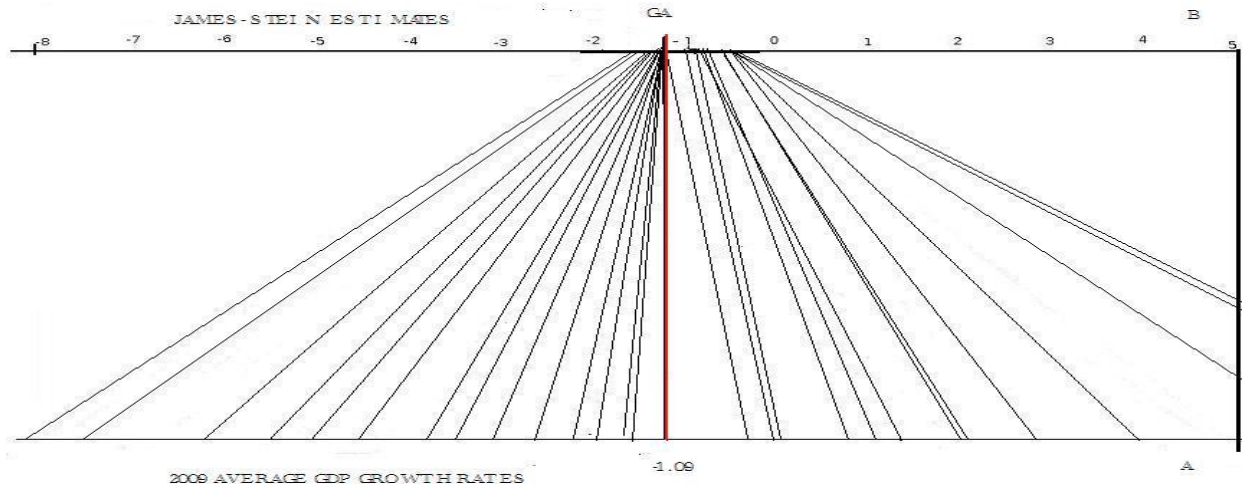
Figure 17 below shows the differences between the 2009 average GDP growth rates for each country and their corresponding James-Stein estimates. The yellow line represents the James-Stein estimates, and the pink line represents the individual average 2009 growth rates for each country. Therefore the yellow line of estimates is more accurate than the pink line of individual average growth rates, and therefore represents a more accurate growth trajectory during the peak of the crisis in 2009 based on the smaller standard deviation and MSE derived.

Figure 17: Difference between the James-Stein Estimates and their Corresponding 2009 Average GDP Growth Rates
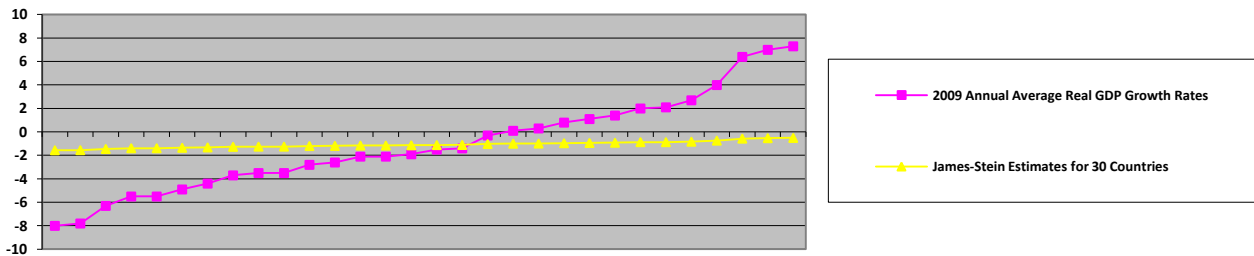
Figure 18, on page 88 shows the 2008 James-Stein estimates (growth rates from the first quarter of 2005 to the third quarter of 2008) using a *common c* in relation to the 2009 estimates. The 2008 James-Stein estimates are depicted on Axis A, and the 2009 estimates are depicted on Axis B. The 2008 James-Stein estimates are arranged in ascending order from left to right according to column 9 in Table 3a on page 47. The 2008 James-Stein estimates are the estimates first calculated which are reflected in figure 8 using a *common c* on page 53, and the 2009 estimates are shown in figure 13 on page 69. Vertical lines are drawn which links up the 2008 James-Stein estimates to the 2009 estimates for each country. This diagram depicts the possible future trajectory of the selected countries given the effects of the economic recession. The diagram shows that in 2008 during the worst periods of the recession, economic growth estimates in each of these countries was declining. This represents all converging lines to the left, ultimately converging to the 2009 James-Stein estimates. This shows that the estimates calculated go from positive to negative values during the peak of the crisis.

Figure 18 on page 88 which shows the 2008 James-Stein estimates against the 2009 estimates can be compared to figure 15 on page 81 which shows actual 2008 GDP growth rates (growth

rates from the first quarter of 2005 up till the third quarter of 2008) against actual 2009 GDP growth rates. This will depict how the James-Stein estimates for 2008 and 2009 differ from the individual average GDP growth rates during this period for each country. The estimates support the actual GDP growth rates as it shows estimates projecting from right to left, i.e. from positive (in 2008) to negative (in 2009) levels. Stein's Paradox however tells us that data contained in figure 15 is more accurate than data contained in figure 12, thus depicting a more accurate growth trajectory of the selected countries in 2008 and 2009 during the peak of the economic crisis. The estimates however show that growth rates in 2009 are more closely distributed and they lie between -1 and -2 per cent as depicted in figure 15 below. In the next section, Stein's Paradox will be used to determine if one can calculate more accurate real GDP growth estimates during 2010 when the global economy began to recover.

Figure 18: 2008 James-Stein Estimates (from the first quarter of 2005 to the third quarter of 2008) against 2009 James-Stein Estimates
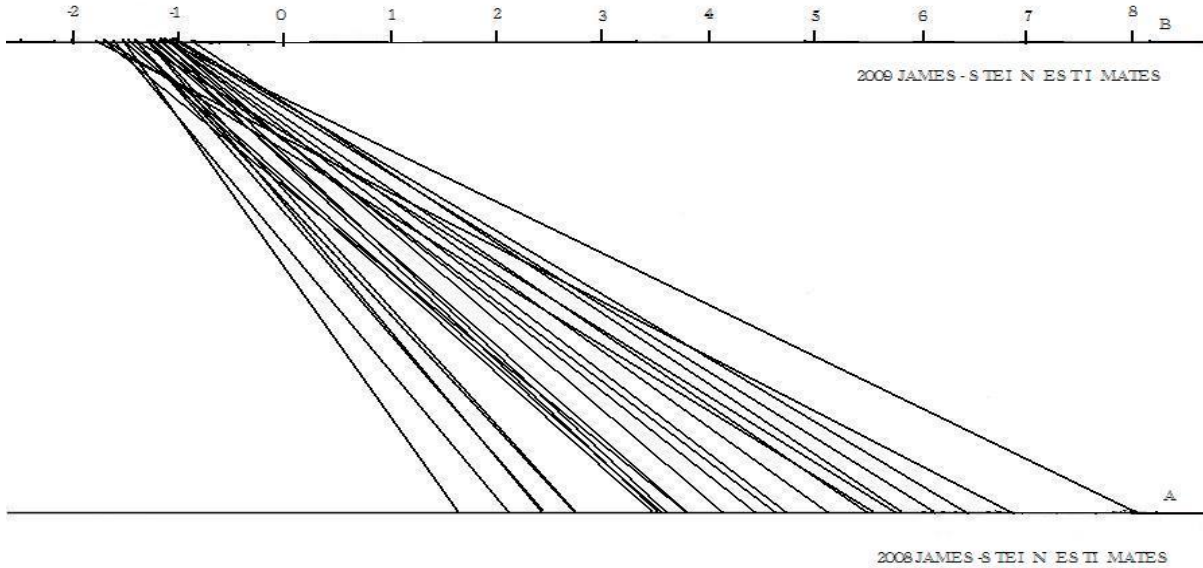
5.5 Calculation of James-Stein Estimates using 2010 Annual GDP Growth Rates

Now the James-Stein estimates will be calculated using annual 2010 real GDP growth rates. This is when growth rates entered positive values post the crisis, and when the global economy began its process of recovery. The objective is to determine whether better estimates of 2010 real GDP growth rates can be calculated using Stein's Paradox throughout the selected countries. The calculated data is shown in Table 5 below on page 90. The 2010 annual real GDP growth rates for each country are shown in column 2. They are arranged in ascending order. The grand average of the individual annual growth rates is 4.08 per cent shown at the bottom of column 2. Next $(y- \quad)^2$ for each country will be calculated shown in column 3. The sum of this column is equal to 142.05 which is the MSE of the individual average GDP growth rates. The variance of the individual growth rates is 4.90, and the standard deviation equals 2.2. All these figures are shown at the bottom of column 2.

Table 5: Calculation of James-Stein Estimates using 2010 Annual Real GDP Growth Rates

	1	2	3	4	5
Countries	**2010 Annual GDP Growth Rate (%)**	**y-)²**	**James-Stein Estimates (z)**	**(z-)²**
Spain	-0.1	17.44	3.79	0.08
New Zealand	1.2	8.28	3.88	0.04
Slovenia	1.4	7.16	3.89	0.03
France	1.4	7.16	3.89	0.03
Netherlands	1.6	6.13	3.91	0.03
Italy	1.8	5.18	3.92	0.02
United Kingdom	2.1	3.91	3.94	0.02
Australia	2.5	2.49	3.97	0.01
Switzerland	2.7	1.9	3.98	0.01
Honduras	2.8	1.63	3.99	0.01
South Africa	2.9	1.38	4	0.01
Cameroon	2.9	1.38	4	0.01
United States	3	1.16	4	0.01
Canada	3.2	0.77	4.02	0
Oman	4	0.01	4.07	0
Senegal	4.1	0	4.08	0
Russia	4.3	0.05	4.09	0
Japan	4.4	0.1	4.1	0
Saudi Arabia	4.6	0.27	4.11	0
Israel	4.9	0.68	4.13	0
Mexico	5.5	2.03	4.17	0.01
Sweden	5.9	3.32	4.2	0.02
Kenya	5.6	2.32	4.18	0.01
Gabon	6.6	6.37	4.25	0.03
South Korea	6.3	4.94	4.23	0.02
Uganda	5.9	3.32	4.2	0.02
Ghana	7.7	13.13	4.33	0.06
Brazil	7.5	11.72	4.31	0.06
Zambia	7.6	12.41	4.32	0.06
Nigeria	8	15.39	4.35	0.07
Grand Average	**4.08**			
Mean Squared Error (MSE)	**142.05**		**0.68**	
Variance	**4.9**		**0.02**	
Standard Deviation	**2.2**		**0.1**	
Constant	**0.07**			
Times More Accurate	**210.25**			

Source: IMF, World Economic Outlook, 2012

The *common c* is calculated as follows:

$$c = 1 - (30-3) * \sigma^2 / MSE$$

$$= 1 - (27) * 4.90/142.05 = 0.07$$

Now the *common c* can be used to calculate the James-Stein estimates. The James-Stein estimate for South Africa using an individual growth rate of 2.9 per cent in 2010, for example, is as follows:

James-Stein Estimate (z) for South Africa = $\bar{y}$ + c (y- $\bar{y}$)

$$= 4.08 + 0.07 (2.9\text{-}4.08)$$

$$= 4 \text{ per cent}$$

Similarly, the James-Stein estimate for the USA using the individual growth rate of 3 per cent is as follows:

James-Stein Estimate (z) for USA = $4.08 + 0.07 (3\text{-}4.08)$

$$= 4 \text{ per cent}$$

The same procedure is repeated for the rest of the countries. The James-Stein estimates are shown in column 4 (Table 5, Pg90). Next the MSE of the James-Stein estimates will be calculated. This will be equal to the $\Sigma (z- \bar{y})^2$, and is therefore equal to 0.68 shown in column 12. This is equal to the sum of column 5 where $(z- \bar{y})^2$ for each country is calculated. This is the amount of error associated with the estimates. This figure will be compared to the MSE derived using the individual GDP growth rates.

The corresponding variance of the estimates is 0.02, and the standard deviation is 0.1. The MSE, variance and standard deviation of the estimates are shown at the bottom of column 4 (Table 5, Pg90). When looking at the results, one finds that the standard deviation of 0.1 and the MSE of 0.68 of the James-Stein estimates are lower than the standard deviation of 2.20 and MSE of 142.05 of the individual growth rates. Therefore the estimates are more accurate and are closer to the true unknown mean theta because a smaller standard deviation and MSE are derived. Thus the estimates are proven to be better or more accurate than the individual average annual GDP growth rates for each country. For example, the James-Stein estimate of 4 per cent for South Africa is a better estimate than the individual growth rate of 2.9 per cent in 2010, and the James-Stein estimate of 4 per cent for United States of America is a better estimate than the individual growth rate of 3 per cent (Table 5, Pg90).

In order to determine the level of accuracy of the James-Stein estimates when compared to the individual average GDP growth rates, the MSE of the individual growth rates is divided by the MSE of the James-Stein estimates. This equals 210.25. This means that the James-Stein estimates are approximately 210 times more accurate that the individual average GDP growth rates for the selected countries during 2010.

Figure 19 below shows the 2010 individual average annual GDP growth rates of each country against their corresponding James-Stein estimates. The 2010 annual GDP growth rates are shown on Axis A, and the corresponding estimates are shown on Axis B. The 2010 growth rates for the selected countries are arranged in ascending order from left to right according to column 2 in Table 5 on page 90. The grand average of 4.08 is shown as the vertical red line. Individual average growth rates greater than the grand average will have their averages reduced and

averages smaller than the grand average will have their averages increased towards the grand average. Therefore the shrunken values are the James-Stein estimates.

Figure 19: 2010 Average Annual GDP Growth Rates against James-Stein Estimates
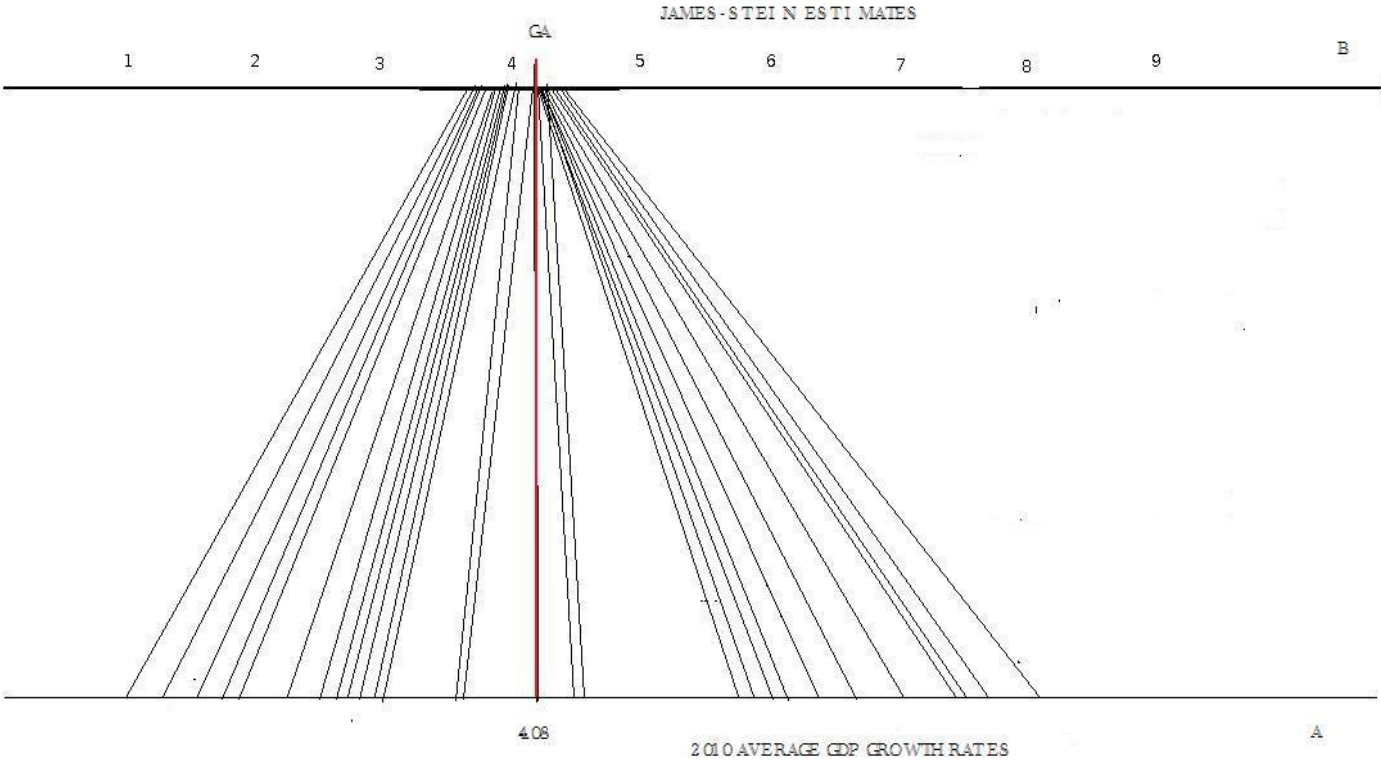
Figure 20 below shows the difference between the 2010 annual average GDP growth rates and the James-Stein estimates calculated for each country. The pink line depicts the 2010 annual average GDP growth rates and the yellow line depicts the James-Stein estimates. Therefore the yellow line of estimates depicts a more accurate growth trajectory of the selected countries than the pink line of individual average GDP growth rates post the recession in 2010 based on the lower standard deviation and MSE derived. James-Stein estimates using 2011 annual GDP

growth rates will not be calculated as growth rates also improved in 2011 post the crisis. Therefore 2010 also represent this post recovery period.

Figure 20: Difference between 2010 Annual Average GDP Growth Rates and James-Stein Estimates
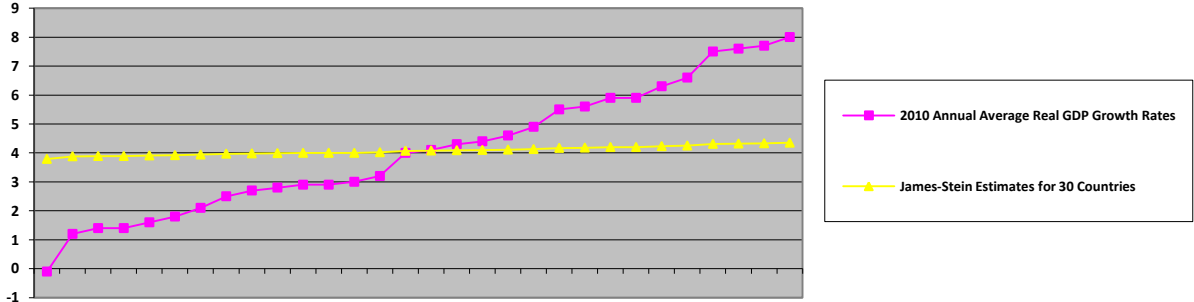
5.6 Calculation of James-Stein Estimates using Forecasted Annual GDP Growth Rates from 2012 to 2016

In this section, forecasted GDP growth rates will be used from 2012 to 2016 for each country in order to determine if one can calculate better future estimates of GDP growth rates using Stein's Paradox as a way to more accurately predict the future trajectory of these countries post the economic crisis of 2008. The average GDP growth rates for each country from 2012 to 2016 are shown in Table 6a below. Column 7 (Table 6a, Pg96) shows the average growth rates for each country between 2013 and 2016, and these are arranged in ascending order. The average GDP growth rates for South Africa and USA are 3.8 per cent and 3 per cent respectively from 2013 to 2016 as highlighted below. The calculations are shown in Table 6b, on page 97, below.

Table 6a: Forecasted GDP Growth Rates from 2012 to 2016

1	2	3	4	5	6	7

Countries	2012	2013	2014	2015	2016	Average GDP Growth (2013-2016)
Italy	-1.9	-0.2	0.5	1	1.2	0.6
Spain	-1.8	0.1	1.2	1.6	1.7	1.2
Japan	2	1.7	1.5	1.3	1.2	1.4
Netherlands	-0.5	0.8	1.4	1.8	1.9	1.5
France	0.5	1	1.9	1.9	1.9	1.7
Slovenia	-1	1.4	1.6	1.9	2	1.7
Switzerland	0.8	1.7	1.8	1.9	1.9	1.8
Canada	2.1	2.2	2.4	2.4	2.3	2.3
United Kingdom	0.8	2	2.6	2.7	2.8	2.5
Gabon	5.6	2.3	2.7	2.6	2.7	2.6
Sweden	0.9	2.3	3.2	3	2.4	2.7
New Zealand	2.3	3.2	2.9	2.6	2.4	2.8
United States	2.1	2.4	2.9	3.3	3.5	3
Oman	5	3.4	3.3	3.4	3.5	3.4
Australia	3	3.5	3.5	3.5	3.5	3.5
Mexico	3.6	3.7	3.8	3.3	3.3	3.5
Israel	2.7	3.8	3.8	3.6	3.6	3.7
South Africa	2.7	3.5	4	3.9	3.7	3.8
Honduras	3.5	3.5	3.8	4	4	3.8
Russia	4	3.9	3.9	3.9	3.8	3.9
South Korea	3.6	4	4	4	4	4
Brazil	2.7	4.2	4	4.1	4.1	4.1
Saudi Arabia	6	4.2	4.4	4.3	4.2	4.3
Cameroon	4.1	4.5	4.7	4.8	5	4.8
Senegal	3.8	4.6	4.9	5.2	5.4	5
Nigeria	6.6	6.3	6.3	6	6	6.2
Kenya	5.2	5.7	6.3	6.3	6.5	6.2
Uganda	4.2	5.4	6	7	7	6.4
Ghana	8.8	7.4	6.6	6.3	5.7	6.5
Zambia	7.7	8.3	7.9	8	7.9	8

Source: IMF, World Economic Outlook, 2012

Table 6b: Calculation of James-Stein Estimates using Average Forecasted GDP Growth Rates from 2012 to 2016

| | 1 | 2 | 3 | 4 | 5 |

Countries	Average GDP Growth from 2012-2016	y-)²	James-Stein Estimates	-)²
Italy	0.12	11.05	3.11	0.11
Spain	0.56	8.32	3.15	0.08
Netherlands	1.08	5.59	3.21	0.06
Slovenia	1.18	5.13	3.22	0.05
France	1.44	4.02	3.24	0.04
Japan	1.54	3.63	3.25	0.04
Switzerland	1.62	3.33	3.26	0.03
United Kingdom	2.18	1.6	3.32	0.02
Canada	2.28	1.36	3.33	0.01
Sweden	2.36	1.18	3.34	0.01
New Zealand	2.68	0.58	3.37	0.01
United States	2.84	0.37	3.38	0
Gabon	3.18	0.07	3.42	0
Australia	3.4	0	3.44	0
Israel	3.5	0	3.45	0
Mexico	3.54	0.01	3.45	0
South Africa	3.56	0.01	3.46	0
Oman	3.72	0.08	3.47	0
Honduras	3.76	0.1	3.48	0
Brazil	3.88	0.19	3.49	0
Russia	3.9	0.21	3.49	0
South Korea	3.92	0.23	3.49	0
Cameroon	4.62	1.38	3.56	0.01
Saudi Arabia	4.62	1.38	3.56	0.01
Senegal	4.78	1.78	3.58	0.02
Uganda	5.92	6.13	3.69	0.06
Kenya	6	6.53	3.7	0.07
Nigeria	6.24	7.81	3.73	0.08
Ghana	6.96	12.36	3.8	0.13
Zambia	7.96	20.39	3.9	0.21
Grand Average	**3.44**			
Mean Squared Error (MSE)	**104.81**		**1.07**	
Variance	**3.49**		**0.04**	
Standard Deviation	**1.87**		**0.2**	
Constant	**0.10**			

The calculated average GDP growth rates from 2012 to 2016 are shown in column 2 above (Table 6b, Pg97). These average growth rates are also arranged in ascending order. The 2012 GDP growth rates for each country are extracted from Table 6a, in column 2 on page 95. This is equal to the sum of the growth rates for each country from 2012 to 2016 divided by 5 which is the number of years for this time period. These growth rates are arranged in ascending order. For South Africa, for example, the average forecasted growth rate is calculated as follows:

Average GDP growth rate for South Africa from 2012 to 2016 = (2.7 + 3.5 + 4 + 3.9 + 3.7) / 5

$$= 3.56 \text{ per cent}$$

This is highlighted in red in column 2 in table 6b on page 96. Similarly, the average forecasted growth rate for USA is as follows:

Average GDP growth rate for USA from 2012 to 2016 = (2.1 + 2.4 + 2.9 + 3.3 + 3.5) / 5

$$= 2.84 \text{ per cent}$$

The grand average is equal to the individual average growth rates for each country in column 2 (Table 6b, Pg97) divided by 30 which is the number of countries. This is therefore equal to 3.44. Then $(y-\ )^2$ is calculated for each country in order to calculate the MSE. This is shown in column 3, and the sum of this column is equal to 104.81 which is the MSE of the individual GDP growth rates. The variance of the individual GDP growth rates is equal to 3.49, and the corresponding standard deviation is 1.87. The variance (σ^2) is equal to the MSE divided by 30 as follows:

$\sigma^2 = \text{MSE}/30$

= 104.81/30 = 3.49

The MSE, variance and standard deviation of the individual growth rates are shown at the bottom of column 2 (Table 6b, Pg97). The variance calculated above is used to calculate the constant c which will then be used to calculate the corresponding James-Stein estimates. The constant is calculated by dividing the variance by the MSE and is as follows:

c = 1- (30-3) * 3.49 / 104.81

= 0.10

The James-Stein estimate for South Africa for example from 2012 to 2016 for the individual growth rate of 3.56 per cent is equal to the following:

James-Stein Estimate (z) of South Africa = 3.44 + 0.10 (3.56-3.44)

= 3.46 per cent

The James-Stein estimate is highlighted in red in the table above. Similarly, the James-Stein estimate for USA for the individual growth rate of 2.84 per cent is equal to the following:

James-Stein Estimate (z) for USA = 3.44 + 0.07 (2.84-3.44)

= 3.38 per cent

Estimates for all countries are shown in column 4 (Table 6b, Pg96). In order to determine the MSE of the estimates, $(z-)^2$ for each country is calculated shown in column 5. The sum of this column is the MSE of 1.07. The MSE is used to calculate the variance of these estimates as follows:

σ^2 = MSE/30

   = 1.07/30 = 0.04

The corresponding standard deviation is 0.2 which is the squared root of the variance. The MSE, variance and standard deviation of the James-Stein estimates are shown at the bottom of column 4 (Table 6b, Pg97). Therefore, the standard deviation of 0.2 and the MSE of 1.07 for the James-Stein estimates are smaller than the standard deviation of 1.9 and the MSE of 104.81 for the individual GDP growth rates. This means there is a smaller error associated with the estimates than with the individual growth rates, and the estimates are therefore closer to the true unknown GDP growth rates, theta, because a smaller standard deviation is derived. The James-Stein estimates are approximately 98 times more accurate than the individual forecasted GDP growth rates calculated as follows:

MSE of individual growth rates/MSE of James-Stein Estimates = 104.81/1.07

$$= 98$$

This means that the James-Stein estimate of 3.46 per cent for South Africa is more accurate than the forecasted individual growth rate of 3.56 per cent from 2012 to 2016. Similarly, the James-Stein estimate of 3.38 per cent for USA is more accurate than the forecasted individual growth rate of 2.84 from 2012 to 2016. Thus by using Stein's Paradox, one is able to project more accurate future GDP growth rates for the range of countries from 2012 to 2016, thus providing a more accurate growth trajectory of the selected countries post the crisis.

Figure 21 below shows the calculated James-Stein estimates on Axis B against the individual forecasted GDP growth rates from 2012 to 2016 on Axis A. The average growth rates for the

selected countries are arranged in ascending order from left to right on Axis A according to column 2 in Table 6b, on page 96. The grand average of 3.44 is shown as the red vertical line. The forecasted GDP growth rates for each country from 2012 to 2016 are shown on Axis A, and the corresponding estimates are shown on Axis B. All individual average GDP growth rates converge towards this grand average. Growth rates lower than the grand average will have their growth rates increased towards this grand average, and growth rates higher than the grand average will their growth rates reduced towards the grand average.

Figure 21: Calculation of James-Stein Estimates using Forecasted Real GDP Growth Rates from 2012-2016
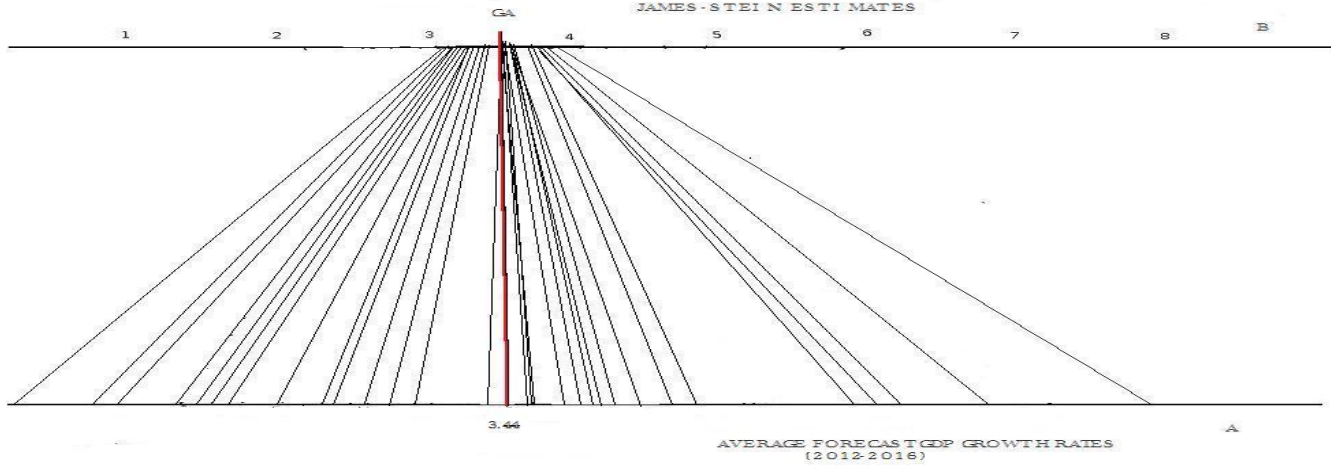
Figure 22, below shows the difference between the forecasted average GDP growth rates from 2012 to 2016 and their corresponding James-Stein estimates for each country. The pink line depicts the forecasted individual average GDP growth rates, and the yellow line shows the James-Stein estimates. The line of estimates projects a more accurate forecasted growth

trajectory for the selected countries than the individual average growth rates. Therefore Stein's Paradox predicts more accurate future growth rates than the individual average forecasted rates.

Figure 22: Difference between Forecasted Average GDP Growth Rates (2012-2016) and James-Stein Estimates
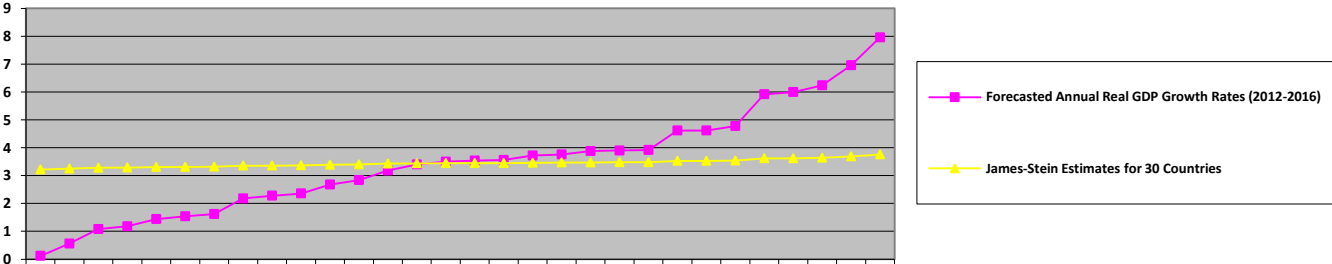
The world economy will not reach its maximum potential over the next 5 years starting from 2012 to 2016. Even though advanced economies seem to pull out of the recession at a slow pace, emerging markets seem to limit the progress, thus slowing global growth. This is based on a forecast released by the Conference Board. The Conference Board is a global association which aims to provide global organisations with knowledge they require as a way to strengthen their performance and cater to the needs of the public (The Conference Board, 2012). The Conference Board anticipates world GDP to grow by 3.5 per cent in 2012. They expect it to increase by 0.1 per cent to a growth rate of 3.6 per cent within a period of 4 years from 2013 to 2016. However, growth is expected to only increase by approximately 2.7 per cent between 2017 and 2025. Therefore the Conference Board projects a much higher growth rate of 3.5 per cent in 2012 than the projection by the IMF noted earlier of 2.7 per cent (IMF, World Economic Outlook, 2012).

In the next section, the forecasted GDP growth rates in developed, emerging and developing countries will be analysed across the sample of countries in the study from 2012 to 2016 in order to determine which type of countries are the engines of growth for the future.

The individual average forecasted growth rates for the selected countries from 2013 to 2016 are depicted in Table 6c, on page 103 below. These averages are extracted from column 7, in Table 6a on page 95. For South Africa for example, the average GDP growth rate from 2013 to 2016 is equal to the sum of the individual growth rates from 2013 to 2016 divided by the number of years which is equal to 4. Therefore, the following is obtained:

Average GDP Growth Rate for South Africa from 2013 to 2016 = (3.5 + 4 + 3.9 +3.7)/4

$$= 3.8 \text{ per cent}$$

Similarly, the average growth rate for USA during this period is the following:

Average GDP Growth Rate for USA = (2.4 + 2.9 + 3.3 + 3.5) / 4

$$= 3 \text{ per cent}$$

Therefore, South Africa is expected to grow by 3.8 per cent over the next four years from 2013 to 2016, and USA is expected to grow by 3 per cent (IMF, World Economic Outlook, 2012). These growth rates are highlighted in column 6 and 3 respectively (Table 6c, Pg103). Growth for South Africa increased by 3.1 per cent in 2011, and forecast for 2012 is 3.6 per cent (World Bank, 2012). Therefore, forecast growth from 2013 to 2016 only increased by a small fraction by 0.2 per cent. However, forecast growth in USA of 3 per cent over the next four years is significantly higher than the growth rate of 1.7 per cent in 2011 and the forecast of 1.8 per cent

in 2012 (International Financial Statistics, 2012). Table 6c below divides the selected countries in the study according to their classification in terms of their Gross National Income (GNI) in terms of developed, emerging and developing countries.

Table 6c: Projected GDP Growth Rates across Developed, Emerging and Developing Countries

1	2	3	4	5	6	7	8	9
Developed economies	**GDP Growth Rates (2012)**	**Average GDP Growth Rates (2013-2016)**	**Emerging Economies**	**GDP Growth Rates (2012)**	**GDP Growth Rates (2013-2016)**	**Developing Countries**	**GDP Growth Rates (2012)**	**GDP Growth Rates (2013-2016)**
Italy	-1.9	0.6	Slovenia	-1	1.7	Cameroon	4.1	4.8
Japan	2	1.4	Gabon	5.6	2.6	Senegal	3.8	5
Netherlands	-0.5	1.5	Oman	5	3.4	Nigeria	6.6	6.2
Spain	-1.8	1.2	Mexico	3.6	3.5	Kenya	5.2	6.2
France	0.5	1.7	South Africa	2.7	3.8	Uganda	4.2	6.4
Switzerland	0.8	1.8	Brazil	2.7	3.8	Ghana	8.8	6.5
Canada	2.1	2.3	Honduras	3.5	3.8	Zambia	7.7	8
United Kingdom	0.8	2.5	Russia	4	3.9			
Sweden	0.9	2.7	South Korea	3.6	4			
New Zealand	2.3	2.8						
United States	2.1	3						
Australia	3	3.5						
Israel	2.7	3.7						
Saudi Arabia	6	4.3						
Average GDP Growth Rate	**1.36**	**2.36**	**Average GDP Growth Rate**	**3.3**	**3.39**	**Average GDP Growth Rate**	**5.77**	**6.16**

Source: IMF, World Economic Outlook, 2012

The average GDP growth rates for each classification of country in 2012 extracted from Table 6a is shown in Table 6c (Pg104), above, in columns 2, 5 and 8, and the average growth rates from 2013 to 2016 are shown in columns 3, 6 and 9. These growth rates are extracted from columns 2

and 7, respectively, in Table 6a on page 95. These average GDP growth rates from 2013 to 2016 are arranged in ascending order from top to bottom. Columns 1, 4 and 7 depict the developed, emerging and developing countries respectively of the selected countries. The average GDP growth rate for 2012 for the developed countries will increase by 1.36 per cent, and this is equal to the sum of the individual growth rates divided by the number of developed countries which is calculated as follows:

Average GDP Growth Rate in 2012 for the developed countries = (0.8 + 2.1 + 3 + 2.1 + 0.5 + 2.7 -1.9 +2 -0.5 + 2.3-1.8 + 0.9 + 0.8 +6)/14 = 1.36 per cent

Similarly, the average GDP growth rate from 2013 to 2016 is equal to the sum of the individual averages for each country during this time period extracted from Table 6a divided by the number of developed economies in the study which is 14. Therefore, it is calculated as follows:

Average GDP Growth Rates from 2013 to 2016 for the developed countries = (1.8 + 3 + 3.5 + 2.3 + 1.7 + 3.7 + 0.6 + 1.4 + 1.5 + 2.8 + 1.2 + 2.7 + 2.5 + 4.3)/ 14 = 2.36 per cent

The GDP growth rates for the emerging and developing economies is calculated in the same way. Therefore, the developed economies' average forecasted GDP growth rate for 2012 will increase by 1.36 per cent, and growth rates will increase on average by 2.36 per cent between 2013 and 2016 shown in columns 2 and 3, respectively (Table 6c, Pg104). GDP growth in emerging and developing economies will be calculated in the same way. Therefore growth in emerging economies is forecast to increase by 3.3 per cent in 2012, and by 3.39 per cent between 2013 and 2016 shown in columns 5 and 6, respectively. GDP growth in developing countries is forecast to increase by 5.77 per cent on average in 2012, and by 6.16 per cent between 2013 and 2016 shown in column 8 and 9 respectively (Table 6c, P103).

According to the average forecasted rates above, GDP growth for the developing economies is forecasted to be the highest at around 5.77 per cent in 2012, and 6.16 per cent from 2013 to 2016, and forecasted GDP growth for the developed world is the lowest at around 1.36 per cent in 2012, and 2.36 per cent from 2013 to 2016 (IMF, World Economic Outlook, 2012). It therefore shows that the developed economies in this study are likely to experience a slower growth rate relative to the developing countries. The emerging countries are in between these two extremes in terms of growth rates. They seemed to have escaped the recession but are not operating at a capacity level as high as that of the developing economies. Countries are however interdependent. Given their higher projected growth rates, emerging and developing economies will propel GDP growth in the near future, and as a group they may be engines of growth for the global economy. This is more so when one considers the impact that economic growth in one country has on the economic growth of another country. The slow projected growth rate of the developed nations seems to be holding back global GDP growth rates. These forecasted growth rates are depicted in figure 23 on page 106, below. The blue bars depict the forecasted growth rates in 2012 for developed, emerging and developing countries, and the maroon bars depict the average forecasted growth rates from 2013 to 2016.

The South African economy has direct links with India and China, for example, as these countries are South Africa's major trading partners and they all form part of the BRICS (Brazil, Russia, India and China, South Africa). So growth in one of these countries directly impacts growth in South Africa. These countries experienced an average growth rate of over 8 per cent in the past 10 years. However, they are expected to experience slower real GDP growth during 2012 and 2013. India experienced real GDP growth of approximately 7.4 per cent over the past decade from 2000 till 2010. Growth may slow down to 3 per cent in 2012. GDP growth in China

is expected to slow down. Growth is expected to decline by 6.5 per cent over the next decade (Azzarello and Putnam. 2012). Therefore this slowdown in economic growth may affect growth rates in South Africa and may have an adverse impact on the economy.

Figure 2 3: Forecasted GDP Growth Rates in Selected Developed, Emerging and Developing Countries from 2012 to 2016
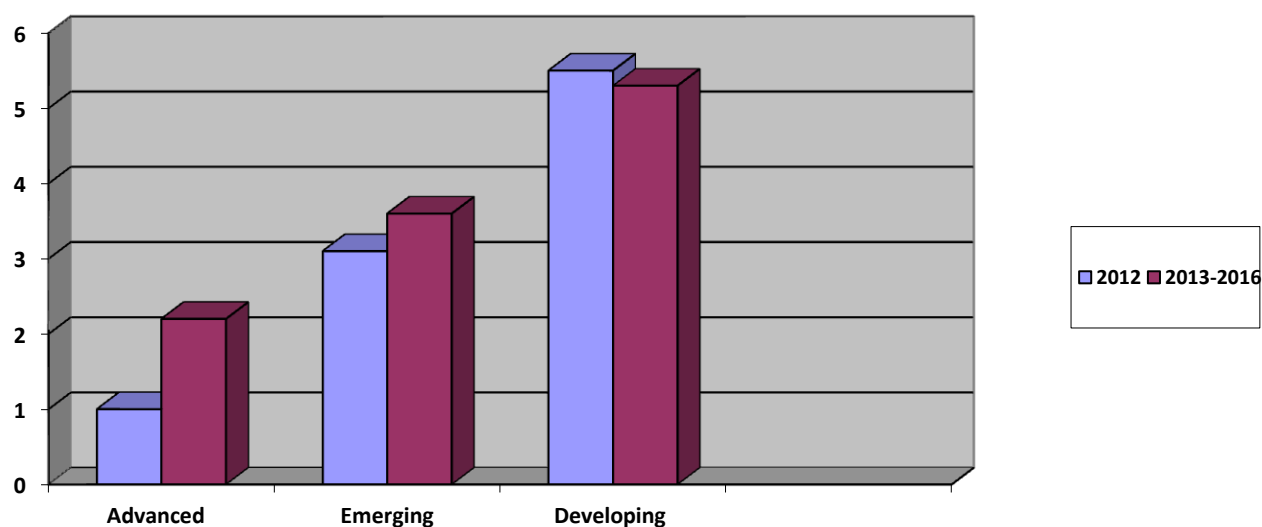
Source: IMF, World Economic Outlook, 2012

5.7 Conclusion

This chapter analysed the workings of Stein's Paradox. The main objective is to determine if better estimates of real GDP growth rates can be calculated post the recession across various time periods across the selected countries to determine if one can calculate James-Stein estimates which are closer to each country's true unknown GDP growth rates theta.

The James-Stein estimates calculated were shown to be better or more accurate than the individual average GDP growth rates for each country during 2008, 2009, 2010 and forecasted GDP growth rates from 2012 to 2016. Better James-Stein estimates of future GDP growth rates allowed one to construct a more precise forecasted growth trajectory of the sample countries post the economic crisis of 2008. Stein's Paradox also proves that using a *common c* will provide more accurate GDP growth rate estimates than when using a *unique c*. This is linked to the Monte Carlo study and will aim to reinforce the simulation which is analysed in the next chapter. Forecasted GDP growth rates were also shown to be the highest in the selected developing and emerging countries, thus proving to be the engines of growth for the future.

CHAPTER 6

THE MONTE CARLO STUDY

6.1 Introduction

Monte Carlo studies are used to examine how statistical estimators perform under different conditions, and ultimately to determine which method of performance works more efficiently or is more accurate (Muthen and Muthen, 2002). The simulation uses random sampling and generates the variables in the sample through a computer programme called Shazam as a way to determine how these variables perform under different situations (Lemieux, 2008). In this particular study, the statistical estimators will be the James-Stein estimators. When focusing on a Monte Carlo study, the standard deviation needs to be calculated and analysed in order to determine which method is more accurate (Muthen. and Muthen, 2002: 601). A smaller standard deviation carries a smaller degree of risk, and therefore produces more accurate results. Therefore the importance of using a Monte Carlo study in this paper is to determine which process (either using the *unique c* or a *common c*) will give better James-Stein estimates of GDP growth rates, thus producing a smaller standard deviation. Using a *unique c* or a *common c* will be the different conditions which need to be tested. In chapter 5, using growth rates from 2005 to 2008 proved that the estimates calculated when using a *common c* are more accurate or better than the estimates calculated when using a *unique c* as the MSE and standard deviation obtained were smaller. The Monte Carlo study will therefore be used to test these two conditions to determine if the Monte Carlo study reinforces this outcome of Stein's Paradox. The programme Shazam will be used for this simulation. Shazam is a software programme used to generate econometrical and statistical information. It will be used in this case for Monte Carlo simulations

whereby certain input will be generated in order to determine how the variable performs. Therefore the Monte Carlo simulation which produces the smallest standard deviation, produces the most accurate GDP growth rates, and is therefore closer to the true unknown GDP growth rates theta.

In conjunction with the above, the three different types of distributions associated with a Monte Carlo study will be applied when the input is generated in order to test which method provides more accurate estimates. They are the normal distribution, uniform distribution, and the slash distribution. The normal distribution will be generated through Shazam as nor (1). The uniform distribution will be generated as uni (1), and the slash distribution will be generated as nor (1) / uni (1). The results will be compared with one another. The data for a *unique c* and a *common c* will be processed to determine the standard deviation of each distribution to determine which process produces the smallest standard deviation, thus indicating the most accurate results, results which will be closer to the true unknown values, theta.

6.2 Definition of Terms

In this section of the study, a few terms will be explained as a way to gain more clarity emanating from the results. The outcome will be based on the standard deviation and the variance. The standard deviation shows the degree of variation from the average or mean. The standard deviation is the square root of its variance. If a small standard deviation is generated, then data is very close to the mean, and therefore, this implies that the results are more accurate and therefore closer to theta. On the other hand, if a large standard deviation is generated, then the data is quite far off from the mean and the results are not as accurate and are further away from theta. By using the Monte Carlo study, the objective is to generate a lower standard

deviation when using a *unique c* than when using a common one. Therefore data is generated into Shazam, and the distribution which produces the lowest standard deviation will therefore be the condition which produces the most accurate growth rates; either by using a *unique c* or *common c*. In the section below, the steps of the Monte Carlo study will be explained.

6.3 Steps of the Monte Carlo Study

The Monte Carlo Study begins by modeling and generating data, and describing the variables in the modeling. A computer programme will have to be written which implements this data generating model (Lemieux, 2008). It will aim to determine the sampling properties of the estimates which are generated into the computer programme. From this, sets of data will be generated. The properties of the estimators will be compared under different conditions (Adkins and Gade, 2012). The commands which are modeled, generated and processed into Shazam for a normal distribution is shown in the appendix. A normal distribution will be nor (1) which is part of the commands generated through Shazam.

Sets of data will also be processed through a uniform and a slash distribution. This is done to determine the standard deviation and variance associated with the James-Stein estimates under the two different conditions of using a *common c* and a *unique c*. Normal distributions are also known as symmetric distributions. Here the error obtained from the results will revolve around zero (Adkins and Gade. 2012). If a smaller standard deviation is achieved, then the James-Stein estimates are more accurate than when a larger standard deviation is achieved. In the command input in the appendix, sdjs will be the standard deviation of the James-Stein estimates using a *common c*, and sdjsu will be the standard deviation of the James-Stein estimates using a *unique c*. The same set of commands as those of the normal distribution will be used with the uniform

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and slash distributions. The only alteration that will be made is changing nor (1) to uni (1) for a uniform distribution, and changing nor (1) to nor (1)/ uni (1) for a slash distribution. The reason for using the three different types of distributions is to test the estimates under different conditions in order to determine which condition provides one with the lowest standard deviation, thus proving to be the most accurate results, and will therefore be the closest to the true unknown value, theta. Thus three different sets of results will be generated which will be analysed in the next section.

6.4 Results

6.4.1 Results using a Normal Distribution

A normal distribution is represented by nor (1) which is processed into Shazam. The normal distribution commands are shown in the appendix and the output is shown in Table 7 on page 112, below in row 2. Column 2 shows the results achieved when using a *common c*, and column 3 shows the results achieved when using a *unique c*. When looking at the results, the mean of the James-Stein estimates when a *common c* is used is 1.49, and the standard deviation is 1.10. The variance is 1.21. The mean of the James-Stein estimates when a *unique c* is used is 1.56, and the standard deviation is 1.24. The variance is 1.54. Therefore the standard deviation and the variance when a *common c* is used are lower than the standard deviation and variance when a *unique c* is used. However, the results between the two do not differ significantly. The standard deviation for when a *common c* is used is only 0.14 smaller than the standard deviation when a *unique c* is used, thus representing an insignificant change. However, the results prove that using a *common c* will produce better estimates than when using a *unique c*. The results obtained here are aligned with the results derived in chapter 5 where Stein's Paradox also proved that using a

common c will provide more accurate estimates of GDP growth than when using a *unique c*. Therefore the Monte Carlo study supports Stein's Paradox as they both produce better estimates when using a *common c*, thus producing results which are closer to the true unknown values, theta. Next, the results obtained with a uniform distribution will be analysed and discussed. The results for all three distributions are illustrated in the appendix.

Table 7: Results Derived from the Three Different Types of Distributions

1	2	3
	Common C	**Unique C**
Normal Distribution	Mean= 1.49 Standard Deviation= 1.10 Variance= 1.21	Mean= 1.56 Standard Deviation= 1.24 Variance= 1.54
Uniform Distribution	Mean= 0.42 Standard Deviation= 0.36 Variance= 0.13	Mean= 0.43 Standard Deviation= 0.39 Variance= 0.15
Slash Distribution	Mean= 73.41 Standard Deviation= 600.43 Variance= 0.36E+06	Mean= 235.34 Standard Deviation= 2102.3 Variance= 0.44E+07

6.4.2 Results using a Uniform Distribution

Now the results obtained when using a uniform distribution will be analysed. When a uniform distribution is used, the only alteration made is using uni (1) for all sixty observations processed into Shazam instead of nor (1). The results are quite different when compared to the normal distribution. With the uniform distribution, the mean of the James-Stein estimates when a *common c* is used is 0.42. The standard deviation is 0.36, and the variance is 0.13. The mean of the James-Stein estimates when a *unique c* is used is 0.43. The standard deviation is 0.39, and the variance is 0.15. The results once again show that the standard deviation is slightly higher when using a *unique c,* and the variance is also slightly higher. However, the standard deviation only differs by 0.03 with a uniform distribution. Thus, it is proved that better James-Stein estimates are achieved when using a *common c* than when using a *unique c*. The results are shown in Table 7 in row 3. The standard deviation using a uniform distribution is also lower than the standard deviation using a normal distribution. Therefore, one can conclude that using a uniform distribution will provide better estimates of GDP growth than when using a normal distribution because a smaller standard deviation is achieved, thus proving that the estimates are closer to the true unknown growth rates theta. In the next section, the results using a slash distribution will be analysed.

6.4.3 Results using a Slash Distribution

Now the slash distribution will be analysed. The slash distribution is represented by nor (1)/ uni (1) for all sixty observations. The results obtained are different from the other two distributions, and is shown in row 4 in Table 7. The mean of the James-Stein estimates when a *common c* is used is 73.41 which are much higher than that of the other two distributions. The standard

deviation is 600.43, and the variance is 0.36E+06. The standard deviation is also much higher than those of the other two distributions. The mean of the James-Stein estimates when a *unique c* is used is 235.34. The corresponding standard deviation is 2102.3, and the variance is 0.44E+07. The results again prove that using a *common c* will provide better James-Stein estimates as a smaller standard deviation of 600.43 is achieved using a *common c* which is lower than the standard deviation of 2102.3 achieved when using a *unique c*. The results, however, derived when using a slash distribution are less accurate than those of the other two distributions as a larger standard deviation is achieved.

6.5 Conclusion

Monte Carlo studies are used to determine how estimators operate under certain conditions, and also to determine which method is more effective and efficient, and will ultimately produce closer estimates of GDP growth to the overall mean. The aim is to determine whether using a *common c* or a *unique c* will provide better James-Stein estimates than the individual observed average growth rates. The results obtained from all 3 distributions proved that when using a *common c*, the results were closer to the overall mean, thus indicating a smaller standard deviation. In all three distributions, using a *unique c* achieved a larger standard deviation and variance, thus indicating that the estimates are further away from the mean and are not as close to the true unknown values represented by theta compared to when a *common c* is used. In conclusion, the results obtained with the three distributions are similar to the results achieved using Stein's Paradox when using growth rates from the first quarter of 2005 to the third quarter of 2008. The results in both cases clearly show that more accurate growth rates are achieved when using a *common c* than when using a *unique c* as a smaller standard deviation is obtained in

all three distributions. Therefore using a *common c* will provide better estimates of GDP growth. Therefore, the Monte Carlo study aims to reinforce Stein's Paradox.

In the next chapter, the policy interventions implemented by South Africa and United States of America will be analysed to determine how these two economies managed to stave of the recession of 2008. The policy interventions will be linked to the GDP growth rates of these countries to determine if these interventions have been efficient, effective and successful.

CHAPTER 7

CONCLUSION AND RECOMMENDATIONS

7.1 Synthesis

In this study, the effects of the financial crisis on the U.S. and South African economies were analysed. GDP growth rates in South Africa and USA declined by -1.7 per cent and -2.5 per cent respectively in 2009. Output expansions increased by 2.9 per cent and 3 per cent in 2010 and by 3.1 per cent and 1.7 per cent in 2011 respectively in the two economies. Growth in both economies is expected to rebound once again in 2013 (IMF, International Financial Statistics, 2012). Unemployment levels increased in both economies during the 2009 recession.

Using the Stein's Paradox, one can calculate more precise estimates of GDP growth rates for the selected countries during different periods of the recession. These Stein estimated growth rates are said to be closer to the true unknown growth rates theta. In relation to Stein's Paradox, the results of the Monte Carlo study using Shazam indicated that using a *common c* provided more accurate estimates of GDP growth than using a *unique c*. The Monte Carlo results are supportive of those of the Stein's Paradox method. Therefore, the Monte Carlo study can be used in conjunction with Stein's Paradox to determine better estimates which are closer to the true unknown estimates of theta as they complement each other.

Policy interventions implemented by the South African and American economies were also analysed in response to the global financial crisis which helped to stave off an extended recession. Policy responses in South Africa included increased borrowing, EPWP, infrastructure investments, maintenance of social spending, lowering of the repo rate, and a move towards a

New Growth Path. In USA, the policy interventions included TARP and the $787bn stimulus package. South Africa's mix of fiscal and monetary policies has contributed to the increase in economic growth from 2.9 per in 2010 to 3.4 per cent in 2011 (South African Reserve Bank, 2012). Similarly, GDP growth in USA has increased by 1.7 per cent in 2011 (International Financial Statistics, 2012).

Government in South Africa must continue to be proactive in aligning its fiscal and monetary policies in order to promote stability, employment creation and growth in the near future. According to the Lucas Critique, econometric models need to accommodate for changes in variables that could affect the model on hand because agents present in the economy look to the future instead of in the past (Jesper, 2001: 986).

7.2 Recommendations

A recent policy intervention is the New Growth Path (NGP) initiative approved by the South African Government in November 2010. The New Growth Path initiative aims to tackle key problems in South Africa like inequality, unemployment and poverty by changing the current path of the South African economy in order to increase employment and boost economic growth. The NGP stipulates that South Africa will have to sacrifice certain things now in order for the economy to grow in the future (South African Government Online, 2009). It focuses on inter alia, infrastructure development, green economy, manufacturing and agriculture. The NGP is largely a state driven Keynesian approach to stimulate the economy by increasing income, output and employment.

The South African government experienced a budget surplus of 0.9 per cent of GDP in 2007 before the crisis hit (National Treasury, 2011). However, in 2011, the budget deficit increased

from 4 per cent of GDP in 2010 to 4.5 per cent of GDP in 2011, and in terms of the medium term expenditure framework, the budget deficit is likely to be higher in 2012/2013 (SARB, 2012). Household debt increased from 56.5 per cent to 78.2 per cent between 1994 and 2010 (SARB, 2011). A budget deficit needs to be financed, thus increasing the public sector borrowing requirement and public debt. Therefore debt servicing cost will accumulate to approximately R77 billion in 2012. This is expected to increase to R104 billion in 2013/14. Therefore the South African government will have to initiate ways of financing the debt. High budget deficits ultimately lead to inflationary pressures which will impact the economy in an adverse manner. Slow economic growth against a background of rising public sector wage bill and limited growth from tax revenue will speed up the accumulation of the deficit (Budget Speech, 2011). Therefore the New Growth Path may be adequate in the short term as a way to increase job creation and economic growth, and decrease public debt and the budget deficit. However, more concrete policy interventions may be needed in the long term in order to sustain economic growth and employment creation as the economic environment will be constantly changing, and also because the South African economy is unable to manage a high budget deficit or an increase in spending, especially during long periods of time (Mahadea and Simson, 2011: 208). Therefore policy interventions will need to be altered at various points in time.

A study was conducted by the Financial and Fiscal Commission in order to assess the impact or effectiveness which this initiative has on households, firms and public debt. The Financial and Fiscal Commission is a constitutional advisory institution in South Africa which has the sole responsibility of providing advice and recommendations to various organs of State related to financial and fiscal issues. The study shows that increased spending associated with the NGP will materialise into an increase in taxes. However, this may have an adverse impact on GDP,

consumption, investment, unemployment and inflation. An investment such as the NGP will enhance GDP, and will decrease the debt and budget deficit (Financial and Fiscal Commission, 2011). The study also found that if government had to pursue an expansionary fiscal policy whereby its spending would be more than income generated, then GDP will increase in the short term, but the debt-GDP ratio will however be higher. Under all the different categories of the financing of the NGP, it was determined that GDP expanded, and the debt-to-GDP and deficit-to-GDP ratios declined. This was mainly due to spending on infrastructure development which has a direct impact on production, thus expanding GDP (Financial and Fiscal Commission, 2011). Government plans on spending R800 billion over three years from 2012/13 to 2014/15 on infrastructure development (Budget Speech, 2011). Therefore infrastructure investment should be a priority in South Africa, and should be constantly reviewed and improved as part of the NGP in order to increase job creation, promote economic growth and reduce poverty in the future by investing in the present. Dedication to the other initiatives like the green economy, manufacturing and agriculture should follow.

7.3 Suggestions for Future Research

One recommendation identified is that the process of estimation using Stein's Paradox can be conducted on a yearly basis to predict future GDP growth rates more accurately on a continuous basis. This will enable one to obtain more accurate growth trajectories of the global economy, and calculate other macroeconomic variables which are linked to GDP growth rates. This could be an area for future research. Stein's Paradox can therefore be applied to any context and not purely to GDP growth.

7.4 Conclusion

The recession of 2008 has had an adverse impact on the South African and American economies, as well as on a global scale. However, prompt policy interventions implemented in South Africa and United States of America helped prevent an extended recession, thus contributing to positive economic growth in these two countries. In conjunction with the effects and solutions to the crisis, Stein's Paradox is used to determine if one can calculate better estimates of past, current and future GDP growth rates post the crisis of the selected thirty countries as a way to determine a more accurate growth trajectory. Stein's Paradox proves that more accurate growth rates can be achieved across various time periods. More accurate forecasted GDP growth rates were also achieved, which can be used to calculate other macroeconomic indicators. The Stein's Paradox method also shows that more accurate growth rates can be achieved using a *common c* than using a *unique c*. This method of calculating more accurate future GDP growth rates can therefore be used for future analysis and for extended research. The Monte Carlo study applied reinforces the Stein's Paradox, confirming that more accurate growth rates are achieved when using a *common c*.

The global economy is gradually exiting from an extended recession. However, conditions in the short term may not return to what they were prior to the crisis. Based on the high budget deficits and unemployment levels in South Africa, policy interventions including the NGP need to be constantly reviewed and altered over time to keep up with the ever changing macroeconomic environment.

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APPENDIX

Macroeconomic Data

Table 2: Real quarterly GDP growth rates across the 30 selected countries from the first quarter of 2005 till the third quarter of 2008

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Countries	Q1-2005	Q2-2005	Q3-2005	Q4-2005	Q1-2006	Q2-2006	Q3-2006	Q4-2006	Q1-2007	Q2-2007	Q3-2007	Q4-2007	Q1-2008	Q2-2008	Q3-2008
Australia	2.7	3	3.6	3.5	2.7	2.5	2.1	3.1	4.5	5.4	5	4	3.3	2.7	2.5
Canada	3.3	2.9	2.8	3.1	3.8	3.3	2.4	1.9	1.8	2.6	3	2.8	1.7	0.7	0.3
France	2.2	1.7	2	1.8	2.1	2.9	2.3	2.4	2.5	1.9	2.5	2.1	1.9	1	0.1
Netherlands	1.2	2	2.4	2.6	3.4	3.7	3.1	3.4	3.8	2.9	3.6	4.2	4	3.3	1.6
Italy	0.5	0.7	0.8	1.2	1.8	1.9	2	2.7	2.3	1.8	1.4	0	0.2	-0.6	-1.6
Japan	0.6	2.1	2.2	2.9	2.1	2.1	1.8	2	3.3	2.4	1.9	1.7	1.1	-0.2	-1.3
Korea	2.7	3.4	4.6	5.2	6	5.1	5	4.6	4.5	5.3	4.9	5.7	5.3	4.2	3.1
Mexico	3.5	2.3	3.4	3.5	4.4	6.7	4.8	3.8	3	3.1	3.4	3.8	4.2	1.6	1.5
New Zealand	2.4	3.5	3.6	3.2	2.4	0.7	0.3	0.7	1.7	2.5	3.1	3.8	2.1	0.7	-0.7
Spain	3.6	3.7	3.4	3.8	3.9	4	4.1	4	4	3.8	3.5	3.1	2.5	1.7	0.5
Sweden	3.1	2.9	3.5	3.8	4.6	4.9	4.6	4.1	3.1	2.9	2.3	2.4	2.2	1.1	0
Switzerland	1.4	1.9	3.1	4.1	4.2	3.9	3.4	3.1	3.3	3.5	3.7	3.9	3.5	2.8	1.3
United Kingdom	1.8	2	2.5	2.4	3.2	2.8	2.7	2.8	2.4	2.7	2.7	2.4	2.4	1.7	0.2
United States	3.4	3.1	3.1	2.7	3	3	2.2	2.4	1.4	1.9	2.7	2.5	2	1.6	0
South Africa	4.3	5.6	5	4	5.9	6.2	4.6	6.3	5.5	3.7	4.5	5.4	1.7	5	0.2
Brazil	3.3	2.8	3	3.5	4.4	2.2	4.7	4.6	5.3	5.8	5.4	6.1	6.1	6.2	6.8
Oman	4.5	4.8	5	5.3	5.5	5.8	6.2	6.6	7	7.5	8	8.3	9.2	8.8	8
Russia	5.9	6	6.4	7.1	7.1	7.5	7.8	8.1	8	8.1	7.4	8.7	9	7.7	5.7
Zambia	4.9	5.1	5.3	5.6	6.4	6.3	6.2	6.1	5.6	5.7	5.9	6	7	6.6	6.1
Israel	4.9	5.7	5.3	5.2	5.7	6.1	4.5	4.8	4.7	4.3	6	5.7	5.6	5.1	4.1
Nigeria	6.4	6.3	6.2	6	5.4	5.2	5.2	5.4	5.8	6.1	6.3	6.5	6.7	6.6	6.3
Kenya	5.6	5.8	6	6.2	6	6.2	6.5	6.8	7.9	7.7	6.9	5.7	3.1	1.9	1.1
Uganda	5.5	5.8	6.5	7.5	10.1	10.9	11.2	10.9	9	8.5	8.4	8.4	9.8	9.6	9
Ghana	5.7	5.8	6	6.1	6.3	6.4	6.4	6.5	6.2	6.3	6.3	6.4	7	6.7	6
Honduras	6	6	6	6.1	6.5	6.6	6.7	6.8	6.9	6.6	6.2	5.6	4.8	4.2	3.7
Senegal	6.4	6.1	5.5	4.6	2.6	2.1	2	2.5	4.4	4.9	5	4.7	3.4	2.7	2.2
Cameroon	2.5	2.2	2.2	2.3	2.9	3.2	3.3	3.4	3.1	3.2	3.4	3.6	4.5	4.4	3.8
Gabon	2.9	3.2	3.1	2.7	0.8	0.7	1.1	2.1	4.9	5.8	6	5.6	4	2.7	1.4
Slovenia	3.8	5	4.4	5.4	5.3	5.5	6.3	7	7.4	7.1	7.4	5.8	5.9	4.9	3.2
Saudi Arabia	5.9	5.8	5.5	5	3.8	3.2	2.9	2.7	2.8	3.1	3.4	3.9	5	4.9	4.4

Source: IHS Global Insight. 2012: OECD Main Economic Indicators

Shazam Version: Command Input (Normal Distribution)

Create enough memory

par 10000

size 5000

* Set counters for sd=standard dev calculation to zero

gen1 sum=0

gen1 sumz=0

gen1 sumzu=0

gen1 sumzs=0

gen1 sumzus=0

* Set variables to hold all the information

* y is the data of sixty observations

* sdjs is the std dev of james stein

* sdjsu is the std dev of james stein with unique c

dim y 60 sdjs 500 sdjsu 500

* Begin loop of 500

do #=1,500

gen1 sum=0

gen1 sumz=0

gen1 sumzu=0

gen1 sumzs=0

gen1 sumzus=0

* Get the first 60 y's

sample 1 60

gen1 y:1=nor(1)

gen1 y:2=nor(1)

gen1 y:3=nor(1)

gen1 y:4=nor(1)

gen1 y:5=nor(1)

gen1 y:6=nor(1)

gen1 y:7=nor(1)

gen1 y:8=nor(1)

gen1 y:9=nor(1)

gen1 y:10=nor(1)

gen1 y:11=nor(1)

gen1 y:12=nor(1)

gen1 y:13=nor(1)

gen1 y:14=nor(1)

gen1 y:15=nor(1)

gen1 y:16=nor(1)

gen1 y:17=nor(1)

gen1 y:18=nor(1)

gen1 y:19=nor(1)

gen1 y:20=nor(1)

gen1 y:21=nor(1)

gen1 y:22=nor(1)

gen1 y:23=nor(1)

gen1 y:24=nor(1)

gen1 y:25=nor(1)

gen1 y:26=nor(1)

gen1 y:27=nor(1)

gen1 y:28=nor(1)

gen1 y:29=nor(1)

gen1 y:30=nor(1)

gen1 y:31=nor(1)

gen1 y:32=nor(1)

gen1 y:33=nor(1)

gen1 y:34=nor(1)

gen1 y:35=nor(1)

gen1 y:36=nor(1)

gen1 y:37=nor(1)

gen1 y:38=nor(1)

gen1 y:39=nor(1)

gen1 y:40=nor(1)

gen1 y:41=nor(1)

gen1 y:42=nor(1)

gen1 y:43=nor(1)

gen1 y:44=nor(1)

gen1 y:45=nor(1)

gen1 y:46=nor(1)

gen1 y:47=nor(1)

gen1 y:48=nor(1)

gen1 y:49=nor(1)

gen1 y:50=nor(1)

gen1 y:51=nor(1)

gen1 y:52=nor(1)

gen1 y:53=nor(1)

gen1 y:54=nor(1)

gen1 y:55=nor(1)

gen1 y:56=nor(1)

gen1 y:57=nor(1)

gen1 y:58=nor(1)

gen1 y:59=nor(1)

gen1 y:60=nor(1)

* Calculate the grand average or "gr"

* Keep the variance too

stat y / mean=gr var=vgr

* Split the sample into four "countries"

sample 1 15

* Calculate each mean and the sum needed for the formulae

* The sum is the square of the individual (1-4) averages from gr

stat y / mean=g1 var=vgr1

gen1 sum=sum+(g1-gr)**2

sample 16 30

stat y / mean=g2 var=vgr2

gen1 sum=sum+(g2-gr)**2

sample 31 45

stat y / mean=g3 var=vgr3

gen1 sum=sum+(g3-gr)**2

sample 46 60

stat y / mean=g4 var=vgr4

gen1 sum=sum+(g4-gr)**2

* Now the c and unique c's

gen1 c=(1-(vgr/sum))

gen1 c1=(1-(vgr1/sum))

gen1 c2=(1-(vgr2/sum))

gen1 c3=(1-(vgr3/sum))

gen1 c4=(1-(vgr4/sum))

* Up until Sammple 1 1 we collect all the info for the

* the std dev of js and unique c js (alt formula sd)

gen1 z1=gr+c*(g1-gr)

print z1

gen1 sumz=sumz+z1

gen1 sumzs=sumzs+(z1*z1)

gen1 z2=gr+c*(g2-gr)

gen1 sumz=sumz+z2

gen1 sumzs=sumzs+(z2*z2)

gen1 z3=gr+c*(g3-gr)

gen1 sumz=sumz+z3

gen1 sumzs=sumzs+(z3*z3)

gen1 z4=gr+c*(g4-gr)

gen1 sumz=sumz+z4

gen1 sumzs=sumzs+(z4*z4)

gen1 z1u=gr+c1*(g1-gr)

gen1 sumzu=sumzu+z1u

gen1 sumzus=sumzus+(z1u*z1u)

gen1 z2u=gr+c2*(g2-gr)

gen1 sumzu=sumzu+z2u

gen1 sumzus=sumzus+(z2u*z2u)

gen1 z3u=gr+c3*(g3-gr)

gen1 sumzu=sumzu+z3u

gen1 sumzus=sumzus+(z3u*z3u)

gen1 z4u=gr+c4*(g4-gr)

gen1 sumzu=sumzu+z4u

gen1 sumzus=sumzus+(z4u*z4u)

gen1 av=sumz/4

gen1 avu=sumzu/4

sample 1 1

* Store each std dev (500)

genr sdjs:#=sqrt(((sumzs-4*(av**2))/3))

genr sdjsu:#=sqrt(((sumzus-4*(avu**2))/3))

endo

sample 1 500

* Calculate the average of all 500 sd's

stat sdjs / mean=m

stat sdjsu / mean=mu

sample 1 1

print m mu

stop

Results using a Normal Distribution

|_sample 1 500

|_* Calculate the average of all 500 sd's

|_stat sdjs / mean=m

NAME	N	MEAN	ST. DEV	VARIANCE	MINIMUM	MAXIMUM
SDJS	500	1.4859	1.1006	1.2113	0.72996E-01	11.122

|_stat sdjsu / mean=mu

NAME	N	MEAN	ST. DEV	VARIANCE	MINIMUM	MAXIMUM
SDJSU	500	1.5644	1.2400	1.5376	0.71403E-01	9.9793

|_sample 1 1

|_print m mu

M	MU
1.485900	1.564405

|_stop

Results using a Uniform Distribution

|_sample 1 500

 |_* Calculate the average of all 500 sd's

 |_stat sdjs / mean=m

NAME	N	MEAN	ST. DEV	VARIANCE	MINIMUM	MAXIMUM
SDJS	500	0.42078	0.36245	0.13137	0.14203E-01	5.4090

 |_stat sdjsu / mean=mu

```
 NAME           N     MEAN        ST. DEV      VARIANCE        MINIMUM

MAXIMUM

 SDJSU         500   0.42639      0.38974      0.15189      0.29883E-01

5.4451

 |_sample 1 1

 |_print m mu

        M                MU

   0.4207839       0.4263900

 |_stop

 TYPE COMMAND
```

Results using a Slash Distribution

```
|_sample 1 500

 |_* Calculate the average of all 500 sd's

 |_stat sdjs / mean=m

 NAME          N     MEAN        ST. DEV      VARIANCE       MINIMUM

MAXIMUM

 SDJS         500   73.409       600.43      0.36052E+06    1.1585

12989.

 |_stat sdjsu / mean=mu

 NAME          N     MEAN        ST. DEV      VARIANCE       MINIMUM

MAXIMUM

 SDJSU        500   235.34       2102.3      0.44198E+07    1.2552

45464.

 |_sample 1 1

 |_print m mu
```

```
        M               MU

    73.40930       235.3405

|_stop
```