THE EFFECT OF STRIKE ACTION ON THE VALUE AND VOLATILITY OF THE SOUTH AFRICAN RAND

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DECLARATION

Except for those references acknowledged in the text, this thesis wholly represents my own work and no part has been submitted for a degree at any other university.

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ABSTRACT

This study analyses whether the advent of strike action has an effect on the value and volatility of the South African Rand compared with the US Dollar. The literature suggests that strike action can have a significant effect on the exchange rate in terms of either value or volatility, and consequences can result that cause inefficiencies in the economy; inhibiting employment and economic growth. Strike action has become common place in South Africa, with 2012 alone recording 99 strikes, 45 of which were "wildcat" or unprotected strikes. This study uses GARCH and Intervention Analyses to determine what the resulting effects of the strikes might be on the exchange rate. The analysis used ZAR/USD exchange rate data for the period January 2000 to October 2013, and covered 72 of the most significant strikes in terms of lost man-days. The results are mixed, suggesting that the effects of strikes do not always conform to expectations (increased volatility and a depreciation in the Rand), and that outside factors affecting the global economy may have a more significant effect on the exchange rate than strikes on their own.

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CHAPTER 1: INTRODUCTION

1.1 Context of the Research

According to Chapter 2, Section 23, of the South African Constitution, every worker has the right to form or join a trade union, to participate in trade union activities, and to strike. This provision is to ensure that the right to fair labour practice is protected and that workers' rights and dignity remain in place. Bhana (1997:43) notes that South Africa has followed the trend of many developing countries since the late 1980's, with a sharp rise in the number of industrial strikes. As the occurrence of strikes is increasing, Dolamo (2012) argues that investors and industry analysts are now paying more attention to the implications of these events. Strike action is usually undertaken by workers in order to force employers to increase their wages or force action on some other dispute such as poor working conditions and other grievances. The effect of such strikes on the relevant company and industry is a significant loss of working hours resulting in decreased productivity, increased unemployment, as well as driving inflationary pressures in the economy of a country. This is especially true if wage rates rise at a rate above that of inflation (Balston *et al*., 2012:36-39).

Some of the strikes that have taken place over the past few years and have dominated news headlines are the Marikana incident (10 August 2012 – 18 September 2012) (*News24*, 2012), the farm workers' strike in the Western Cape (27 August 2012 – 22 January 2012) (Etheridge, 2013), and the truck drivers' strike or transport strike (24 September – 12 October 2012) (*City Press*, 2012). Strike contagion often causes prolonged unrest in the country, and negatively affects investor sentiment with regard to South African stocks and products. According to *News24* (2013b) and Brand (2013), the Rand traded weaker following the above-mentioned strikes, and investor sentiment weakened due to concerns surrounding the future of the strike-affected industry and the violent nature of the strikes.

Dolamo (2012:15) estimated that by early November 2012 the short-term cost of the Marikana incident was already significant, with around 780 000 ounces of platinum production lost, amounting to R15 billion in lost revenue to the sector and R1 billion in lost income to the state. According to *News24* (2013a), "the rand softened against the dollar […] amid fears of more trouble in the mining sector after Anglo Platinum said workers at its Rustenburg operations were likely to stay away following violence [the previous day]", which indicated that there were still on-going issues in the industry, stemming from previous labour unrest.

Melvin and Tan (1996:340) argue that country risk variables such as strikes, riots and related deaths and violence lead to an increase in the spread (level) of the exchange rate directly, as well as indirectly through the conditional variance (volatility) in the exchange rate. Investor sentiment is thus an

important aspect when considering the impact of strikes on the South African exchange rate, as investors will quickly relocate their assets if they foresee volatile, degenerating conditions. With the advent of strikes and general labour unrest in various sectors, Scherer (2013) suggests that foreign investors may be dissuaded from investing in South Africa due to the perceived danger relating to the risk inherent in developing countries as well as the local market conditions. This is evidenced in an article by *Fin24* (2013b) in mid-May 2013, which stated the Rand has become weaker due to renewed concerns over South Africa's labour dynamics and the large current account deficit.

Strike action may produce some immediate economic effects that influence the exchange rate. For instance, Bollerslev and Melvin (1994) and Melvin and Tan (1996) show that the volatility of a currency can be heavily influenced by social-political unrest, and that it will reduce production, resulting in higher per unit costs as well as fewer units available for export. Koehler and Hespenheide (2013:106) argue that the resulting "loss in productivity/increase in cost" will in turn cause a fall in the revenue of the firms involved, which will reduce the value of the firms' shares. These factors will then make labour comparatively more expensive, thereby reducing the demand for labour. This would have the effect of reducing the buying power of the Rand domestically, ultimately resulting in higher prices and increased unemployment, as companies lay off workers to cut costs.

When considering the effects which strikes have on the economy, it is evident through the previous two paragraphs that strikes seem to have both long-run and short-run effects. For example, Scherer (2013) suggests that investor sentiment can have an immediate effect on the exchange rate due to a perceived increase in risk, while Koehler and Hespenheide (2013) note that the loss in productivity will cause a fall in revenue over time as there is less of the product to sell. If the company is in the export industry this will mean that a decreased amount of foreign exchange will be earned, there will be a lesser demand for the Rand to purchase these products, and as a result depreciation will occur. It was decided to pursue the immediate and contemporaneous impacts in this study as it was thought that measuring the impacts over a short time frame would provide more accurate results than a long term period as there were fewer variables to consider.

The scenario of wages rising above the inflation rate is evidenced in Roelf (2012), who reported that truck drivers "have agreed to accept wage increases of 10% from March 2013, 8% in 2014 and 9% for 2015." These wage increases are significantly above the inflation band target of the Reserve Bank (3-6%), implying an increase in real wages. In addition, in 2013 Brand (2013) noted that the unemployment rate may rise due to mining companies' plans to dismiss workers, after strike action in 2012 reduced production and increased labour cost. Brand (2013) also argues that recent major

strikes in the mining, transport and farming industries have had a negative effect on exports and growth in South Africa, which has further implications in terms of investor sentiment.

While much of the discussion so far has related to matters regarding the increased volatility of the exchange rate in times of violent protest, little has been said on the level of the Rand when compared to other currencies. Many news articles (*News24*, 2013a; Brand, 2013; Downing, 2012) suggest that the Rand is open to significant devaluations following the news of strike action in the country's more significant or vulnerable sectors. A depreciating currency has a number of implications including, but not limited to, the increased cost of imports (including petroleum products), capital flight (investors fear losing their gains to exchange rate fluctuations), as well as making foreign debt more expensive to repay for local government and firms. In addition, Aron *et al.* (1997:25) argue that inflation is also worsened by low economic growth as higher wages outstrip growth, which may force the Reserve Bank to hike interest rates. Another consequence of a depreciating currency is the possibility of increased unemployment as employers lay off workers in an attempt to retain profitability or reduce input costs (Brand, 2013).

1.2 Goals of the Research

The primary goal of this research is to examine the effect of strike action in South Africa on the level and volatility of the Rand/Dollar exchange rate.

1.3 Methods, Procedures and Techniques

This study will employ a positivist paradigm that involves using quantitative methodology and modelling to obtain the results. Daily exchange rate data for the Rand/US Dollar exchange rate will be used for the period January 2000 to April 2013 (Standard Bank, 2013). Strikes to be considered were selected based on the number of man-days lost in production (South African Survey, 2013).

Specific econometric methods will be employed to determine the effect of strikes on the level and volatility of the Rand. These include intervention analysis and Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models. While intervention analysis makes use of appropriate exogenous dummy variables applicable for analysing the effects of strike action on the level of the exchange rate, a GARCH model can be used to examine the effect on volatility. Intervention analysis allows for estimating both the initial and long-run impact of strikes on the exchange rate (Enders, 2010). GARCH models, in turn, would make it possible to analyse the effect of strike actions on the conditional volatility of the exchange rate.

1.4 Organisation of the Study

The study is organised as follows: Chapter 2 provides a theoretical background relating to the effects of strike action, and provides a review of the relevant literature. Chapter 3 discusses the data and econometric methods used. Chapter 4 presents the empirical results. Chapter 5 concludes and provides areas for future research.

CHAPTER 2: A REVIEW OF STRIKE LITERATURE AND THE ECONOMIC CONSEQUENCES OF STRIKE ACTION

2.1 Introduction

This chapter discusses the theoretical literature relating to strike action as well as the expected economic effects resulting from such an occurrence. Section 2.2 explores the various characteristics and risks associated with strikes, and tracks the historical evolution of strike action. This includes views on the use of strikes as a bargaining tool for wage negotiations and what effect they are expected to have on the exchange rate, as well as the related benefit and cost to both worker and employer. Section 2.3 investigates the theoretical effects of strike action such as increased bid-ask spreads for foreign exchange, the depreciation of the currency in question, and inflation. Section 2.4 explores the impact on trade created by strike action and the associated economic effects of depreciation, inflation and a volatile exchange rate. Labour unrest is then linked to volatility in Section 2.5. Section 2.6 explores literature surrounding previous studies of the effect of strikes on the exchange rate and stock market, and also links the performance of stocks and the exchange rate. A summary of the chapter is provided in Section 2.7.

2.2 The characteristics and risks of strike action

Bhana (1997) considered various studies surrounding strikes and their costs. The study includes notes on whether there is a discernible effect on industry output, the costs of strikes at a micro level (including lost productivity within the business and customers diversifying their products or changing their suppliers), lost profits, and long-term costs such as maintaining an inventory in case of work disruptions. It is thus evident that actually measuring the exact costs of strikes can be difficult, given all the variables involved and the unique environment characteristic of the industry in which the business is located. This is due to outside factors having a significant effect on exchange rate data; such as quantitative easing and economic events such as the release of large economies' employment data. It is thus important to note that studies may employ different techniques and assumptions in reaching their conclusions, as well as viewing data and models in a different situational context (Bhana, 1997; Melvin and Tan, 1996; McConnell, 1989).

Bhana (1997:43) and McConnell (1989:801) note that strikes are traditionally viewed by economists as a breakdown in collective bargaining, and that strikes can be seen from the point of view of the worker, as a sacrifice of current income in the hope of larger returns in the future. With economists and negotiators viewing strikes as a failure in the bargaining process, Bhana (1997:44) however argues that strikes are actually an "inevitable part of the functioning of an institutionalized market

economy." This theory is backed up by Becker and Olsen (1986:437) who also suggest that the market would respond positively to a peaceful settlement. This is an interesting observation, which seems applicable given the increasing global trend of strike action or threatened strike action to achieve a worker's objectives.

Bhana (1997:43) found that higher post-strike wages were of higher present value than the income lost due to strike activity, and these combined with the costs mentioned earlier in this section, make strikes rather costly to firms. It was also argued by Bhana (1997:43) that, due to these costs and the resulting decrease in expected cash flows, the firm's business strategies would need to evolve. This would result in decreased efficiency in the decision making process, and cause a further reduction in the firm's value. Bhana (1997:49) finds that the costs of strikes are usually underestimated, as nearly 70% of the decline in stock market share prices occured after a strike was announced. Becker and Olsen (1986:425) offer very similar evidence to Bhana, as they state that the stock market consistently underestimates the cost to shareholders of a strike, as "nearly two-thirds" of the fall in returns occurs after the strike was announced, which is in contrast to the view offered by the efficient market hypothesis.

The conclusions drawn by Bhana (1997) show that the advent of a strike brings about statistically significant, negative abnormal returns, implying increased volatility and a fall in value of the shares in question. This occurred even though there was some evidence of market efficiency with decreases beginning in the days preceding a strike announcement. However, Bhana (1997) argued that if strikes were completely predictable, the announcement of a strike would not have such negative effects. Due to wage bargaining and labour contract expiration dates being known in advance, investors can sometimes predict the onset of a strike as well as how long it will continue for, with longer strikes expected to be more costly (Balston *et al*., 2012:38).

McConnell (1989:801) examines the relationship between wages and strikes in order to shed light on the empirical relevance of some strike models, arguing that there are two theories that explain why strikes occur. The first theory coincides with the view held by Bhana (1997:43) and states that strikes are accidents or mistakes that occur during negotiations, and that the only prediction of this theory is that strikes should happen less often and be shorter when the cost of the strike is higher. The second theory proposed by McConnell (1989:802) suggests that the strike is used to detect asymmetrical information in the wage-bargaining environment to gain information from the firm's management on the size of the economic rent that accrues from the firm's activity. The interpretation of this second theory is essentially that workers believe that the profits reaped by the firm may be large enough to

justify higher wages for themselves. This model predicts that strikes should occur more regularly and be more persistent when the unions believe that there is more rent to be had than there actually is. The most significant finding of McConnell's (1989) study is that both the occurrence and length of a strike are negatively related to the component of the real wage that is uncertain. This supports the theory that strikes are used as tools to reveal information rather than as a result of errors during the negotiation process.

Cramton and Tracy (1992) assess the theory and implications behind strikes and holdouts, and to do this they analyse what is behind the union's decision to embark on a strike action or hold-out, and the significance of this decision with regards to strike action. Cramton and Tracy (1992:1) trace the development of strike literature from John Hicks in 1932 with his theory that strikes were a result of faulty negotiation to Arthur Ross' view in 1948 that argued that a union leader may be motivated by personal advancement and the elevation of the union; therefore a more political than economic cause. Cramton and Tracy (1992:1) also note that Ashenfelter and Johnson (1969) advanced Ross' theory by arguing that strikes occur when certain wage expectations are higher than what the firm is willing to offer. In order to avoid internal conflict between members and union leadership by not negotiating the employers to a higher wage settlement, union leaders may prefer to resort to strike actions in order to demonstrate to the workers that a higher wage is not possible (Ashenfelter and Johnson 1969:39). Cramton and Tracy (1992:2) argue that there is an increase in the chance of workers striking if there is a decrease in their real wages due to uncompensated inflation increases, unemployment rates decrease and therefore the reservation wage increases, as well as when there is a significant increase in the firm's profitability due to an increased demand for its products.

2.3 Theoretical economic consequences of strike action

2.3.1 Inflation

One of the effects of strike action is inflation caused by rising wages and price levels. This is why it was noted by Tswamuno *et al*. (2007:81) that South African monetary authorities have taken a number of steps to improve macroeconomic reform as well as to increase the participation of local investors. Furthermore, it was also noted by Tswamuno *et al*. (2007:81) that possibly the most important of these steps was the South African Reserve Bank's decision to adopt an inflation targeting framework in February 2000, with a target range of between 3% and 6%. It was also mentioned that a commission was appointed to investigate the fall and instability of the Rand in 2001, and that the recommended reforms led to a massive comeback in terms of the value of the Rand, as well as reduced volatility in the market for foreign exchange (with regards to the trading of the Rand). The reforms

suggested by the commission, as well as the security and assurance provided by the implementation of an inflation targeting framework by the South African Reserve Bank, seemed to increase investor confidence and inspire a more stable and valuable Rand (Tswamuno *et al*., 2007).

Some causes of inflation are "an increase in the international price of oil, a fall in the exchange rate, nationwide excessive salary and wage hikes, or an increase in food prices caused by drought or other forces of nature" (SARB, 2012b:2). Two of these causes, namely a depreciation in the exchange rate and nationwide excessive salary hikes, can theoretically link inflation with strike action. This is evident in Downing (2012), for example, where it was observed that the Rand weakened due to concern by traders as strikes for large pay hikes continued in early November 2012.

The South African Reserve Bank (SARB, 2012a:2) describes some of the key negative aspects related to inflation. The first is related to the loss of value to savers, as inflation erodes the purchasing power of the money that is saved. Investopedia (2015) describes purchasing power parity as "An economic theory that estimates the amount of adjustment needed on the exchange rate between countries in order for the exchange to be equivalent to each currency's purchasing power," which essentially translates to the amount an exchange rates must adjust so that a specific product in two different countries is the equivalent price when stated in the same currency. For example, a motor vehicle which sells for USD10,000 in America would cost R100,000 in South Africa if the exchange rate was ten rand to the US Dollar. Thus when inflation occurs, this raises the relative cost of the good and causes a depreciation in that country's currency. Secondly, inflation affects retirees as it has an eroding effect on the value of pension plans, making the elderly more vulnerable to increasing costs. De Wet and Diale (2013) note that many workers in South Africa are facing considerable erosion to their lifestyles and quality of life due to significant increases in energy and food costs, with workers seeking relief through wage negotiations to maintain or increase their real wage levels. Another adverse effect of inflation is the reduction in real income to those who receive fixed incomes, as purchasing power decreases over time (SARB, 2012a:12). Inflation can also accrue as a loss to taxpayers, as an inflation-linked salary may advance one into a higher tax bracket, causing one to pay a greater percentage of one's income towards tax than before. Another adverse effect of inflation noted by SARB (2012a:2) is the confusing price signals sent to producers that complicate the business environment. This means that traders would not know how to efficiently allocate their resources and miss-allocations would occur until some sort of equilibrium was reached. This particular factor was also highlighted by Fedderke and Schaling (2005:79) who state that due to inflation uncertainty, mark-ups on goods in South Africa are three times higher than in the USA.

Inflation also causes less attention to be paid to productivity in a sector (SARB, 2012a:3). In order to achieve a higher standard of living in a country, improving productivity levels is important as it is sustainable and generates greater income. In the absence of inflation, wage negotiations are focused on employees' productivity levels and whether they have improved or not. High incidences of inflation, however, cause wage negotiations to lose focus of these aspects, and thus productivity becomes less important and output levels suffer. Balston *et al*. (2012:38) argue that the growth of real wages far above that of productivity growth in recent years has resulted in South Africa having one of the weakest employment performances in the emerging markets, with competitiveness expected to remain weak.

It is argued in SARB (2012a:3) that a society infected by a high incidence of inflation will focus more energy on redistributive issues, in which each consumer attempts to gain a better price, wage or position. This has a seriously negative effect, as it consequentially destroys the fabric society is built upon by undermining the position of others relative to their own. Some may argue that inflation is good as it helps stimulate economic growth, however, Mishkin (2007:617) shows that an increased money supply causes a rise in price levels and effectively there is no real increase in GDP. This is evident in Figure 2, where price levels and the supply and demand for labour can be observed graphically.

According to SARB (2012b:4), the South African Reserve Bank is strongly opposed to inflation pressures and implements policies in an attempt to combat it. Policy action is determined to be imperative for sustained economic growth, prosperity and an equitable distribution of wealth. It has thus been deemed necessary that a low level of inflation and a stable financial environment are required for a sustainable future. However, de Wet and Diale (2013) argue that excessive salary hikes could push inflation out of the SARB's target band, and also noted that the Economist Intelligence Unit gave South Africa the low score of 57/100 for labour risk rating in 2009, implying a considerable perceived risk in the South African labour market.

Mishkin (2007:620) notes that there are two types of inflation that occur when countries follow policies that seek to increase employment levels. These are namely cost-push inflation and demand-pull inflation. The former kind occurs due to negative supply shocks or an attempt by workers to increase their wages, while the latter results from policies that shift the aggregate demand curve to the right. In terms of South African strikes, most are either for higher wages and better working conditions or sympathy strikes for those seeking the higher wages or suffering under poor working conditions. This is evidenced in the South Africa Survey (2000-2012) (Table 1) with the majority of

strikes being wage and grievance related. As such, the theory surrounding cost-push inflation will be examined and how it is affected by workers seeking higher wage rates.

The theory is depicted in Figure 2, adapted from Mishkin (2007:620). We assume the economy is initially at the intersection point of the aggregate demand curve (AD1) and the aggregate supply curve (AS1) at point 1. Assuming workers decide to strike because they believe they deserve higher wages either to increase their real wage or combat inflation, the effect of such an increase in wages is to shift the aggregate supply curve to the left (AS1 to AS2). If government does not take action and amend the fiscal and monetary policies, the economy would shift to 1', which would mean that output would decline below its natural level to Y' and prices would increase to P1'. An important aspect to consider then is how policy makers would respond to this decline in relative productivity and increased price levels. Policy makers targeting unemployment would theoretically seek to raise aggregate demand (shifting AD1 rightward toward AD2) and return to the natural rate of output, and a further price increase to P2. The short term result would be that the workers had not done too badly and received higher wages. The government or company has in effect given in to the workers' demands at their own expense. A policy, whereby its aim is to seek high employment levels, is sometimes referred to as an accommodating policy. South Africa is likely following such a policy due to president Zuma's continued promise to create jobs, as well as the pressure put on companies by government when they threatened to dismiss workers (Fin24, 2013*b*).

Mishkin (2007:261) argued that if a country pursues such accommodation policies, it is easy for workers to take advantage and effectively "jump on the band wagon" in terms of striking and demanding higher wages. This is because workers have realised they have power and either want to raise their wages even more, or because they want to keep up with their fellow workers' rising wages i.e. "keeping up with the Jones's". The result is a continued movement up the long-run AS (i.e. LRAS) curve with policies maintaining the natural rate of output through expansionist policies and workers shifting the supply curve upwards with increased wage demands in a never ending cycle. Some evidence of workers "jumping on the band wagon" is noted in Stoddard and Flack (2012) where wildcat strikes had spread from the gold and platinum mines to the iron mines, with fears of strike action spreading to the coal sector, which would compromise Eskom and the country's power supply.

However, Mishkin (2007:261) argues that "cost-push inflation is a monetary phenomenon because it cannot occur without the monetary authorities pursuing an accommodating policy of a higher rate of growth." The SARB (2012a:2) notes that it is the Reserve Bank's mission to protect the value of the Rand and thus to prevent high inflation. It could thus be argued that because the Reserve Bank is the

monetary authority in the country, the South African economy should not be subject to cost-push inflation. However, due to the uncompromising nature of the strikes in South Africa and the inability to effectively negotiate with workers, government and companies are facing ever increasing labour costs, with some mining companies now shifting towards automation (Maboja, 2013). The phenomenon described in the cost-push inflation analysis using supply and demand curves is becoming a reality, with striking workers usually winning a substantial (greater that projected inflation) increase in wages (Balston *et al.,* 2012:38).

Balston *et al*. (2012:38) note that the problems in South Africa's labour market are complex and are mainly a result of apartheid era legacies such as high transport costs, lack of formal housing, skills shortages, and excessive labour policies that protect workers from being fired. These structural concerns are exacerbated by low levels of education and high youth unemployment. The result has been an excessive growth in real wages, far above that of productivity growth. This resulted in South Africa having one of the weakest employment performances in the emerging markets category (Balston *et al*., 2012:38). When wages rise faster than productivity, goods become relatively more expensive (inflation), which in turn causes a greater disparity in purchasing power parity terms, resulting in that country's currency depreciating.

2.3.2 Investor Perceptions

Investor perceptions are essentially the views that investment professionals hold concerning the value of an asset. Essentially it comes down to a risk versus reward scenario with factors such as currency risk, company performance, and the state of the local economy, being important factors worth considering. Mishkin (2007:95) argues that "the degree of risk or uncertainty of an asset's returns also affects the demand for the asset", and because most investors are risk-averse, if one holds all other variables constant, the quantity of the asset (in this case foreign exchange) demanded will decrease if there is no corresponding increase in return to an increase in the risk of the asset.

Aron *et al*. (1997:1) note that exchange rate management is one of the most important concerns in South Africa, with the real exchange rate being an important price signalling mechanism for inter-sectoral growth in the medium to long term, and hence is also a signal to investors as to what the economic environment might be like over the same period. With the Rand experiencing a long term decline, this means that the Rand will be weaker in the future and may contribute to a long term investor's decisions. Evidence showing the long term depreciation of the Rand can be seen when constructing a graph showing the value of the Rand compared to the US Dollar (Figure 3).

2.3.3 The bid-ask spread and country risk

Melvin and Tan (1996:329) note that volatility in time series data insinuates that there is a bigger difference between the bid and ask prices of volatile assets, which are used to compensate dealers for the risk that they assume. Additionally, they argue that emerging markets, such as South Africa, are more exposed to changes in the economy and inflation from exchange rate fluctuations than the larger, more developed economies. Khan (2009:125) argues that exchange rates are also more likely to exceed their accepted levels with emerging markets being vulnerable to trade swings and the risk of capital flight. Melvin and Tan (1996:330) state that these vulnerabilities are driven by changing economic fundamentals or contagion effects from risk-wary investors. This suggests that if there are high levels of foreign denominated debt, a large flux in the exchange rate can have very significant effects as the domestic cost of the foreign debt balloons.

According to Melvin and Tan (1996:334), country risk can be described as the risk of an unexpected change in the political or social situation in a country that negatively affects the returns of foreign investors. Evidence found by Melvin and Tan (1996) indicates that the more often risk-perceived events take place in a country, the higher the conditional variance will be with regards to the value of the Rand and a greater bid-ask spread will be found in the foreign exchange market. Mulholland *et al.* (2013:5) argue that most foreign investors still prefer to hedge their local (South African) purchases using bonds and equities in the foreign exchange market, and will do so until some of these risks (e.g. trade data and labour strikes) improve. Consistent with Mulholland *et al*. (2013), Porter (2013) shows that the proportion of foreign investment since early 2009 has been directed mainly towards South African bonds, with the level of equity investment remaining fairly constant after an initial surge. It thus follows that South Africa's future foreign direct investment (FDI) flows will most probably be dominated by short-term deposits and bonds, as risk-averse investors will fear losses through depreciation and volatility concerns.

This confirms Melvin and Tan's (1996) findings that unrest resulting from strike action causes broader bid-ask spreads (increased volatility). This is evident in Fin24 (2013*b*) where it was noted that the Rand was under pressure from a strengthening dollar and bonds also weakened due to concerns that job losses in the mining sector could reignite previous labour unrest and thus contribute to instability in the economy.

2.3.4 Investor sentiment with regard to labour

Teitelbaum and Robertson (2008) examine the relationship between labour protest and FDI in low- and middle-income countries and the effect that it has on investor behaviour. Teitelbaum and

Robertson (2008:2) argue that research on FDI has shown that public protests can cause instability within the economy, which has a negative effect on foreign investment volumes. Teitelbaum and Robertson (2008:2) argue that this arrangement of "democracy good, protest bad" is a paradox of sorts, as democracy is not just about property rights, but also about the right to vote and freely speak one's mind, and it is because of this that democracies have more protests and make the local market less appealing to potential foreign investors. A major point raised by Teitelbaum and Robertson (2008:2) that may merit further research, is that while the idea of a country being democratic is perceived to have a positive effect through accountability and property rights, the major down-side risk for investors it exacerbates is the freedom it affords to the local labour unions.

When considering what characteristics of an economy may create (or negate) higher FDI, it is prudent to assess which characteristics of the country in question are held in favourable regard by investors. Asiedu (2006:12) found that "sizeable local markets, natural resources, decent infrastructure, a low inflation environment, an efficient legal system and a well-structured investment framework promote FDI." However, it was also found that corruption and instability have a negative effect in attracting foreign capital flows.

Fedderke and Romm (2006) investigated the growth impact and determinants of FDI and note that increasing wage costs impact FDI significantly and with a highly negative elasticity. This would mean that FDI would flow out of the country as soon as the cost of labour begins to increase as it would reduce potential profits to investors. This theory could be applied in the case of strike action to those companies/industries forced to increase wages due to ongoing strikes. Other observations by Fedderke and Romm (2006) include views on the openness of the economy and the volume of its trade influencing FDI. The volume of trade may be affected by work stoppages and the loss of man-hours due to strikes. In addition, the political institutional structure is also an important determinant of FDI, as it is concerned with the protection of property rights and political stability. Thus, increasing wages and incidences of strike action (as a sign of political instability) could be seen as portraying a negative image to potential foreign investors.

According to Visser (2005:30), COSATU spokespersons have indicated on numerous occasions that the federation would resist any actions by employers, whether by the state or the private sector, which would lead to the retrenchment of workers. Such resistance is likely to materialise as protest actions by means of strike action. This means that where companies are becoming non-profitable to operate, and thus may need to lay off workers to reduce the variable portion of their costs, they are being threatened with further losses in income to prevent them from shedding jobs. This may not be a

situation in which a foreign investor wishes to have their funds tied up, and so there is a fall in demand for the Rand over time, and the currency depreciates.

2.3.5 Foreign exposure and firm value

An additional factor worth considering is the extent of damages that specific industries are exposed to through the effects of strikes and a volatile, depreciating currency. In relation to this, Doukas *et al.* (2003:342) have identified in Japan a strong consistency that links current stock returns and unanticipated fluctuations in the value of the Yen. This relationship appears to be stronger for those corporations and firms with higher foreign exposure, compared to firms with little or no involvement in the international market. Put into a South African context, this link may explain why the more significant strikes appear to occur in South Africa's key export or export-related industries. Furthermore, Doukas *et al.* (2003:342) note that capital flows in and out of a country aid in determining the strength of the exchange rate by measuring the demand for the currency, and thus the firms who conduct business with foreign countries and firms tend to be the most affected by changes in the value of the currency as the trading of goods and services either becomes more profitable or expensive.

The view that exchange rate movements affect the cash-flows and hence stock returns for various firms and consequentially has a role in influencing the value of a firm, is explored by Doukas *et al.* (2003). This was achieved by analysing the exposure of various Japanese firms to exchange rate fluctuations using various testing procedures such as impact analyses and GARCH applications. The effect the changing exchange rate had on foreign denominated costs and revenues, as well as on the terms of competition for firms with international linkages, were some of the main focus areas.

Doukas *et al.* (2003:292) noted that there has been a broadened use of exchange rate management tools and applications, as well as extensive utilization by firms of foreign-denominated derivatives and other forms of hedging instruments to protect their foreign cash flows and portfolios from unexpected shocks in the market. This would imply that the value of firm is sensitive to exchange rate uncertainty. The implication of this is that firms which have an exposure to international markets run the risk of having their revenue stream influenced by changes in the exchange rate. These firms thus have to engage in hedging strategies if they are to avoid the risk of a sudden flux in the value of the Rand eroding their profits and possibly causing losses. Additionally, Doukas *et al.* (2003:292) argue that currency risk is an important aspect to investors, since a devaluation of the currency erodes the value of the local investment on the international market. Currency, or exchange rate risk, was explored by Jorian (1991:2) who noted that this type of risk is a "major source of concern" for

multinational companies, and that it means that strikes in those areas with higher foreign exposure bear a greater risk of causing a reduction in the value of the currency. This is especially true in South Africa where a large number of strikes are occurring in the mining industry, as is evidenced by the number of man-days lost in production in this sector over recent years (South Africa Survey: 2000-2012). This is worrying as the mining industry is a significant contributor to South Africa's GDP (around 7% of GDP) (SARB, 2013).

Bodnar and Gentry (1993) also present evidence that exchange rate fluctuations have an impact on the perceived value apparent at an industry and firm level. The results indicated that of the countries tested (Canada, Japan and the USA) more than 20 per cent of industries had significant exchange rate exposures, while exchange rate fluctuations were also of significance in determining the individual industry returns. An interesting aspect highlighted by Bodnar and Gentry (1993:42) was that the impact of exchange rate movements on returns for most industries was greater for the smaller economies of Canada and Japan compared to the larger economy of the USA. Bodnar and Gentry (1993:42) went on to suggest that the changing exchange rate is more likely to have a larger impact on smaller open economies. One might assume that the South African economy is relatively open; as Porter (2013:3) notes that the Rand is one of the "most liquid and frequently traded" currencies and that there is significant foreign involvement by foreigners in terms of investing in stocks and bonds, we might expect similar effects here.

2.3.6 Lagged effects of strike action

While it is not particularly evident in any economic publications, Maswanganyi (2014) and Mail and Guardian (2013) both note how the effects of strikes are still evident after the strikes have been concluded. Maswanganyi (2014) notes how strikes in the platinum, engineering and steel industries throughout the year had combined to mute industrial output and reduced the business confidence index, while Mail and Guardian (2013) argues that due to industrial action, the Beti index (BankservAfrica Transaction Index) showed a decline for an additional month or so, as transactions lagged after strikes. This would indicate that there is a dynamic related to strike action which reduces the efficiency of the economy and causes negative effects for a period after the strike has ended. These negative effects (loss in business confidence and reduced production levels) would have a corresponding negative effect on the exchange rate (depreciation).

2.4 The link between labour unrest and a volatile exchange rate

In an emerging markets report on South Africa, Mulholland *et al*. (2013:1) stated that the wage negotiation season of 2013 was expected to be plagued again by labour relations issues that began in

2012. Workers were able to secure unplanned salary increases and bonuses as a result of (illegal/unprotected) strikes and are thus expected to continue to use work stoppages as their primary tool for negotiations. This is worrying from an investor's perspective due to lost productivity and revenue as well as decreasing returns on equities. Decreased productivity and higher costs make it more difficult for South African firms to compete abroad and thus contribute towards a weaker exchange rate. From an employer's perspective, Mulholland *et al*. (2013:2) argue that the recent reduction in commodity prices and continued pressures on revenue will make companies negotiate harder than in earlier years, with the closure of business operations as a primary means of negotiation. This would imply the retrenchment of workers and higher unemployment. An example of this is provided by Shilton (2012) who noted that on the 26th of September 2012, *Lonmin* was about to retire one of its mine-shafts and terminate a contract with a labour agency that was responsible for supplying staff, which effectively led to approximately 1 200 people losing their jobs. This would potentially have a depreciating effect on the exchange rate as less platinum would be exported, resulting in a decrease of export oriented foreign exchange earnings and a negative impact on the balance of trade.

Mulholland *et al.* (2013:1) stated that the majority of bargaining power lay with the workers and thus there was expected to be continued pressure on shares and the Rand. It was further noted that the negative pressures shown in the stock market can cause currency depreciation. This would be as a result of foreign investors diversifying their risk away, which would compound inflation pressures in the economy, as imported goods would become relatively more expensive.

Mulholland *et al.* (2013:1) also discuss the various risks that could possibly cause disruptions in the negotiating process with regard to the mining industry in particular. The National Union of Metal Workers (NUM) has been challenged by the emergence of a new union in the form of the Association of Mineworkers and Construction Union (AMCU), which could cause tensions in the bargaining process. It has also been stressed by Mulholland *et al.* (2013) that the circumstances leading up to the strikes in 2012 had still not been resolved, these being discontentment arising from inconsistent wage structuring, poor living conditions and harsh production-related remuneration conditions.

The spread of strikes in the mining sector in late 2012 was attributed to the emergence of AMCU as a viable alternative and rival to NUM as well as the opportunistic nature of the strikers and the involvement of their respective communities (Mulholland *et al*., 2013). Janse van Vuuren (2013) describes the difficulty of formulating bargaining agreements between mine management and the competing unions. Problems were encountered when a confrontation broke out between members of

an AMCU worker committee and officials belonging to NUM, as well as companies stalling in their recognition of AMCU as a legitimate union as they were not involved in a peace negotiation process.

In terms of investor perceptions, Mulholland *et al.* (2013:1) also indicated that strike fatigue in the mining sector during the 2013 wage negotiation season would be lower than expected due to the emergence of AMCU as a rival to NUM. The unions are expected to compete for the best offers for their members and thus aggressively pursue higher wages, compounding inflation and weak exchange rate woes. The only effective bargaining tool available to companies is a closure. It is then argued that foreign investors "prefer stocks with lower earnings exposure to South Africa, and those with less labour cost through higher exposure to open-pit and mechanised mining" (Mulholland *et al.*, 2013:1). It could be argued that the persistence of strike action is creating a negative view of South Arica's labour system as well as forcing companies to become less dependent on labour, thus further contributing to unemployment.

Balston *et al.* (2012:36) argued that the "seasonal strikes" of the past have come to an end, replaced instead by contagion, as the recent wave of violent unrest that accompanied the recent wildcat strikes was out of proportion, even by local standards. This resulted in some employers taking a stand by dismissing the illegally striking workers. Government failed to play any sort of meaningful role in the resolution process, arguably due to the internal elections which were due to be held in December 2012. The situation was not expected to change and a combination of wage increases and job losses were expected. Worryingly, it was further noted by Balston *et al.* (2012:37) that these wage increases could force closures in high cost marginal gold and platinum mines, which employ a large proportion of gold/platinum mining labour. This further propagates the view that strikes and the resulting wage increases may be posing a threat to the competitiveness of the South African economy, the strength of the Rand, as well as the problem of unemployment, as evidenced in CEIC (2013).

2.5 South African strike behaviour in context

As South Africa is a reasonably open economy, it is exposed to international events and trends. The views that investors hold concerning a country and its economic environment are an important determining factor in the movement of capital. International Monetary Fund (2003:16) notes that besides sector-specific determinants of foreign direct investment and healthy macroeconomic fundamentals (such as sustained growth, low inflation and a stable exchange rate), investors are mostly concerned about two things; the commercial side of the market; such as liquidity, taxes, labour and infrastructure, and the institutional and regulatory policies and frameworks which encourage investment. It would thus mean that should any of these factors change in a detrimental way,

investment funds would flow out of the country, and hence the value of the Rand may be affected.

Another point worth noting that may apply to both international and domestic investors is that South Africa has seen an increase in the number and wages lost due to strike action since 2009 (Sidimba, 2014), with 2011 being an exception to this trend. This may have stemmed from the divisions of the past and the significant presence of trade unions and unionised workers in the country. South Africa is also perceived as a country which has strict laws regarding labour that makes it difficult for employers to simply dismiss striking workers (Sidimba, 2014). However, Sidimba (2014) argues that this view is due to the opinions of executives rather than the actual labour laws which are in place. It is thus difficult to accurately determine the exact perception international investors have, and ultimately it will depend on their opinions of the market and labour situation as to whether they invest their capital in South Africa.

2.6 Studies exploring strikes and their impact on exchange rates and the stock market

2.6.1 Impact on stocks

There have been a number of studies conducted that consider the impact which strikes have on the exchange rate, as well as the effect that they have on stocks and commodities. Bhana (1997) explored the effect which a strike has on the share price of an asset, i.e. if there was a strike at Anglo American, what affect that might have had on the underlying stock. Bhana (1997:48) found that the beginning of the strike was associated with significant, abnormal returns, and that there was a slight reaction just before the strike took place, suggesting that some market participants may have been able to predict the strike. However, it was also noted by Bhana (1997) that there was a strong negative reaction the day after the strike began, suggesting that the market may not have been able to predict the strike as consistently as some. Bhana (1997) also found that the market was also unable to predict the outcome and length of the strike, as around 70% of the decline in the stock's value happened after the onset of the strike. In short, Bhana (1997) found that at a strike's onset, the market reacts negatively and significantly, while the day after a strike ends, the market reacts in a positive and significant way. Additionally, Bhana (1997:48) notes that the positive reaction at the end of the strike is generally smaller than the decline at the onset of the strike, suggesting that strikes decrease the value of the stock. This suggests an overall negative impact of strikes on the value of stocks.

2.6.2 Impact on exchange rate

While it is not the value or volatility of stocks which we are concerned with in this study, Dimitrova (2005:2) suggests that there are two ways in which the value of currency and stocks can influence each other. The first way, described by Dimitrova (2005:2), is that stock prices are expected to act ambiguously with regards to the value of the currency; this depends on how the value of the currency affects a multinational company's balance sheet.

The second hypothetical link is that the currency will depreciate if the value of the stock market declines. The reason provided by Dimitrova (2005:2) for this is that in markets which have a high degree of capital mobility, it is the capital flows rather than the trade flows that determine the demand for a particular currency. This means that if a decline in stock prices occurs, foreign investors would sell the assets which they hold in that currency, which leads to that currency depreciating. Linked with the results of Bhana (1997), this would suggest that strikes would cause both a depreciation in the exchange rate, as well as increased volatility (due to foreign investors exchanging their Rand denominated investments for something less risky).

Melvin and Tan (1996) followed a similar approach to Bhana (1997), but instead of measuring stock returns, they analysed the difference in spreads (bid and offer prices) in the foreign exchange market. The time series evidence from Melvin and Tan's (1996) study showed that country risk variables like strikes and related deaths leads to both a direct and indirect increase in the conditional variance of the exchange rate, which cause an increase in the spread. Melvin and Tan (1996:340) also note that there is evidence from the cross-sectional analysis that there is an increase in the spread of the exchange rate if risk variables such as country risk (which includes strikes) increases. The cost of social/political unrest, according to Melvin and Tan (1996:340), was an increase in the spread of the South African Rand by 540 basis points on the day upon which the strike occurs. Additionally, if there is a death due to politically motivated violence, the spread on the Rand was found to increase by 400 basis points.

Clearly, very little research has been conducted on the effect of strike action on the exchange rate specifically. From what has been done, the literature surrounding strikes and their effect on the exchange rate (and other related financial instruments) suggests that strikes generally increase volatility and cause a depreciation of the exchange rate.

2.7 Summary

This chapter explored the literature relating to labour unrest and the consequential effects that it has at both a micro and macro level in the economy. Challenges created by strikes included an increase in inflation as most strikes were wage related and resulted in wage increases significantly above CPI figures. These increased wages would result in higher variable costs and increased unemployment. Purchasing power parity was also briefly discussed, as it is important to see how economic conditions in a country can affect the strength of its currency relative to others. Investor sentiment regarding the country is expected to deteriorate if strikes take place, as strikes are associated with violence and unrest which increases perceived risk levels. Firms are also expected to be impacted through strikes, especially those with exposure to the global markets as foreign profits can be eroded and volatile markets can make it difficult to predict price movements. Effects from strike action can also take time to materialise, which could be in the form of inflation, reduced production levels and knock-on effects to other industries. Some of these effects are more immediate such as the movement of funds in the stock and foreign exchange market, while others may take longer to materialise, such as inflation and knock-on effects. Strikes were also found to portray a negative image in the view of investors, as they could reduce the value of investments while simultaneously increasing risk levels. Additionally, it was found that there was a link between the returns on shares listed on the local bourse and the level and volatility of the exchange rate.

CHAPTER 3: METHODS AND DATA

3.1 Introduction

This chapter explores the methods and data used in this study to determine whether strike action has an effect on the value and volatility of the Rand/Dollar exchange rate. A number of methods, including GARCH models and intervention analysis are employed to determine the effects of strikes on the exchange rate. The outline of this chapter is as follows: Section 3.2 specifies and sets out GARCH framework while Section 3.3 explores the dynamics of intervention analysis. Section 3.4 outlines the data that will be used, and a summary of the chapter is provided in Section 3.5.

3.2 Generalized Autoregressive Conditional Heteroskedasticity (GARCH) Framework

Most economic/financial time series do not display signs of having a constant mean and are subject to periods of relative tranquillity as well as phases of high volatility (Enders, 2010:121). Campbell *et al.* (1997:481) observe that large returns tend to be followed by more large returns, and thus the volatility of returns appears to be serially correlated. Melvin and Tan (1996:330) note that exchange rate data is of a high frequency (in the present case, daily) and that it exhibits clusters of volatility. A GARCH model is thus used as it is the most appropriate method of modelling conditional volatility.

Bollerslev (1986) developed the GARCH approach, which allows the conditional variance of the time series to be an autoregressive moving average (ARMA) process. The error process thus becomes:

$$\varepsilon_t = V_t\sqrt{h_t} \quad (1)$$

Where: $\sigma_v^2 = 1$ and since V_t is a white noise process, both the conditional and unconditional means of ε_t amount to zero. The conditional variance of the error term (h_t) can be represented by the following ARMA process (Enders, 2010:131):

$$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \, \varepsilon_{t-1}^2 + \sum_{i=1}^{p} \beta_i \, h_{t-1} \quad (2)$$

The lagged conditional variance term (h_{t-1}) represents the sum of the conditional variance in the moving average component of the heteroskedastic variance, while the ε_{t-1}^2 term is a measure for the autoregressive component of the variance.

Enders (2010:131) notes that an important characteristic of GARCH models is that the shocks to the $\{y_t\}$ sequence are representative of an autoregressive moving average (ARMA) process. The $\{h_t\}$ series above is similar to what one would expect an ARMA process to look like. If there is conditional heteroskedasticity present, then the correlogram of the squared residuals would indicate such.

In order to estimate a GARCH model, one must first create an ARMA model of the residuals (Campbell *et al.*, 1997:484; Enders, 2010:132). It is also essential that the time series is stationary before the estimation of the model can be done, and this can be achieved by differencing (Campbell *et al.*, 1997:484). The test for stationarity is thus done before the ARMA equation is estimated as it is necessary for the series to be stationary for the equation to be relevant.

Once the ARMA process has been estimated, a unit root test should be performed on the series in order to ensure that it is stationary (Enders, 2010:79). This ARMA process is essentially a plot of the residuals of the original exchange rate sequence, and before a GARCH model can be estimated these residuals must be tested for ARCH effects. This test is formally known as the Engle test for ARCH effects, and was developed using the Lagrange multiplier test in the early 1980's by R.F. Engle. An ARCH LM test essentially tests the residuals of the equation for autoregressive conditional heteroskedasticity. The ARCH test employs a regression of the squared residuals on the lagged squared residuals and a constant term. Enders (2010:138-140) argues that if the test statistic turns out to be significant we reject the null of no ARCH effects and conclude that ARCH effects are present. If this is the case, then a GARCH model can be implemented.

Enders (2010:78, 80, 126, 158) notes that the mean will take the form of an ARMA (p, q) model, and that by using the Box-Jenkins procedure, the Akaike Information Criterion (AIC) and Schwartz Information Criteria (SIC) can be used to select the most appropriate lag lengths. Burger (2008:340) notes that the model with the lowest AIC and SIC is selected, depending on the specification showing no evidence of autocorrelation. The model for the dependent variable should thus be free of serial correlation and be stationary (characteristic roots falling within the unit circle) (Burger, 2008:340).

In estimating a GARCH process, two related equations are estimated (Enders, 2010:146; Chinzara and Aziakpono, 2009:6):

$$y_t = \alpha_0 + \beta x_t + \varepsilon_t \text{ (Mean equation)} \quad (3)$$

and

$$\varepsilon_t = v_t\left(\alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \cdots + \alpha_q\varepsilon_{t-q}^2 + \beta_1 h_{t-1} + \cdots + \beta_p h_{t-p}\right)^{0.5} \text{ (Variance equation)} \quad (4)$$

In equation (3) x_t is an ARMA process of the order (p^m, p^q) as well as any exogenous variables. The relationship between the two equations is evident in that the h_t is the conditional variance of the

error term ε_t. Thus, the variance equation above is the GARCH process relating to the ε_t sequence, which is essentially the conditional variance of the mean equation.

The GARCH (1, 1) framework is argued by Enders (2010:147) to be the most common in use for assessing volatilities in financial data, with the variance equation taking the form:

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} \quad (5)$$

which states that the conditional variance h_t is a function of the mean level of volatility (α_0), shocks from the previous period (ε_{t-1}^2) as well as a part of the conditional variance that remains from the previous period (h_{t-1}). Additionally, Brooks (2008:389) and Enders (2010:131) state that because h_t is the conditional variance, it always remains positive.

For the purposes of this study, a GARCH (1, 1) model is estimated with the inclusion of an exogenous variable in the variance equation. Specifically, the exogenous factor takes the form of a dummy reflecting the period of the particular labour strike. The estimated GARCH (1, 1) model is thus specified as:

$$y_t = \alpha_0 + \beta x_t + \varepsilon_t \quad (6)$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \delta D_i \quad (7)$$

Where all variables are defined as in equations (2) and (3), and where D_i is a dummy variable denoting the dates of strike i, and is set equal to 1 for the days on which a strike occurs, and 0 otherwise. Of main interest for the purposes of this study is the parameter δ in equation (7), which would indicate the effect of the specific strike on the volatility of the exchange rate. If $\delta > 0$ ($\delta < 0$), it is assumed that a particular strike led to greater (lower) exchange rate volatility. Finally, for the regression results to be reliable, all coefficients in the variance equation should be strictly positive, and $\alpha_1 + \beta_1 < 1$.

It is worth noting that other studies have included dummy variables in the conditional variance equation. Fang and Miller (2008) and Lamoureux and Lastrapes (1990) both use dummy variables in their studies. Fang and Miller (2008:16) incorporate a dummy variable into their conditional variance equation in order to accommodate any changes which occur. Lamoureux and Lastrapes (1990:226) also use dummy variables in their conditional variance equation in order to ascertain at what time sifts in the variance are likely to have occurred. The use of a dummy variable in the conditional

variance equation is thus acceptable and useful in determining the timing and impact of shocks and changes to the conditional variance.

3.3 Intervention Analysis

Intervention analysis essentially explores whether there is a significant change in the level of a series due to a specific event or intervention. According to Enders (2010:272), an intervention analysis allows the time path of a dependent variable to be influenced by the occurrence of an exogenous independent variable. Enders (2010:272) adds that if a feedback effect is known not to exist, then intervention analysis can be used as a tool to aid in forecasting and the testing of hypotheses. Sridharan *et al.* (2003:9) also argue that intervention analysis is used to assess the impact of a special event on the time series of interest such as a strike or other event. The main focus is thus to estimate the effect that the intervention or event has on the mean level of the series, but other effects can also be considered (Enders, 2010:274).

There are many kinds of interventions, and these differ both in terms of the onset of the event (whether they are immediate or gradual) as well as its duration (permanent or temporary). For example some interventions occur only once, are brief in duration, and usually have an effect that occurs abruptly and fades quickly (Enders, 2010:274). An example of such an intervention effect may be that which occurs following an earthquake or a riot. However, Enders (2010:275) notes that there are effects which have a more sustained or gradual onset, and these are generally attributed to scenarios where long term effects are expected or are the norm.

Assuming the existence of an ARMA (p,q) process, the intervention analysis model can be stated as follows:

$$y_t = \alpha_0 + (\alpha_0 + \beta x_t + \varepsilon_t) + c_0 z_t + \varepsilon_t, \ |\alpha_1| < 1 \qquad (8)$$

Where z_t is the intervention or dummy variable that takes on the value of zero prior to the event taking place and unity from when the event occurs, and ε_t is a white-noise disturbance term. This study adopted a method similar to the pulse dummy, where a vector of zeros is employed over the entire data set, except for the days the strike happened over, which are made to equal to one.

The dummy variable essentially assumes a value, given a set of criteria. This has the effect of either making the variable null and void or, very relevant in assessing the magnitude of the impact. Enders (2010:274) notes that this is because the variable assumes the coefficient of zero prior to the test date, resulting in a long-run mean for the series equal to $\alpha_0/(1-\alpha_1)$. However, on the occurrence of an

event, the dummy variable assumes the value of unity. This creates a new long-run mean in the form $(\alpha_0 + c_0)/(1 - \alpha_1)$ as the dummy causes the intercept to jump to $\alpha_0 + c_0$, thus the initial effect of the event (strike) is given by the size of c_0. The long-run effect of the intervention is therefore calculated as $c_0/(1 - \alpha_1)$ (Enders, 2010:274).

Sridharan *et al.* (2003:9) note that a pulse intervention is employed to capture a single specific event in a certain time period, for instance; a holiday or strike action. Events such as this are expected to create outliers within the time series sequence. The prolonged pulse allows for these outliers to be considered. Enders (2010:275) describes the function as the z_t sequence being equal to zero in all periods except the ones in question i.e. over the period of the strike,, where there it is equal to unity and there is a spike or pulse in that period. Enders (2010:275) notes that this function is typical of a "purely temporary intervention", and that the effect of the pulse may well last many periods, due to the autoregressive nature of the time series.

The intervention process which was adopted in this study was of the pulse intervention type, assuming that the pulse lasted the duration of the strike whether it is a day or a month under consideration.

In order to assess whether strike action caused a change in the value of the Rand, an intervention analysis is used to measure the initial impact of the strike, as well as the long run effects on the Rand after the event. To do this, exchange rate data is selected and put through a number of tests.
Step 1: Utilise the foreign exchange data to find plausible ARIMA models. Enders (2010:277) notes that it is important to ensure that the $\{y_t\}$ sequence is stationary, and this can be confirmed by employing unit root tests on the data. An appropriate model must be selected, ensuring that it is the most parsimonious for the data at hand.

Step 2: Estimate the models over the sample period, as well as the intervention effects. The effect of strikes could be viewed as either a pulse or a prolonged pulse, depending on the persistence of volatility in the system as well as the duration of the strike.

Step 3: The third step involves diagnostic checks of the equations that have been estimated. Enders (2010:278) notes that diagnostic checks in this step are especially important as the observations from both pre- and post-intervention periods have been merged. A well estimated intervention model is described by Enders (2010:278) as having the following characteristics: All coefficients used in the regression analysis should be statistically significant if the model was selected correctly. However, coefficients for the dummy variables will only be statistically significant if the event they are representing (a strike) has an actual effect on the mean level or volatility of the exchange rate. In

order to ensure the selected model is as parsimonious as possible, Enders (2010:51) argues that the residuals should be indicative of a white noise process (constant mean, variance, and independently distributed) and the model should "outperform plausible alternatives". The model was run through Eviews using various autoregressive and moving average terms, and the one which best fitted the historical exchange rate data was chosen.

3.4 Data

This study employs data from the South African Reserve Bank as well as from the South Africa Survey (2000-2012). Daily Rand/USDollar data is used in both the GARCH analysis and intervention analysis. The data which was sourced from the South African Reserve Bank was the daily exchange rate data from the beginning of January 2000 until October 2013.

The ZAR/USD exchange rate was selected for the study for two reasons. Firstly, the US dollar is recognised as the international reserve currency (JP Morgan, 2009:1), and thus creates a standard benchmark to conduct an analysis on. The second reason why the ZAR/USD exchange was chosen is due to the USA being one of South Africa's biggest trading partners; second in terms of exports from South Africa to the USA, and fourth in terms of imports to South Africa (DTI, 2014).

Strike data was taken from the annual South Africa Survey (2000-2012) as this data was consistent and focussed on only the biggest, most significant strikes (in terms of man-days that were lost of production to firms whose workers were involved in strike action). This allowed significant strike periods to be isolated and investigated.

Due to the increased occurrence of illegal/unprotected/wildcat strikes in South Africa, they are also included in the strike statistics. Thus both protected (legal) and unprotected (illegal) strikes are included in the analysis. Bhana (1997) argues for the inclusion of unprotected strikes. Bhana (1997) argues that the advent of a strike precipitates negative non-normal returns. This means that the share value may decline prior to the announcement of a strike and continue for a significant period after the onset, with a significant jump in volatility on actual announcement (Bhana, 1997:47). Additionally, Bhana (1997:47) notes that if we consider that these strikes occurred around set bargaining dates and are therefore predictable to some extent, then the onset of unprotected, wildcat strikes should cause considerably more concern or panic. This may have an even more significant impact on share values, as well as the value of the Rand, as negative investor sentiment drives away foreign investors (Bhana, 1997:47). Put into context with the recent strikes and their wildcat nature, they are potentially more harmful and influential to share prices and exchange rate levels.

The duration of strikes is especially significant in the context of this study, as it the period over which the study tests for changes in volatility and value in the exchange rate. Additionally, the duration of the strike will affect its severity, meaning more man hours and production will be lost if the strike is over a protracted period. As currency is only traded on exchange during week days and man-days lost due to strike action are those during the week (South African Survey, 2000-2012), the data did not need to be amended and the complete data set could be used. This ensured that the dummy variables, which were constructed using a vector of zeroes for the entire period, except the strike period which contained a vector of ones, were accurately defined. However, it is a concern that strikes occurring over an extended duration may fail to capture the initial volatility caused by the onset of the strike as suggested by Bhana (1997:48). However, is has been argued by Enders (2010:122) and Campbell *et al.* (1997:379) that volatility can vary over time as well as display degrees of persistence. The dummy for each individual strike was thus constructed specifically to match the duration of the strike to the relevant period in the exchange rate data. In this way, the period over which the strike took place could be tested for changing levels and volatility.

3.4.1 Descriptive statistics

The strike data which was sourced from South Africa Survey (2000-2012) included 72 strikes for the period (12 years), to make an average of six strikes which were covered each year. Some years have more strikes than that were examined than others however, this was due to the South Africa Survey not covering the same number of strikes in their strike tables each year, while a couple of other strikes were omitted from the data due to no further information being available on them i.e. exact dates and other necessary information. The period over which the strike data is taken is twelve years (2000-2012), however the exchange rate data was taken between January 2000 and October 2013. This was done to provide a slightly longer period for the analysis as well as to ensure strike statistics fitted well within the exchange rate data range.

Strikes were spread between a number of different sectors, with the majority taking place in the mining (37.5%), transport (13.9%), public (9.7%), retail (9.7%), and automotive (8.3%) sectors. The total number of days which were lost due to the strikes which were examined amounted to 1,240 (An average of 17.22 days per strike), while the total number of man-days lost came to 44,861,290 (an average of 623,073 man-days per strike).

3.5 Summary

This chapter discussed the data and methodology employed in this study. The first section of the chapter outlined the various testing techniques and procedures followed, which included examining the GARCH and intervention analysis techniques and how they would be used to determine the effects that strikes have on the exchange rate. The next section covered the data used and the reasoning behind including certain strikes in the testing procedure, as well as certain important characteristics of the data, such as which sectors were most likely to be impacted by long-term strikes. The most significant strikes in terms of man-days lost in production were used. The total and average duration and man-days lost were also noted so as to get a better idea on the nature and magnitude of the strikes which took place.

CHAPTER 4: RESULTS

4.1 Introduction

This chapter reports the econometric results obtained from the various regressions conducted on the volatility and mean level of the exchange rate in relation to strike action. ARCH effects are discussed in Section 4.2, while Section 4.3 contains the results and interpretations for the GARCH analysis relating to individual strikes. Section 4.4 outlines the results obtained from the intervention analysis and discusses these results in context. Section 4.5 deals with the results from the industry GARCH and intervention analyses and discusses the rationale behind some of the results which were obtained. It also discusses certain aspects of the testing procedures and the results, and what they mean in context with the global economy and investor perceptions. Finally, Section 4.6 provides a summary of the chapter.

4.2 Prerequisites for GARCH

Before estimating the relevant GARCH models, it is necessary to test for ARCH effects.
However, before this, the time series must be made stationary and this was done by differencing in Eviews. Figure 5 shows the exchange rate series after it was differenced once, and it appears to be stationary. The correlogram which was constructed from the stationary time series data was used to provide an indication for the appropriate lag structure to use in the regressions. Eventually, an ARMA (5, 7) specification was adopted to best fit the data.

The ARCH LM test results revealed that there are indeed ARCH effects present in the exchange rate data. The null hypothesis is that there are no ARCH effects present (Enders, 2010:135), however we reject the null hypothesis as the p-value is significant (Prob < 0.1) and the squared residuals of the PACF and ACF show significant correlations, indicating that there are indeed ARCH effects (heteroskedasticity) present. In order to ensure that the variance equation which will be used throughout the study is correctly specified, one should test the residuals of the mean equation for ARCH effects. Eviews was used to test the residuals for ARCH effects. The test indicated that there were no ARCH effects in the residuals (Prob > 0.1), meaning that the null hypothesis was accepted (failed to reject), and which meant that the model could be used for the purposes of the study.

4.3 Strike Specific GARCH Results

Firstly, it should be noted that all GARCH coefficients were significant at the 1% level. This is indicative of GARCH effects being present in the data, meaning that the exchange rate is subject to fluctuations based on past deviations in the error term. Due to these effects being present and significant, it allows us to assess whether the occurrence of specific events has a significant effect on the volatility of the market.

In terms of the overall view of the results; of the 72 strikes covered between January 2000 and October 2013, fourteen produced statistically significant figures which showed an impact on the volatility of the exchange rate. Nine of the fourteen statistically significant results had negative coefficients, while five registered positive coefficients. The effect of these would be either decreased volatility (negative coefficient) or increased volatility (positive coefficient). Negative results were found in the mining, automotive, education, power, retail, and transport industries, meaning that in essence, these strikes reduced the volatility of the exchange rate. The increased volatility of the exchange rate could be attributed to strikes in the following industries: mining, transport, security, and retail. Interestingly, thirteen of the fourteen significant strikes were due to wages and wage disputes, while the only other significant strike was due to a grievance. This shows that the main concern of workers is the amount of money they make and is far more likely to be the cause of strike action than other issues such as adverse working conditions, safety concerns, or the dismissal of fellow workers. Another point worth noting is that the strikes which yielded these results were quite diverse in that the duration over which they occurred was anywhere between one and 79 days. It could thus be argued that the period over which the strike takes place is not that important in terms of the effect it has on volatility.

4.3.1 Reduced Volatility Results

The strikes which yielded a negative coefficient for volatility varied in the extent of the effect they had on the exchange rate. Coefficients measured between -0.0257 and -0.9845, which in effect translates to a decrease in the volatility of the exchange rate by between 0.9845 units and 0.0257 units, depending on the particular strike in question. In terms of the significance of the results, all of the strikes produced a probability figure for the GARCH component translating to this section of the results being highly significant (95% significance level i.e. all p-values are smaller than 0.05). This was however not true for all the strike dummy variables, the majority of which failed to produce p-values in the 90% – 100% level of significance band.

In terms of expectations, these results (those which produced statistically significant dummy variables with negative coefficients) did not conform to conventional literature, where the expectation is for

strike action to increase the volatility of the exchange rate. The reasons why these results indicate that a decline in volatility occurred will be explored in the Explanation of Results (Section 4.3.3).

4.3.2 Increased Volatility Results

The strikes which produced positive coefficients also showed a range in the extent of the effect they had on volatility, with coefficients ranging from 0.0869 to a much greater 4.0004. The translation of these results is that the strikes caused an increase in the level of volatility by between 0.0869 units and 4.0004 units. With regard to the significance of the results, all p-values for the GARCH component are smaller than 0.05 and thus probability levels are all also at the 95% significance level. P-values for the dummy coefficient were however not all significant, with p-values ranging from 0.00 (highly significant) to 0.9850 (not significant at all). This suggests that while there were GARCH effects present, they could not always be linked with strike action. The explanation of the results will be explored in the next section.

4.3.3 Explanation of Results

The first strike to produce a statistically significant coefficient for the dummy variable was a strike by the Road Freight Employer's Association employees, which resulted in a loss of 55 000 man-days, even though the strike itself only lasted a day. The coefficient suggests a decrease in volatility by 0.3809 units, which is contrary to expectations.

Other GARCH regressions which resulted in a decrease in exchange rate volatility were; the Eskom strike (24 July 2001, -0.1290), the Automobile Manufacturers Employers Organisation strike (6 August 2001, -0.0257), Northam Platinum strike (13 August 2001, -0.0272), the Public Service and Administration strike (16 September 2004, -0.7368), the Pick 'n Pay strike (22 July 2005, -0.1050), and the Bokoni Platinum strike (1 October 2012, -0.0241). Other than that, the GARCH industry regression results for the Mining Industry (4 December 2007, -0.9845) and the Retail Motor Industry (1 September 2010, -0.0582) also produced a decrease in exchange rate volatility, however the industry results will be discussed at a later stage in the chapter.

In order to accurately assess these outcomes, the context of the strike as well as the economic environment at the time is important aspects to consider. For example, Ampofo *et al.* (2003:7) note that during 2001 the Rand depreciated by 34% against the dollar. This is an important contextual point as the period noted by Ampofo *et al.* (2003:7) produced three statistically significant negative GARCH coefficients and one statistically significant positive GARCH coefficient.

A theoretical view behind the decrease in volatility adapted from Enders (2010:123) is that generally volatility is experienced in clusters, thus a coefficient displaying a negative sign could be found where the exchange rate is recovering from a bout of volatility, or in other words, the exchange rate is settling to a more constant rate. This situation would occur if the dummy variable was able to capture the end of a relatively volatile period and the continuation of a relatively normal trend in the exchange rate, which is possible given the unpredictable nature of strikes.

Due to uncertainty playing a major role in increasing volatility (Bloom, 2009:623), another possible reason for a decline in volatility may be that due to the nature of the strike (protected, legal, and announced in advance), the expected increase in volatility did not materialise. The strikes which were used in the study were essentially a mix of protected and unprotected strikes that depended primarily on the number of man-days that were lost of production rather than whether the strike was legal or not. In future studies it would be useful to further explore and test this theory to ascertain whether there was an appreciable difference in the effects caused by protected vs unprotected strikes, as well as the timing of how/when the effects manifest themselves. Additionally, Carlson and Osler (1998:25) argue that currency traders and speculators can have the effect of smoothing exchange rate volatility at low levels of speculation, while higher levels of speculation increase volatility. This theory could be used to support the view that "wildcat" or unprotected strikes have a greater initial impact on the volatility of the exchange rate as the market was previously unaware of the intention to strike, and also helps explain why certain events (e.g. violence) may cause volatility to suddenly spike. Low levels of speculation might thus be able to explain reduced levels of volatility, even after the advent of a strike.

Of the remaining strikes which exhibited negative coefficient results, the two which produced the largest negative coefficients were the Public Service and Administration strike (2004, -0.7368) and Mining Industry strike (2007, -0.9845). Interesting points worth noting when comparing the two are that they were both the same in terms of duration, 1 day, and both had p-values of smaller than 0.01. This shows that the regression results were highly significant and that the volatility change over a short period of time was able to be successfully captured. It may also provide credence to the view held by Bhana (1997) that the biggest changes in volatility occurs in the lead up to the strike, and that volatility may in fact be decreasing by the time the strike actually begins (unless it is a wildcat strike).

The environment within which these entities operate is however different. The Public Service and Administration employees are employed by the state, while the Mining Industry consists of private and publically owned companies that operate in order to produce profit. The Public Services and

Administration strike is thus not expected to have a significant impact on the exchange rate as the goods and services of the state are mostly consumed by the local economy. However, the result suggests otherwise. Additionally, a strike in the Mining Industry may be expected to have an effect on volatility due to its significance in the economy. MiningIQ (2014) notes that mining in South Africa contributes around 20% towards South Africa's GDP, of which around 50% are direct contributions. The mining industry is also exposed to the exchange rate through the export of its products to other countries, this would make it more susceptible to fluctuations in the exchange rate and may be the reason why the Mining Industry strike in 2007 caused the largest decline in the Rand/Dollar exchange rate.

The 2001 strike which produced a positive coefficient, and thus increased the volatility of the exchange rate, materialised at Samancor; a chrome and manganese producing company. The increased volatility could be due to a number of factors. Firstly, with a depreciating exchange rate (Ampofo *et al.*, 2003:7) and with South Africa holding 75% of chrome reserves (Tharisa, 2014), there may have been some major concerns as to the future supply of chrome, as well as the price it would be available at. This may have sparked concern by investors, which resulted in a spike in volatility.

The strike at Equity Aviation caused an increase in volatility by 0.5506 units. The strike itself involved only 800 employees and continued for almost three months, resulting in the loss of 63 200 man-days. Volatility stemming from this strike could possibly be attributed to the nature of the services provided by the company. Equity Aviation (2014) details the services it offers as ground handling, permits, fuel, charters, cargo, and aviation security. The company offers these services to the internationally linked airlines industry. If the services were to be suspended for such an extended duration due to strike action, concern and volatility may have arisen on these concerns.

Another strike which led to increased volatility was the South Africa National Security Employer's Association strike, which saw a massive loss in man-days (1 280 000). The importance of this strike is due firstly to the massive scale, and secondly as it involved security companies who provide important protection and services throughout the country. Enders (2010:143) notes that risk increases volatility. The increase in volatility could thus be attributed to increased concern about increasing risk levels (unsystematic risk, and more precisely; foreign exchange rate risk, political risk, and market risk).

The last two strikes which resulted in increased volatility in the Rand/USDollar exchange rate involved Woolworths; a food and clothing retailer, and Pamodzi Mining, the resources arm of

Pamodzi Group. Both of these strikes occurred in the latter stages of 2008, which is worth mentioning due to the economic environment at the time. The Economist (2013) notes that when Lehman Brothers collapsed in September 2008, it almost brought down the global financial system. This resulted in a global credit crunch which made it difficult to access credit facilities and made financial institutions very wary with regards to granting loans. The decline in the value of the Rand relative to the Dollar spiked in September 2008 (see Figure. 3), and may have played a role in the increased volatility captured by the GARCH regressions for Pamodzi and Woolworths. If one was to consider the economic environment in which these strikes took place (global financial crisis), one would conclude that due to the Rand being more vulnerable, any additional problematic occurrences like strikes would have a more significant effect on the volatility of the Rand exchange rate.

4.3.4 Marikana

The Marikana strike which started on the 10th of August 2012 might be seen as an important strike in terms of the international exposure it received due to the violence and deaths surrounding it, however it failed to produce a statistically significant coefficient for the strike dummy. There are a number of reasons why this may have been the case. The first factor could be that as there were a number of strikes around this period (nine between the beginning of August 2012 and the end of October 2012), which may have erased or hidden the specific volatility created by the strike in question. The second factor has to do with timing. If one observes the ZAR/USD exchange rate for 2012 (Figure 5), there is actually a slight appreciation of the Rand following the start of the strike, before a large depreciatory trend begins on the 14th of August 2012 and ultimately continues for the duration of the month. In terms of timing, the strike started on the 10th, however, people only really started paying attention to it a few days later, when stories of violence started to emerge. News24 (2012) notes that between the 12th and 14th of August, ten people were killed in the violence, two of them security guards. This was before the 16th of August, when 34 miners were shot dead by police. By the time the Lonmin strike ended, strikes in the agricultural sector, as well as at Anglo Platinum were under way. Thus if one wanted to isolate the volatility caused by Marikana specifically, it would be necessary to test volatility for the periods during the strike where the biggest impact might be expected, i.e. the initial stages where the majority of deaths occurred.

4.4 Intervention Analysis: Strike specific

There were only four strikes which significantly affected the level of the Rand/Dollar exchange rate. The first two significant events in question concern the strikes at *Delta Motors* in the automotive industry, which began on the 22nd of September 2003, and the strike at *Harmony Gold Mine* which commenced on the 11th of February 2004. The intervention analysis of the *Delta Motors* strike

produced a coefficient for the dummy variable of -0.8402 with a 5% level of significance. The direct effect of the intervention would cause an appreciation of the exchange rate by 0.8402 units and increase the value of the Rand by 0.8403 units in the long run. However, it does not conform to the expectations provided by the literature that suggests a depreciation following a strike should rather take place. The *Harmony Gold Mine* strike also yielded a negative coefficient of -1.4517 with a 5% level of significance. This suggests that the strike caused a direct appreciation of the Rand by 1.4517 units and increased the long term value of the Rand by 1.4337 units. This result also did not conform to the expectations of a reduction in the value of the Rand.

The other two significant results occur on the 13th of April 2006 and the 17th of September 2008. The dummy variable for the strike which took place on the 13th of April strike was positive (0.2408) at a 10% level of significance, and is related to a strike in the security industry concerning the *South African National Security Employer's Association* (Sansea). The presence of a positive coefficient indicates that the effect on the exchange rate would be a direct depreciation to the value of 0.24077 units, while the long run effect would be a depreciation of 0.24082 units. The dummy variable for the Woolworths strike which took place on the 17th of September 2008 had a statistically significant, positive coefficient. The relevant dummy variable had a coefficient of 1.1344, suggesting that the direct effect of the intervention was a depreciation of the Rand by 1.1344 units while the long term effect is a depreciation of 1.1264 units.

Possible reasons for an appreciation of the Rand following strike action depend on the context of the strike. It is worth noting that the duration over which the strikes took place was important in determining whether the respective dummy variables were either positive or negative. The strikes which resulted in an appreciation of the exchange rate were of 3 and 7 days in duration respectively and took place in 2003 and 2004, while the strikes which caused a depreciation of the exchange rate were of a longer duration; 53 and 27 days respectively, and took place in 2006 and 2008. This may indicate that shorter strikes do not have a negative impact on the exchange rate and instead result in an appreciation of the Rand, while longer strikes are perceived with more negativity and are expected to have a greater impact on the economy in terms of costs associated with strike action. Additionally, the longer strike periods resulted in a much greater loss in man-days for Woolworths (405 000) and Sansea (1 280 000) compared to the Delta (21 000) and Harmony (13 500) strikes.

If we consider the period over which these strikes occur (Figure 3), one would observe that between 2002 and 2004 the Rand was gaining in strength against the dollar. This is in line with the results, which suggested that the strikes caused an appreciation of the Rand over the period in which they

took place. This is not to say that the strikes were the major cause of the appreciation, but that that they possibly played a part in contributing towards the strengthening of the Rand. The opposite is true for the 2006 and 2008 strike period, where the rand was weakening against the dollar. The results from the Sansea and Woolworths strikes thus fit the general trend of the exchange rate for the period. What this may suggest is that the overall trend in the exchange rate market may have enhanced or reduced the effects created by the strikes. Economicshelp (2015) notes that there are seven key ways in which an exchange rate can appreciate. These are; an increase in interest rates, lower inflation, increased competitiveness, expectations of appreciation, current account surplus, high economic growth, and the buying of the currency. The only two which might apply are the current account surplus (2002/2003) and/or a greater demand for the Rand. Due to the current account only experiencing a surplus for around a year, we can exclude it as much of the test data lies outside that range. Therefore, the only reason for the currency to appreciate is due to an increased demand for the Rand. This supports the observations earlier that the appreciation or depreciation caused by the strikes may instead just be the underlying trend in the exchange rate at the time. There is no evidence which could be found that suggested a strike could cause an appreciation of the exchange rate on its own.

When comparing the individual strikes, the sectors that they belong to are also worth considering. What is worth noting is that the individual strikes in the various sectors produced different results. Individual strikes in the mining and automotive industries caused the value of the Rand to rise, while strikes in the security and retail industries caused the value of the Rand to fall. These results are contrary to expectations as one would expect the sectors with the most exposure to the exchange rate be the worst affected from strike action (Melvin and Tan, 1996:330). Additionally, with the Rand strengthening the export focused sectors (Mining and Automotive) may not perform quite as well as expected with a weaker Rand. The two strikes which caused a depreciation in the Rand occurred in the Security and Retail sectors. As mentioned before, these strikes were of a longer duration than the others and as such had more time to create a negative perception in the market. The security sector strike is especially relevant as this sector provides security to operations with high value, and as such posed a significant risk to assets should the dispute continue or become more violent. Schroeder (2006) noted that striking security guards and community members looted shops and disrupted business during the Easter weekend. This may be indicative of the type of behaviour by strikers that causes a negative perception in the media and results in a depreciation of the Rand. Abrahams (2008) argued that the strike at Woolworths was due to the employment structure, with a large percentage of the workforce (70%) being casual employees. This caused strife as employment security was low and employees believed that their rights were not being met (Abrahams, 2008).

4.5 Industry: GARCH and Intervention Analyses Results

Of the seven industry/sector groupings (automotive, education, public, mining, retail, textiles, and transport), three of the seven had strikes which had an impact on the volatility of the exchange rate. These are the automotive (-0.01541), mining (-0.0137) and transport (+0.0510) sectors. The interpretation of these coefficients is that strikes in the automotive and mining industries would reduce the volatility of the exchange rate, while strikes in the transport industry would increase the volatility. In terms of exports, mining export values contributed 25.3% to the total export value of R926.8 billion in 2014, while the automotive sector contributed 9.5% towards the total (DTI, 2014). Additionally, while the transport sector is not necessarily an exporter, its contribution to delivering goods from centres of production to ports is significantly important. This may be expected due to the importance of these sectors with regard to international trade and their contributions to the effective, efficient delivery of products in the market. Kaggwa (2011:1) notes that the automotive sector has been an object of emphasis in South Africa's economy for the past decade as international firms such as *Volkswagen* and *Toyota* have found South Africa as a useful staging area for producing vehicles as well as providing a useful market for their products. Kaggwa (2011:2) suggest that the South African government has put significant emphasis on this sector as a potential job provider for many people. Allix and Gernetzky (2013) argue that this has exposed the sector to politics and strife as workers seek to gain a larger proportion of the perceived profits by demanding above-inflation wage increases.

Media Club South Africa (2014) noted that with the growth of South Africa's tertiary and secondary industries, as well as a fall in the production of gold, the contribution of mining to South Africa's GDP has fallen over the last few decades. However, it was also noted by Media Club South Africa (2014) that this decrease may well be offset by a growth in the beneficiated and downstream minerals industry. The transport industry is an important aspect of any country's economy as it provides the means to deliver products to and from ports. This makes it a key component in the economy and thus affects the efficient delivery of products and services in South Africa. These two points provide context for assessing the impact of strikes in the mining and transport industries. Mining, while still a significant contributor to GDP, is no longer the cornerstone of the economy as it once was. The transport industry however, has the important role of connecting South Africa's industries with the domestic economy as well as the rest of the world.

The other sectors (education, public, retail, and textiles) are perhaps not as internationally linked as the three sectors (mining, transport, and automotive) which contribute a significant amount to South Africa's trade balance through exports (Media Club South Africa, 2014). Education is essentially

more of a domestically consumed good and does not have the same characteristics as tradable items such as gold, vehicles and oil. One would thus expect that strikes in the education sector, while a concern to the South African public, do not have a direct link to foreign investment and perceptions regarding South African stocks and companies. With regard to the public sector, one may expect a more volatile response due to bond offerings and returns, however it seems that due to the long term nature of bonds and their characteristic of essentially being "risk-free" (Howells and Bain, 2008:322), investors are more concerned with changes in the prime interest rate than whether or not civil servants go on strike. Another view that could be taken and is offered by Bhana (1998:43) is that to strike and public displays of dissention are a constitutional right and are thus indicative of a healthy democracy, however this theory is not supported by the evidence (strikes effect the exchange rate) and could be considered outdated.

In this analysis, the retail sector incorporates strikes that have occurred in various retail chains such as *Pick 'n Pay* and *Shoprite Checkers* as well as the cleaning industries. Thomas White International (2011) notes that the retail sector in South Africa is import-driven, and is thus dependent on the exchange rate for making purchases abroad, rather than exporting goods and earning foreign exchange.

Another defining characteristic of the retail sector is that the goods are sold mostly in the domestic market. This means that local producers and consumers are most affected by strikes. Fedderke and Schaling (2005) note that mark-ups of prices in South Africa are 30% compared to 10% in the USA, which could have a profound influence on negating the negative shocks/wage increases caused by strikes in this sector, as there is a higher margin of profitability available. The same could be said of textiles. International Trade Centre (2010:1-9) notes that textiles in South Africa have faced a rather grim past, with cheap Chinese goods eroding market share and making it difficult for domestic producers to compete. The textiles industry in South Africa is thus mainly a domestic one and is not a large contributor to GDP or foreign exchange. International Trade Centre (2010:1) additionally notes that strength of the Rand is an issue for the domestic firms as it makes South African textiles less competitive abroad. Thus, while imports of foreign produced textiles have grown since 2005, exports of South African textiles products have significantly declined (International Trade Centre, 2010:6). This would suggest that the strength of the Rand has a far greater effect on the industry, than the industry has on the Rand.

The sectors which showed significant results that suggest a change in the volatility of the Rand following strikes, are the automotive, mining and transport sectors. These results can be found in

Table 4. The automotive sector dummy registered a coefficient of -0.0154 with a level of significance just above 10% (probability value of 0.1044), which is both negative and borderline significant. This suggests that strikes in the automotive sector reduce the volatility of the Rand in the foreign exchange market by 0.0154 units. This does not conform to expectations. However, South Africa's automotive industry, while producing for the local market, also produces a large number of vehicles for export. Many of the parts are imported before assembly and so there is a flux of components and vehicles in and out of the country. The reduced volatility may thus stem from operations being suspended (due to strike action) which led to a decrease in speculation or hedging activity in the foreign exchange market. Another explanation is that investors/speculators had already decided what effect the strike may have on the industry, made their decisions, and are patiently waiting for the strike to end. Bhana (1997:48) argues that with strikes there is also usually uncertainty regarding the expected duration of the strike and that strikes which continue for an extended duration are usually more costly. Thus, as a strike goes on, the potential for it to create losses for investors increases. This would make it difficult for investors to assume what the actual effects on the industry will be at the onset of the strike, and may explain why levels of volatility differ between strikes and over the duration of the strike.

The mining industry dummy is perhaps the most surprising result, registering a coefficient of -0.0137 with a level of significance just below the 10% level (probability value of 0.0958). This could be interpreted as being weakly significant, and that a mining industry strike would reduce the volatility of the Rand in the foreign exchange market. This does not conform to expectations, as due to mining being one of South Africa's greatest contributors to GDP and earners of foreign exchange (Kaggwa, 2011), one might expect a mining industry strike to increase the volatility of the Rand as uncertainty regarding the value of the Rand and South African stock prices increases.

The first possible reason for this result is that the period over which the dummy variables are employed is too long. The explanation for the period which the dummy variable captures as possibly being too long is that if there is a strike for an extended period, one might fail to capture the initial cluster of volatility which is produced (Enders, 2010:123). This would mean that the increased volatility would be focussed, for a short period, around the initial date of the strike. This would also depend on whether the strike was announced in advance or whether it was a wildcat strike. An argument for the strike dummies being too short also holds some merit. Gleditsch and Maestas (1998:6) argue that volatility may persist over time instead of flaring and abruptly adjusting back to and contextual changes. This would suggest that if there was already volatility in the market, the impact of the strike may have little noticeable difference in terms of the volatility of the exchange rate. The characteristics of the strike are also important to consider; if the event is a sudden, violent,

wildcat strike one might expect a short period of volatility (Bhana 1997:48). Prolonged volatility would occur if there was constant speculation within the market regarding the outlook on the strike, or if there were intermittent events (e.g. violence, breakdown of relations between bargaining parties, sympathy strikes) during the period of the strike which caused volatility to spike. The volatility dummy variables used in this study managed to capture changing levels of volatility over both short and extended periods, so it is difficult to say for certain whether extending or decreasing the period over which they were used would have led to better results.

This would mean that the economic effects from the strike (lost production and revenue, increased wages and operating costs, as well as inflation) would be lagged, and may only begin to be noticed after more time has elapsed (Chaudhary and Shrestha, 2013:18; Maswanganyi, 2014; Mail and Guardian, 2013). Additionally, as noted before, the actual strike duration is not known when the strike commences, so investors must make a choice and either hold on to their stocks or reduce their exposure by selling off the stocks. Investors may also simply shift their funds from the mining industry into a more profitable or stable one, such as real estate, pharmaceuticals or bonds. This would not cause a significant change in the level or volatility of the exchange rate.

The transport industry dummy produces a coefficient of 0.0510 with a probability value of 0.0559 (statistically significant at the 10% level). This would translate into a strike in the transport industry causing the volatility of the Rand to increase by 0.0510 units; a result which conforms to initial expectations. The transport industry plays a major role in transporting goods and services around the country. Marrian (2012) notes that a strike in this sector affects all other industries as it influences the fuel supply, the delivery of goods to and from their places of production to consumers as well as the international market. By preventing the delivery of fuel, labourers cannot get to their places of work, products cannot be delivered, and consumers/producers cannot purchase what they need. This, combined with the non-delivery of goods means shops run low on consumables, warehousing costs mount and perishable goods spoil. Transport strikes effectively bring the economy to a labouring halt and a compromising position. An increase in the volatility of the Rand is thus expected as Chaudhary and Shrestha (2013) and Marrian (2012) note that not just the strike-affected industry is affected, but also those which rely on the industry for product delivery.

The results for the intervention analysis (when conducted across industries) yielded only one borderline significant result. This was for the retail industry and a coefficient for the dummy variable was registered as 0.1361 with a probability value of 0.1172. This result would suggest that the direct result of a strike in the retail industry was a 0.0136 unit decrease in the value of the Rand and the long

term effect is a 0.1432 unit decrease in the value of the Rand. This result conforms to the expectations discussed in the literature review where it was noted that strikes should generally cause the value of a currency to depreciate.

What is interesting is that of the seven sectors tested for a change in the value of the Rand, only the retail sector produced a (weakly) significant result which showed that a strike would decrease the value of the Rand relative to the US Dollar. Other sectors such as the Automotive, Mining, Transport and Textiles, which one might expect to yield significant results, did not. If one observes the individual results one would note that all of the strikes relating to the retail industry, bar the *Woolworths* one, produce a negative coefficient for their respective dummy variables (even though they are statistically insignificant). This would suggest that the retail dummy as a representative for the industry as a whole is dominated by the *Woolworths* result (which produced a significant, depreciatory result in the individual tests). If the test is accurate, and strikes in the retail industry do indeed cause a depreciation of the Rand, then the expectations discussed earlier would be fulfilled and we could conclude that strikes in the Retail sector have a negative effect on the value of the Rand.

The reason why strikes may have an effect contrary to expectations could be that investors pursue different strategies. Fedderke and Schaling (2005) discovered that mark-ups in South Africa are far larger than those in many developed economies. The reasons they gave for this is that inflation is expected to be higher and the margin for profit is thus 30% compared to that of the USA where it is 10%. Increased profit margins, even if they come with the higher risk associated with labour costs, may have an influence on investment decisions i.e. investors may choose to hold the risky stock in expectation of greater returns further down the line. This would have mean that the strike would have little impact on the volatility of the exchange rate. However, the generic view of the relationship between strikes and inflation has been discussed in detail in the literature review, as well as in the South African Reserve Bank Factsheets (SARB, 2012*a*, 2012*b*) with the general conclusion being that strikes and inflation are linked through increasing wages and therefore costs. An investor who held this latter view may be more risk averse and therefore inclined to move their assets elsewhere. Addionally, Carlson and Osler (1998:25) argue that speculation can influence the exchange rate in different ways, depending on the level of speculation and different views held by market participants. This would imply that contrary expectations are possible, especially when there is a degree of speculation in the market.

4.6 Summary

Both individual and industry strike dummies were constructed to assess the effect of strikes on the volatility and mean level of the Rand/US Dollar exchange rate. For the individual GARCH analysis, only a few of the regression results proved significant and conformed to the expectations of increasing the volatility of the exchange rate. Other significant results yielded coefficients that suggested a decline in volatility was caused by the strike action. The dummy variable and the appropriate period of a strike it should cover was also discussed. This was due to a concern that the dummy variable may not be able to capture very short term volatility clusters if the dummy covers an extended period, or that a dummy variable which covers a short duration may miss volatility effects which occur outside the defined period.

Most of the regression results for the GARCH analysis dummy variables are insignificant with varying coefficient signs. Bhana (1997:48) notes that the beginning of a strike is the period which is usually associated with abnormal, statistically significant, negative returns with regard to share prices. This has important implications with regard to the efficiency of information in the market and how investors may respond. Since the volatility of the Rand was measured over the whole duration of the strike, instead of a short period around the initial onset of the strike, the lack of significant results might be attributed to this.

Overall, the regression results for the GARCH dummy variable were mainly insignificant. Of the 72 regressions, there were only fourteen which indicated that a strike had an effect on exchange rate volatility. Nine of the dummy variables were statistically significant and had negative coefficients, which is to say that the strike would decrease the volatility in the foreign exchange market for the Rand and defy the expectations. Thus only five of the results of the 72 adhered to expectations and increased volatility in the market. Additionally, of the seven industry GARCH regressions only three produced (weakly) significant results (automotive, mining and transport), and only one of these with a positive coefficient (transport).

The results for the individual intervention analysis produced fewer significant results than the GARCH analysis. There were a few strikes (two out of four) which conformed to expectations by causing a depreciation of the Rand. There were also a number of results which suggested that the strike caused an appreciation of the Rand. In the majority of cases however, it was found that strikes did not have a statistically significant impact on either the value or volatility of the exchange rate, suggesting that the level and volatility of the Rand in the foreign exchange market is not very sensitive to strike actions.

CHAPTER 5: CONCLUSION

5.1 Conclusion

The objective of this paper was to explore whether labour strikes in South Africa have an impact on the value and volatility of the Rand. In order to do this a number of econometric regressions were carried out using Rand/Dollar exchange rate data to try and identify which strikes were significant in influencing the value and/or the volatility of the Rand. Literature regarding the various effects and characteristics of strikes was reviewed to gain a better understanding of the existing ideas surrounding the topic, as well as to help in interpreting the results of the regressions.

The literature review explored how strikes affect the rest of the economy (micro and macro factors) and identified various challenges which arise due to strike action. Strikes were seen to increase inflation, increase costs, and cause a decline in investor confidence. The conventional view which emerged was that strikes should cause an increase in the volatility of the exchange rate, as well as to reduce the value at which the local currency trades (depreciation). Volatility is seen to increase due to a greater level of perceived risk, and the value is seen to decline due to the same reason, combined with lower levels of productivity relative to cost and higher inflation. Additionally, it was found that there was a link between the returns on shares listed on the local bourse and the level and volatility of the exchange rate. This explains that shares traded on the exchange could have an impact on the level and volatility of the Rand, meaning that listed companies which are exposed to strikes may have an impact on the volatility/level of the Rand through the trading of their shares.

A GARCH and intervention analysis was conducted for the periods of strike action relating to the most significant strikes for each year from 2000 until 2012. “Significant” strikes were judged to be those where the greatest amount of production was lost due to strikers not being at work. The phrase “man-days” refers to the amount of work a typical worker is expected to get done in a day. The strikes were separated into seven broad categories: automotive, education, mining, public, retail, textiles and transport, for the additional purpose of an industry analysis. In total, a number of 72 strikes were investigated between January 2000 and October 2013. Of these, fourteen showed statistically significant results when subjected to a GARCH analysis, while only four registered significant intervention analysis results. The majority of statistically significant GARCH results did not conform to the expectations that a strike would cause an increase in volatility, while the significant results in the intervention analysis were mixed in that some of the results suggested that the value of the Rand would decrease (as expected), while other suggested an appreciation of the Rand. One could thus conclude that strikes are not as significant as one might expect to the South African exchange rate..

However, due to the changing nature of volatility (sometimes persistent, sometimes occurring in brief clusters) and the multitude of factors which influence the level of the exchange rate, it is difficult to interpret the results with absolute certainty.

When considering the effects which strikes may have on foreign investors' investment, it is important to note that foreign investment has been shown to be mostly denominated by holdings in South African government bonds (Porter, 2013:4). Since bonds are known to increase in value with a falling interest rate as well as their long term nature, foreign investors may not be particularly concerned with a strike occurring, unless there is a sudden fall in the value of the Rand or interest rates are expected to be increased. Since only four of the strikes showed any significance in the individual strike analysis with regard to influencing the mean level of the exchange rate, with two showing an appreciation of the Rand and two showing a depreciation, strikes may be regarded as being relatively unimportant to many foreign investors. However, in the industry tests, the intervention analysis results indicated that strikes in the Retail sector would cause a fall in the value of the Rand, thus conforming to expectations.

Another factor has been the role of international events such as quantitative easing, which officially began in March 2009. It was noted by Porter (2013:4) that quantitative easing in the USA has a significant effect on investment decisions. Rumours that it could come to an end creates risk for international investors and may result in them turning away from developing markets to more developed markets which are viewed as more secure and less risky. The analogy of "herd behaviour" plays a role here, with investors disinvesting from South Africa in the advent of political or social tensions (in this case strikes) as they do not wish to be the last to do so. The financial crisis which began in 2007 and gained steam in 2008 is also an example that is very important in a global risk context. The year 2008 produced three significant results, all of which conformed to expectations i.e. the two GARCH results (Woolworths and Pamodzi Mining) showed increased volatility, while the intervention analysis (Woolworths) showed a significant depreciation in the value of the Rand. While these are important results as they add credence to the expectations (increased volatility and decreased value) noted in the literature, there are also alternate views which should be considered. The first is that the regressions (both GARCH and intervention analysis) may have simply captured the trends created by the unstable macroeconomic environment at the time. The other view supported by OECD (2009:3) is that the effects created by the strikes may have been emphasised by the negative macroeconomic perceptions at the time, and thus made the impact created by the strikes more evident.

The next conclusion revolves around the dummy variables which were used in the various GARCH and intervention analysis regressions. As noted in the interpretation of the GARCH and Intervention Analysis results, there are concerns surrounding the appropriate duration the dummy variable should cover in order to best capture the effects of a strike. Bhana (1997) produces a strong argument in favour of a short dummy with regards to volatility testing. This would mean that the dummy variable would only be constructed for a few days around the immediate strike date. However, even with a dummy variable constructed over a longer period, some significant results could be found using the GARCH analysis. This may be indicative of prolonged volatility in some industries, as well as increased uncertainty about the outcome of the strike as it extends in duration and bargaining councils fail to reach an agreement.

The intervention analysis dummy has also been identified as an area of contention. This is due to the effects of a strike not immediately dissipating when the strike ends. As discussed previously, "knock-on" effects may exist that continue to haunt the strike affected company/industry, as well as the industries which are linked to it long after the strike has been concluded. These effects could be in the guise of increased costs, interest payments on debt, lost production, inflation, unemployment and uncertainty linked to the future of the industries in question (SARB, 2012a:2-3). This could indicate that the effects on the level of the Rand caused by strikes take much longer to materialise, and if they were to be properly measured a longer period may need to be considered. The limitations relating to the study are further discussed later in the chapter.

The decision to only analyse the immediate effect that a specific strike had on the exchange was taken due to the complicated nature of exchange rates, especially over extended durations. As noted in earlier sections, there are many factors which can and do influence exchange rate behaviour. Separating the actual effect caused by the strike from all the other variables over an extended period would be difficult indeed, and would require extensive further research to understand all the factors at play and how to adequately account for them. Thus the decision was made to cover only the duration of the strike in an attempt to capture the more immediate effects.

The regressions which were conducted that included all the strikes in a certain industry may be influenced in a similar fashion by the length/specification of the dummy variable as those tests which investigated each strike individually. This is due to the industry tests using a combination of all the dummies for the strikes which took place in the specific industry. The results suggest that that mining and automotive strikes reduce the volatility while the transport strikes increase the volatility, while the intervention analysis for the various industries suggest that retail strikes cause a depreciation of

the exchange rate. This makes it difficult to interpret the results as one would not usually expect strikes in the mining and automotive industries to reduce the volatility of the exchange rate, as many news articles in financial sections blame strikes for increased uncertainty and for creating a negative view of the Rand. Increased uncertainty would mean that the typical risk adverse investor would disinvest, which should increase volatility, as is indicated by Melvin and Tan (1996). Reasons for the Transport industry producing a positive coefficient in the Industry GARCH regression as opposed to a negative one would mean that volatility over the period increases. The reason why volatility may seem to be prolonged in this industry while not in other industries is that the transport industry is very central to the whole economy and therefore its effects on different sectors in the economy take time to occur, which may make investors wary of the spill-over effects impacting their investments (Allix and Gernetzky, 2013). The only intervention analysis regression which achieved a significant coefficient for the industry analysis was regarding the Retail industry, which produced a positive coefficient and thus indicated that strikes in the retail industry cause a depreciation of the Rand. This result supports the theory that strikes result in a decrease in the value of the local currency.

In final conclusion, while most of the regressions produced insignificant results, there were a number of interesting findings. Firstly, by achieving significant results in some of the regressions, it proves that some strikes do indeed have an impact on the exchange rate. This impact may be an increase or decrease in the relative volatility or the value of the Rand. Secondly, it has highlighted that some sectors may be more exposed to the exchange rate than others, i.e. the automotive, mining and transport sectors may have a greater impact on the volatility of the exchange rate, while the retail sector has a greater impact on the value of the Rand. Some sectors (those with a more international context i.e. mining, automotive, transport and retail) seem to be more sensitive to the perceptions of investors than others. This conforms to expectations as it is these foreign-linked industries that produce much of South Africa's foreign exchange income. It must also be noted that it is the belief of many that strikes cause adverse effects in the economy relating to increased uncertainty and costs, as is evidenced in (Allix and Gernetzky, 2013; News24, 2012*a*; News24, 2013*b*; OECD, 2013). These perceptions, as displayed in local and international media, certainly play a role in determining the volume of investments within an economy. The fact that most foreign investment is currently tied up in government bonds (Porter, 2013:4) may also be suggestive that post-crisis investments by foreign investors prefer the relatively risk-free option of bonds than the swings associated with the stock market and South Africa's restive labour unions.

Thus, it can be said that while not all strikes have the potential to have a significant impact on the value and volatility of the exchange rate, there are a few which have the characteristics to do so. The

expectations that were created by the literature review that the effect of strike action is an increase in the volatility and a depreciation of the exchange rate does not hold true for all cases. Most of the GARCH regressions that produced statistically significant results also indicated that a reduction in volatility was the result of the strike, and not the expected increase in volatility. However, the intervention analysis was slightly more in line with the expectations that strikes would cause a depreciation of the Rand. Two of the four significant results achieved in the intervention analysis for individual strikes (Sansea and Woolworths) resulted in a depreciation of the Rand, while the only significant industry intervention analysis result (retail industry) also showed a fall in the value of the Rand. The support for strikes causing a depreciation of the Rand is thus slightly stronger than the evidence behind the increased volatility theory. On a final note, it was found that the intervention analysis results were in line with the economic trends at the time (appreciating during the "boom" years, and depreciating in the "bad/crisis" stricken years). This may have been due to the economic environment at the time emphasising the effects of the strikes. Additionally, three of the significant GARCH results occurred during the financial crisis of 2008. This may indicate that the economic environment at the time also had an effect on volatility and may also have exacerbated the results.

5.2 Possible Limitations

A number of limitations should be noted, particularly related to the construction of dummies and the intervention analysis. The dummy periods extend from the onset of the strike until its conclusion. They were constructed in this way so as to ascertain whether the period over which the strike occurred caused a change in the volatility of the Rand and if the long run mean of the exchange rate was affected by these strikes. Concerns pertaining to using the same dummy variable for both the GARCH and intervention analyses are that, according to Bhana (1997:48), it is the beginning of the strike that shows the most significant changes in volatility. It was also noted that abnormal returns occurred before the strike was announced. Additionally, Enders (2009:123) argues that volatility occurs over periods and is not constant over time, this would suggest that volatility may increase for a period before the series would then revert to its mean level.

Thus, while it can be difficult to determine the exact periods when volatility will be most evident, employing a dummy variable that covers the entire duration of the strike should have the most chance in capturing any volatility which occurs. Additionally, the tests which were conducted did find statistically significant GARCH coefficients for strikes which took place over an extended duration. This would support the theory by Enders (2010:122) that suggests volatility can be persistent.

What may help increase the accuracy of the tests is a more in depth look at the characteristics of the strike, which would help determine which periods within the duration of the strike should be expected to create the greatest change in the volatility of the exchange rate. This idea was inspired by Bhana (1997) who noted that the greatest volatility occurs around the onset of the strike. With strikes in South Africa sometimes occurring over an extended duration; for example: the Lonmin/Marikana strike lasted 29 working days (News24, 2012a), analysing specific periods of the strike may provide valuable insights into the specific nature of volatility in the exchange rate due to strike action. Analysing periods of strikes linked to violence and death, as suggested by Melvin and Tan (1996:340), would also increase the chances of detecting significant changes in volatility levels. This creates a limitation for the study as this theory was not originally incorporated in the testing procedure. Future research should incorporate this theory in order to more accurately assess the impact of strikes.

Another important consideration relates to legal and illegal strikes. Bhana (1997:48) notes that if a strike is announced by unions in advance, investors may not wait for the strike to actually occur before disinvesting. This may result in volatility increasing or the value of the Rand depreciating before the strike actually begins. On the other hand, wildcat strikes are not announced in advance, and investors may only notice a strike once it is announced on the news. This may have the effect of delaying the volatility until the onset of the strike.

Intervention analysis produces another set of limitations. These concerns revolve also around the duration of the period of the intervention dummy. As mentioned before, the dummy variable covers the entire period of the strike. Thus, for the dummy to be statistically significant there must be a sustained change in the mean value of the exchange rate that coincides directly with the strike duration. Chaudhary and Shrestha (2013:18) suggest that the economic effects of a strike can take a while to manifest (one to two months with regard to inflation). The concern surrounding this issue is that, the effects of the strike may take longer to manifest due to the nature of economic environment. Western Union (2014) note that companies that are exposed to international markets generally utilize hedging and risk neutralising strategies that cover a company's risk profile months in advance, this means that companies which may have exposure to currency risk, market risk, and political risk.

It was earlier argued by Bhana (1997) that volatility related to strikes may well only last a few days around the initial start of the strike. If there was indeed a change in the mean it would either occur directly following the volatile period due to a sudden jump or fall in the value spurred by the volatility or economic fundamentals, or over a far longer duration as companies struggle to manage their costs,

as well as the knock-on effect strikes have on domestic market. The automotive strike for example may influence domestic steel and parts producers, while the transport strikes may have an effect on costs pertaining to most industries that need to store and transport goods. The granting of credit by banks and other financial institutions may well aid these businesses in riding out the initial storm (of costs), however these need to be paid back over time and at interest. This would theoretically reduce growth prospects as instead of embarking on profitable ventures and employing more labour and hence contributing more positively to economic growth, businesses are forced to pay back costly, interest bearing loans (Business Day, 2014).

For the intervention analysis, therefore, the dummy variables should perhaps be either shorter or much longer (depending on the nature of the industry affected and the knock-on effects it has on locally linked businesses). This would also provide more insight into the short and long term impacts of the strike.

Many of the limitations which are listed above were discovered during the research which was conducted to explore certain results and how they came about. The study produced a number of results which were contrary to expectations, so these had to be further analysed through additional research. The limitations which were identified may have reduced the significance of the results in hindsight, however the correct conventional procedures and tests were used to assess the data so the results should be accurate within reason.

5.3 Further Research

Following on from the limitations, further research would be required to determine which industries are most affected by strikes. From the research done it is evident that the following areas would need to be explored: how the industry is linked to the international market, what tools are available in various industries that may offset or exacerbate the effects of strike action, whether the company/industry is more exposed to the international market through imports or exports, which unions are the most aggressive, and how dependent the consumers are with regard to the product/service being withheld. These studies should focus on the short and long term impacts of a strike, as well as the time frames over which various effects manifest themselves i.e. how volatility manifests itself through the duration of the strike, how changes in the value of the Rand occur and what decisions drive the change, and the magnitude and duration with which knock-on effects affect other linked industries and businesses. Bhana (1997) has already suggested that volatility is most evident for short periods around the onset of strike action or violence. Constructing multiple dummy variables for specific periods (selected to coincide with certain events i.e. a death caused by striking

workers) within the strike may increase the accuracy of the results. Another factor worth investigating would be whether wildcat strikes had a greater impact on the volatility or value of the Rand than legal strikes. This would provide insight as to how volatility evolves over time, as well as whether the effects created by wildcat strikes are of a greater magnitude than those for planned strikes.

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Figures and Graphs

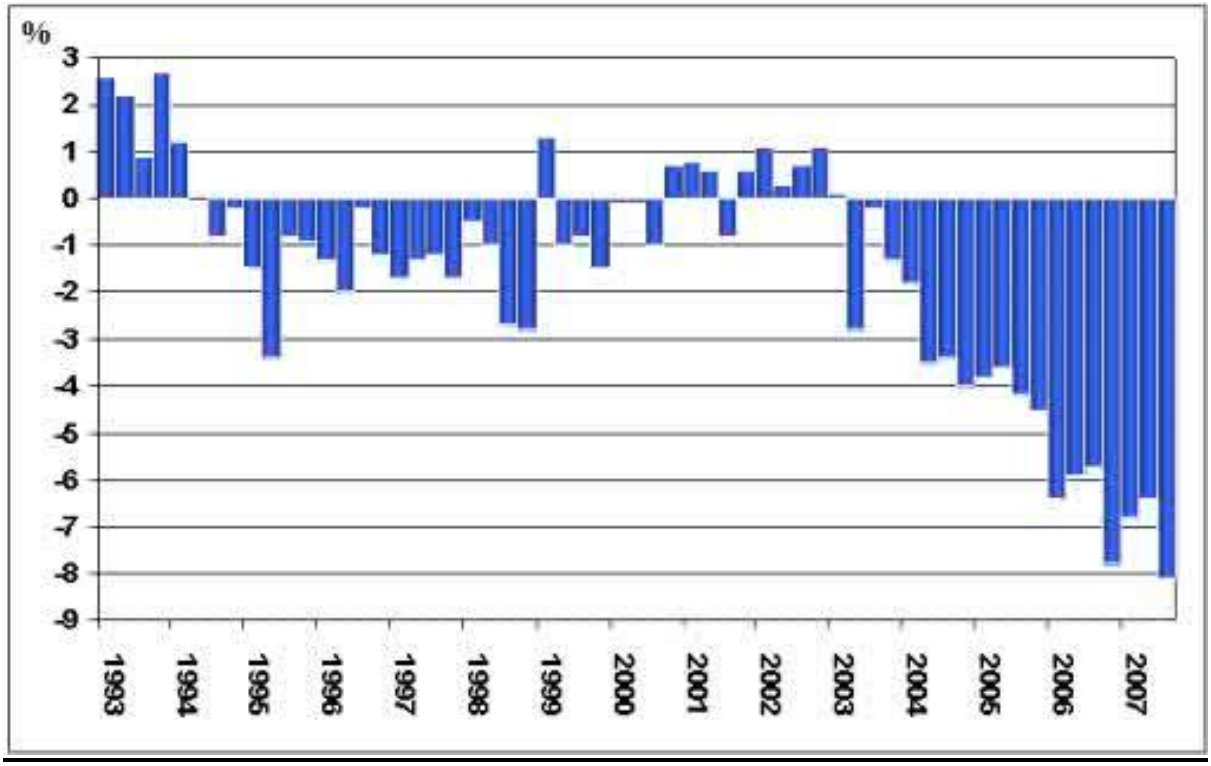

Figure 1: Current Account Deficit - % of GDP Sourced from Porter (2013:4)

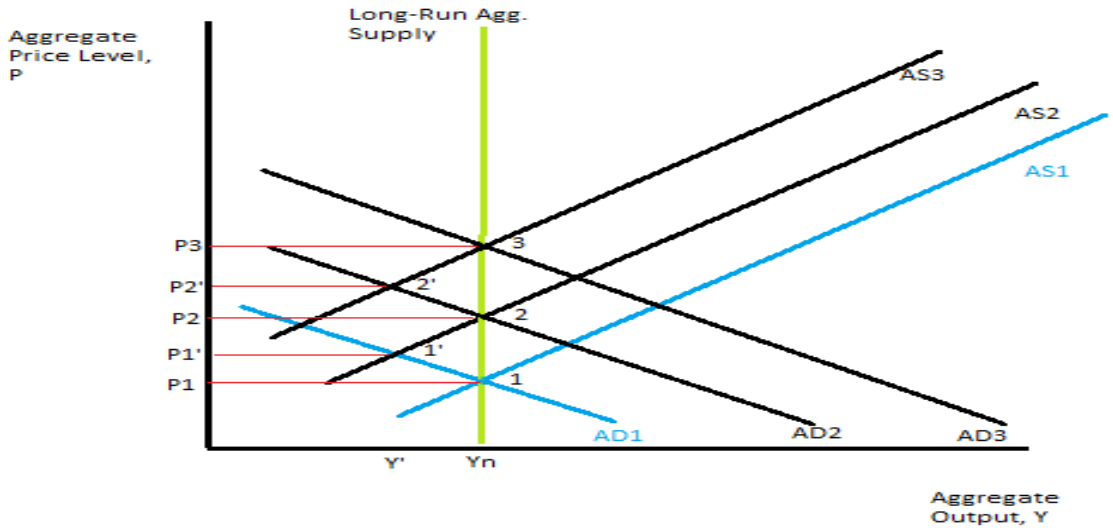

Figure 1: Cost-Push Inflation
Adapted from Mishkin (2007:621)

Figure 2: Supply and Demand for Labour Sourced from Mishkin (2007:620)

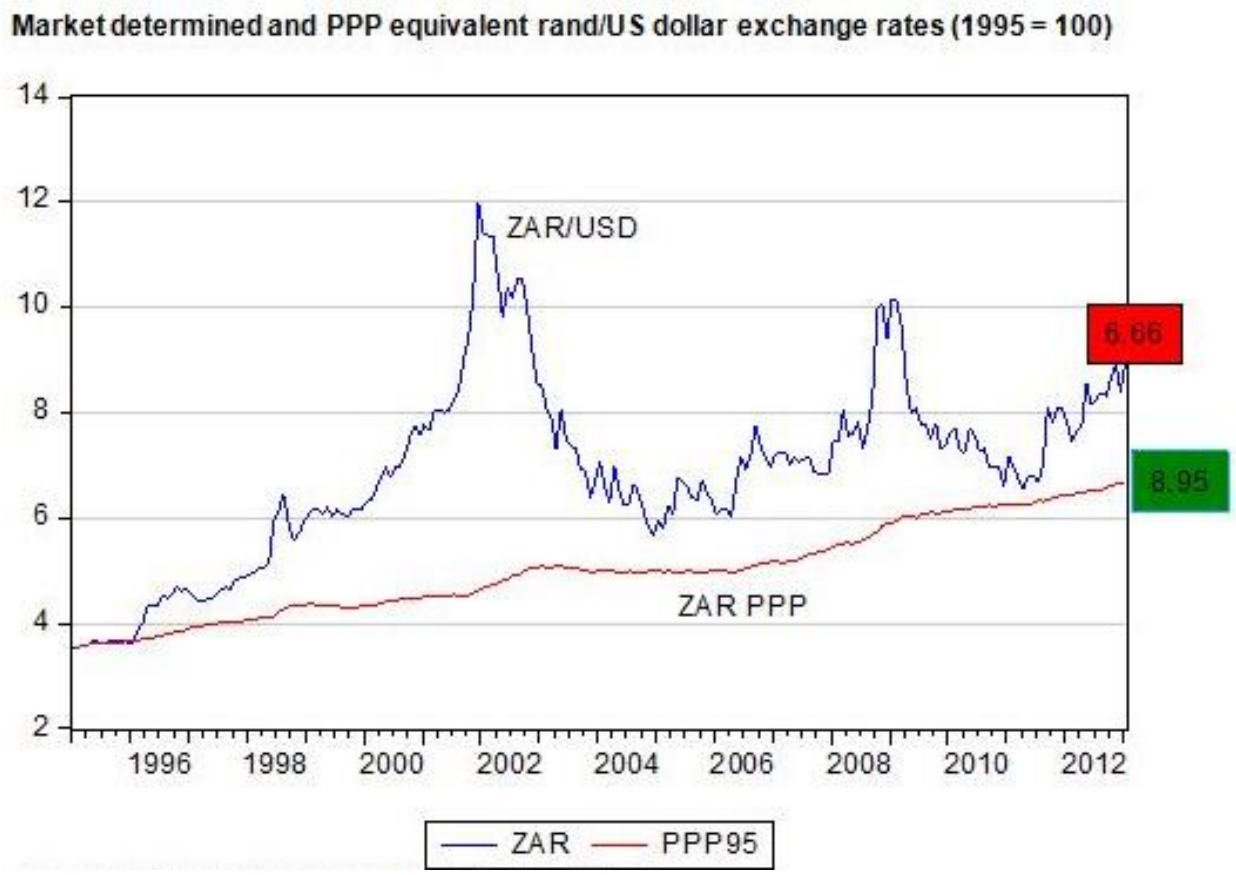

Figure 3: ZAR/USD exchange rate (1995-2012) Sourced from Investec Wealth & Investment

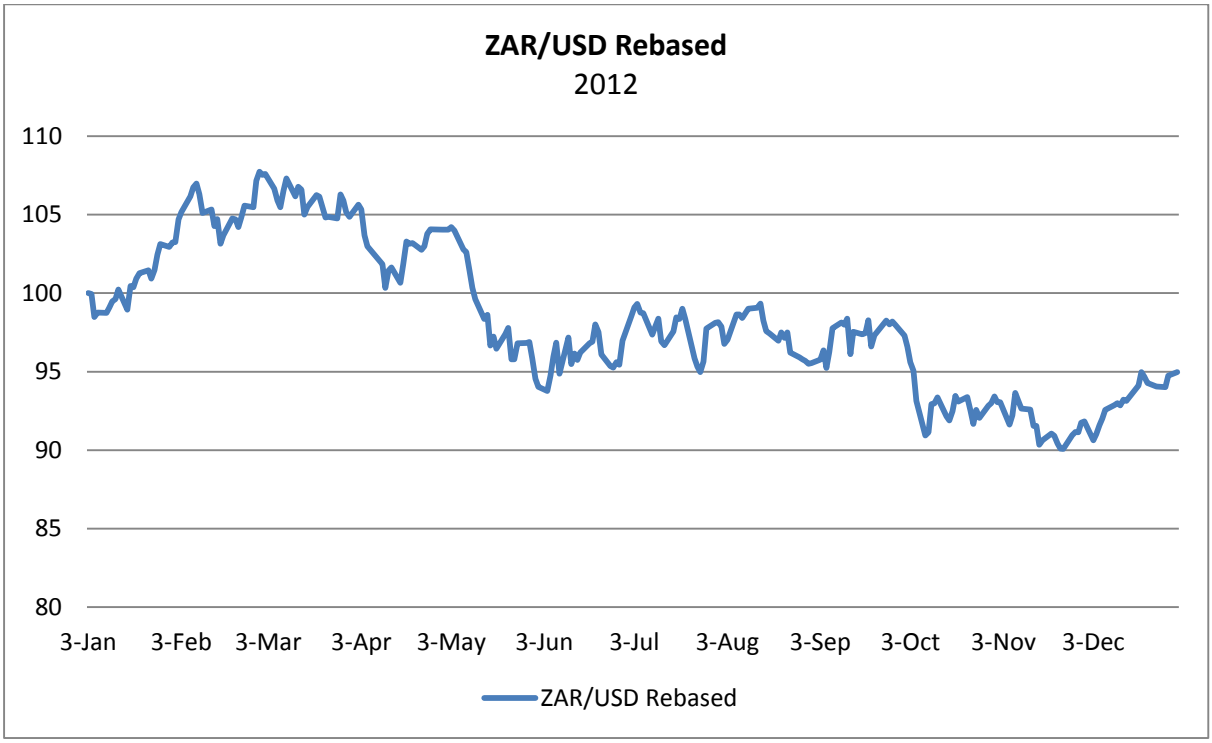

Figure 4: ZAR/USDollar exchange rate for 2012 Sourced from Standard Bank

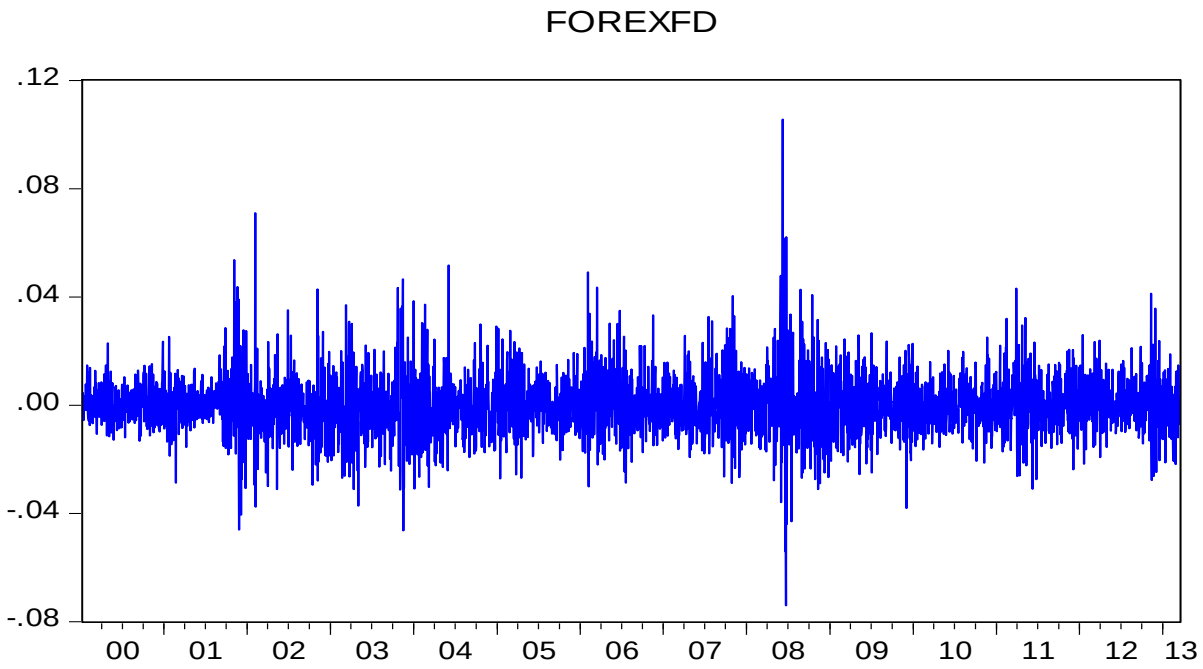

Figure 5: Forex stationary at first difference

```
Null Hypothesis: LOG_FOREXFD has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=19)

                                        t-Statistic          Prob.*

Augmented Dickey-Fuller test statistic  -2.675602            0.0997
Test critical values:    1% level                -3.432059
                         5% level                -2.862181
                         10% level               -2.567155

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

Figure 6: ADF stationarity results

Table 1: Significant Strike Actions: Man-days lost in top Strikes

Mandays lost in the top four strikes, 2000						
Rank	**Date**	**Union**	**Company/Industry**	**Man-days**	**Duration (days)**	**Trigger**
1	18-Sep	NUM	Amplats	110000	20	Wages
2	15-Dec	Satawu	SEA	100000	12	Wages
3	21-Feb	TGWU	RFEA	55000	1	Wages
4	21-Jan	Numsa	Volkswagen South Africa	14300	11	Dismissal

Sourced from South African Survey (2000)

Mandays lost in the top five strikes, 2001						
Rank	**Date**	**Union**	**Company/Industry**	**Man-days**	**Duration (days)**	**Trigger**
1	06-Aug	Numsa	AMEO	315000	15	Wages
3	13-Aug	NUM	Northam Platinum	113400	21	Wages
4	11-Oct	Numsa	Samancor	100000	20	Wages
5	06-Aug	Numsa	NTMEA	75000	15	Wages
6	24-Jul	Numsa/NUM	Eskom	60000	3	Wages

Sourced from South African Survey (2001)

Mandays lost in the top four strikes, 2002						
Rank	**Date**	**Union**	**Company/Industry**	**Man-days**	**Duration (days)**	**Trigger**
1	02-Jul	Samwu	Salga	700000	14	Wages
2	16-May	NUM	Randfontein GM	50000	10	Wages
3	20-May	Fawu	Simba	28000	40	Wages
4	15-Jul	Sactwu	Team Puma	24000	80	Wages

Sourced from South African Survey (2002)

Mandays lost in the top six strikes, 2003						
Rank	**Date**	**Union**	**Company/Industry**	**Man-days**	**Duration (days)**	**Trigger**
1	23-Oct	Saccawu	Shoprite	300000	10	Wages
2	17-Mar	NUM	Impala Platinum	180000	10	Grievance
3	27-May	Numsa	Iscor	75000	15	Grievance
4	08-Sep	NUM	Safsec	56000	8	Wages
5	22-Sep	Numsa	Delta Motor	21000	7	Grievance
6	27-Oct	Satawu	ACSA	15000	15	Wages

Sourced from South African Survey (2003)

Mandays lost in the top six strikes, 2004						
Rank	**Date**	**Union**	**Company/Industry**	**Man-days**	**Duration (days)**	**Trigger**
1	16-Sep	Sadtu	Public Service and Administration	800000	1	Wages
2	07-May	Fawu	Rainbow Chicken	93500	17	Wages
3	18 Dec 2003-2 Jan 2004	Satawu	Equity Aviation	63200	79	Wages
4	26-Feb	Satawu	Contract Cleaning	42000	21	Wages
5	30-Sep	NUM	Impala Platinum	30000	2	Wages
6	11-Feb	NUM	Harmony GM	13500	3	Wages

Sourced from South African Survey (2004)

Mandays lost in the top six strikes, 2005						
Rank	**Date**	**Union**	**Company/Industry**	**Man-days**	**Duration (days)**	**Trigger**
1	08-Aug	NUM	Chamber of Mines	450000	5	Wages

2	26-Feb	Satawu	RFEA	300000	10	Wages
3	12-Jul	Samwu	Salga	300000	3	Wages
4	22-Jul	Saccawu	Pick ‘n Pay	220000	11	Wages
5	23-Mar	NUM	Harmony GM	210000	10	Retrenchment
6	08-Aug	Samwu	Salga	150000	5	Wages

Sourced from South African Survey (2005)

Mandays lost in the top six strikes, 2006						
Rank	**Date**	**Union**	**Company/Industry**	**Man-days**	**Duration (days)**	**Trigger**
1	23 March & 13 April	Satawu	Sansea	1280000	64	Wages
2	31-Jul	Satawu	NCCA	580000	29	Wages
3	10-Aug	Saccawu	Shoprite Checkers	472190	46	Wages
4	13-Mar	Satawu	Sansea	120000	2	Wages
5	23-Feb	Satawu	Transnet	105000	3	Retrenchment
6	29-Sep	Saccawu	Sun International	66000	44	Wages

Sourced from South African Survey (2006)

Mandays lost in the top five strikes, 2007						
Rank	**Date**	**Union**	**Company/Industry**	**Man-days**	**Duration (days)**	**Trigger**
1	01-Jun	Sadtu	DPSA	11400000	19	Wages
2	12-Sep	Numsa	Retail Motor Industry	320000	8	Wages
3	04-Dec	NUM	Mining Industry	240000	1	Grievance
4	09-Jul	Numsa	MEIBC	100000	5	Wages
5	09-Jul	Ceppwawu	NPEA	90000	5	Wages

Sourced from South African Survey (2007)

Mandays lost in the top six strikes, 2008						
Rank	**Date**	**Union**	**Company/Industry**	**Man-days**	**Duration (days)**	**Trigger**
1	17-Sep	Saccawu	Woolworths	405000	27	Wages
2	27-May	Samwu	Ekurhuleni Metro Council	119000	17	Wages
3	22-Aug	NUM	Lonmin Platinum	100000	17	Wages
4	05-May	Samwu	Tshwane Metro Council	76000	19	Wages
5	October	Samwu	Joburg Metro Council	30000	3	Wages
6	08-Oct	NUM	Pamodzi	22500	5	Wages

Sourced from South African Survey (2008)

Mandays lost in the top six strikes, 2009						
	Date	**Union**	**Company/Industry**	**Man-days**	**Duration (days)**	**Trigger**
1	15 & 28 Sept	Sactwu	NBCCMI	666000	18	Wages
2	27-Jul	Samwu	South African local Govt Authority	500000	5	Wages

3	08-Jul	NUM	Safcec	490000	7	Wages
4	07-Apr	Satawu	Road Freight Employer's Association	420000	7	Wages
5	20-Jul	Ceppwawu	Chemical Industry Bargaining Council	165000	8	Wages
6	24-Aug	NUM	Impala Platinum	200000	10	Wages

Sourced from South African Survey (2009)

Mandays lost in the top six strikes, 2010						
Rank	**Date**	**Union**	**Company/Industry**	**Man-days**	**Duration (days)**	**Trigger**
1	29-Jul	Sadtu	DPSA	12000000	15	Wages
2	12-Apr	Samwu	Salga	560000	7	Wages
3	01-Sep	Numsa	Retail Motor Industry	550000	11	Wages
4	10-May	Satawu	Transnet	500000	10	Wages
5	11-Aug	Numsa	AMEO	256000	8	Wages
6	05-Sep	NUM	Northam Platinum	91800	17	Wages

Sourced from South African Survey (2010)

Mandays lost in the top six strikes, 2011						
Rank	**Date**	**Union**	**Company/Industry**	**Man-days**	**Duration (days)**	**Trigger**
1	15-Aug	Samwu	Salga	1320000	11	Wages
2	28-Jul	Num	Chamber of Mines	1250000	5	Wages
3	04-Jul	Numsa & Others	MEIBC	1170000	10	Wages
4	10-Jul	Ceppwawu	NBCCI	1050000	15	Wages
5	08-Aug	Satawu, Hotellica & Others	NCCA	400000	20	Wages
6	13-Feb	Satawu	Road Freight Employer's Association	224000	7	Wages

Sourced from South African Survey (2011)

Mandays lost in the top ten strikes, 2012						
Rank	**Date**	**Union**	**Company/Industry**	**Man-days**	**Duration (days)**	**Trigger**
1	20-Sep	Worker led	Anglo Gold Ashanti	700000	28	Wages
2	13-Sep	Worker led	Anglo Platinum	516000	43	Wages
3	20-Jan	NUM	Impala Platinum	447200	26	Wages
4	25-Sep	Worker led	Goldfields KDC West Mine	362500	29	Wages
5	27-Aug	Worker led	Agri SA	306500	34	Wages
6	25-Sep	Satawu	Road Freight Employer's Association	100000	5	Wages
7	01-Oct	Worker led	Bokoni Platinum	100000	50	Wages
8	03-Oct	Worker led	Harmony Gold Mine	97200	18	Wages
9	14-Oct	Worker led	Goldfields KDC East Mine	87500	7	Wages
10	10-Aug	Worker led	Lonmin Platinum	87000	29	Wages

Sourced from South African Survey (2012)

Table 2: GARCH Results: Strike Specific

Date	Company	Man-Days	Duration	Coefficient	ARCH	GARCH	Probability	Year
21 Jan	VW SA	14300	11	0.0148	0.0777	0.9093	0.5565	2000
21 Feb	Road Freight Employers	55000	1	-0.3809	0.0780	0.9074	0.0039	2000
18 Sept	Amplats	110000	20	-0.0010	0.0779	0.9086	0.9743	2000
15 Dec	SEA	100000	12	0.0025	0.0778	0.9087	0.9308	2000
24 July	Eskom	60000	3	-0.1290	0.0765	0.9086	0.0110	2001
6 Aug	Ameo	315000	15	-0.0257	0.0779	0.9067	0.0234	2001
13 Aug	Northam Platinum	113400	21	-0.0272	0.0805	0.9023	0.0034	2001
11 Oct	Samancor	100000	20	0.1762	0.0703	0.9178	0.0047	2001
16 May	Randfontein Gold Mine	50000	10	*0.0234	0.0780	0.9085	0.7635	2002
20-May	Simba	28000	40	0.0067	0.0777	0.9087	0.8076	2002
02-Jul	Salga	700000	14	-0.0123	0.0780	0.9084	0.7408	2002
15-Jul	Team Puma	24000	80	-0.0002	0.0778	0.9909	0.9831	2002
17-Mar	Impala Platinum	180000	10	0.0821	0.0769	0.9096	0.4234	2003
27-May	Iscor	75000	15	0.0065	0.0779	0.9085	0.9467	2003
08-Sep	Safsec	56000	8	0.0027	0.0778	0.9087	0.9811	2003
22-Sep	Delta Motor	21000	7	0.0738	0.0779	0.9084	0.5793	2003
23-Oct	Shoprite	300000	10	-0.0264	0.0784	0.9080	0.6219	2003
27-Oct	Airports Company South Africa	15000	15	0.0268	0.0774	0.9092	0.5632	2003
18Dec- 2 Jan	Equity Aviation	63200	79	0.5506	0.0749	0.9094	0.0469	2003 – 2004
11-Feb	Harmony GM	13500	3	0.0329	0.0779	0.9085	0.9492	2004
26-Feb	Contract Cleaning	42000	21	0.0632	0.0786	0.9071	0.5014	2004
07-May	Rainbow Chicken	93500	17	-0.0701	0.0773	0.9099	0.2183	2004
16-Sep	Public Service and Admin	800000	1	-0.7368	0.0764	0.9101	0.0000	2004
30-Sep	Impala Platinum	30000	2	-0.1768	0.0789	0.9068	0.1887	2004
26-Feb	Road Freight Employer's Association	300000	10	0.1289	0.0770	0.9093	0.2803	2005
23-Mar	Harmony GM	210000	10	0.0849	0.0778	0.9084	0.5498	2005
12-Jul	Salga	300000	3	-0.1788	0.0768	0.9104	0.5341	2005
22-Jul	Pick 'n Pay	220000	11	-0.1050	0.0758	0.9114	0.0383	2005
08-Aug	Chamber of Mines	450000	5	-0.0898	0.0766	0.9102	0.1820	2005
23-Feb	Transnet	105000	3	0.0376	0.0778	0.9088	0.7619	2006

13-Mar	Sansea	120000	2	0.1380	0.0773	0.9094	0.7239	2006
23 March & 13 April	Sansea	1280000	64	-0.1689	0.0791	0.9070	0.5837	2006
				0.0869	0.0781	0.9065	0.0020	2006
31-Jul	NCCA	580000	29	0.0326	0.0783	0.9077	0.3281	2006
10-Aug	Shoprite Checkers	472190	46	0.0465	0.0792	0.9059	0.1420	2006
29-Sep	Sun International	66000	44	-0.0199	0.0774	0.9097	0.4365	2006
01-Jun	DPSA	11400000	19	-0.0051	0.0779	0.9085	0.8635	2007
09-Jul	MEIBC	100000	5	0.0179	0.0776	0.9091	0.8069	2007
12-Sep	Retail Motor Industry	320000	8	-0.0608	0.0783	0.9079	0.1812	2007
04-Dec	Mining Industry	240000	1	-0.9845	0.0787	0.9078	0.0165	2007
05-May	Tshwane Metro Council	76000	19	-0.0242	0.0770	0.9098	0.4514	2008
27-May	Ekurhuleni Metro Council	119000	17	-0.0148	0.0777	0.9088	0.7129	2008
22-Aug	Lonmin Platinum	100000	17	0.1860	0.0712	0.9157	0.1541	2008
17-Sep	Woolworths	405000	27	0.5354	0.0682	0.9161	0.0022	2008
08-Oct	Pamodzi	22500	5	4.0004	0.0704	0.9132	0.0262	2008
07-Apr	Road Freight Employer's Association	420000	7	-0.0495	0.0778	0.9089	0.8842	2009
08-Jul	Safsec	490000	7	0.0565	0.0778	0.9085	0.8191	2009
20-Jul	Chemical Industry Bargaining Council	165000	8	0.0555	0.0779	0.9084	0.7268	2009
27-Jul	South African local Govt Authority	500000	5	0.0602	0.0778	0.9085	0.8136	2009
24-Aug	Impala Platinum	200000	10	-0.0247	0.0780	0.9086	0.8373	2009
15 & 28 Sept	NBCCMI	666000	18	0.0603	0.0779	0.9081	0.4809	2009
12-Apr	Salga	560000	7	0.0761	0.0761	0.9108	0.5232	2010
10-May	Transnet	500000	10	0.0730	0.0780	0.9081	0.6678	2010
29-Jul	DPSA	12000000	15	-0.0223	0.0774	0.9090	0.4402	2010
11-Aug	AMEO	256000	8	-0.0191	0.0775	0.9090	0.6409	2010

01-Sep	Retail Motor Industry	550000	11	-0.0582	0.0783	0.9072	0.0309	2010
05-Sep	Northam Platinum	91800	17	-0.0272	0.0783	0.9073	0.1408	2010
13-Feb	Road Freight Employer's Association	224000	7	0.0124	0.0779	0.9087	0.8826	2011
04-Jul	MEIBC	1170000	10	0.0690	0.0772	0.9095	0.3618	2011
10-Jul	NBCCI	1050000	15	0.0811	0.0770	0.9095	0.3089	2011
28-Jul	Chamber of Mines	1250000	5	0.1699	0.0770	0.9095	0.3903	2011
08-Aug	NCCA	400000	20	-0.0008	0.0779	0.9086	0.9850	2011
15-Aug	Salga	1320000	11	-0.0269	0.0785	0.9079	0.6440	2011
20-Jan	Impala Platinum	447200	26	-0.0101	0.0775	0.9090	0.6351	2012
10-Aug	Lonmin Platinum	87000	29	0.0107	0.0777	0.9090	0.6231	2012
27-Aug	Agri SA	306500	34	0.0193	0.0782	0.9082	0.4645	2012
13-Sep	Anglo Platinum	516000	43	-0.0162	0.0768	0.9102	0.3432	2012
20-Sep	Anglo Gold Ashanti	700000	28	-0.0197	0.0771	0.9098	0.4142	2012
25-Sep	Goldfields KDC West Mine	362500	29	0.0134	0.0778	0.9086	0.9152	2012
25-Sep	Road Freight Employer's Association	100000	5	-0.0178	0.0769	0.9101	0.4211	2012
01-Oct	Bokoni Platinum	100000	50	-0.0241	0.0757	0.9109	0.0151	2012
03-Oct	Harmony Gold Mine	97200	18	-0.0407	0.0765	0.9106	0.2321	2012
14-Oct	Goldfields KDC East Mine	87500	7	-0.0874	0.0764	0.9107	0.1497	2012

Table 3: GARCH dummy variables showing an increase in volatility

Table: Increased Volatility of Exchange Rate										
Date	**Company**	**Industry**	**Man-days**	**Days**	**Trigger**	**Coefficient**	**ARCH**	**GARCH**	**Prob**	**Year**
08-Oct	Pamodzi	Mining	22,500	5	Wages	4.0004	0.0704	0.9132	0.0262	**2008**
18 Dec 2003-2 Jan 2004	Equity Aviation	Transport	63,200	79	Wages	0.5506	0.0749	0.9094	0.0469	**2003**
17-Sep	Woolworths	Retail	405,000	27	Wages	0.5354	0.0682	0.9161	0.0022	**2008**
11-Oct	Samancor	Mining	100,000	20	Wages	0.1762	0.0703	0.9178	0.0047	**2001**
24 March & 13 April	Sansea	Security	1,280,000	64	Wages	0.0869	0.0781	0.9065	0.0020	**2006**

Table 4: GARCH dummy variables showing a decrease in volatility

Table: Decreased Volatility of Exchange Rate										
Date	**Company/Industry**	**Industry**	**Man-days**	**Days**	**Trigger**	**Coefficient**	**ARCH**	**GARCH**	**Prob**	**Year**
04-Dec	Mining Industry	Mining	240,000	1	Grievance	-0.9845	0.0787	0.9078	0.0165	**2007**
16-Sep	Public Service and Administration	Education	800,000	1	Wages	-0.7368	0.0764	0.9101	0.0000	**2004**
21-Feb	Road Freight Employer's Association	Transport	55,000	1	Wages	-0.3809	0.0780	0.9074	0.0039	**2000**
24-Jul	Eskom	Power	60,000	3	Wages	-0.1290	0.0765	0.9086	0.0110	**2001**
22-Jul	Pick 'n Pay	Retail	220,000	11	Wages	-0.1050	0.0758	0.9114	0.0383	**2005**
01-Sep	Retail Motor Industry	Automotive	550,000	11	Wages	-0.0582	0.0783	0.9072	0.0309	**2010**
13-Aug	Northam Platinum	Mining	113,400	21	Wages	-0.0272	0.0805	0.9023	0.0034	**2001**
06-Aug	AMEO	Automotive	315,000	15	Wages	-0.0257	0.0779	0.9067	0.0234	**2001**

Table 5: Intervention Analysis Results: Strike Specific

Intervention Analysis Results								
Dummy/Strike Date Start	**Strike**	**Coefficient**	**AR(5)**	**AR(7)**	**Std. Error**	**T-Statistic**	**Prob.**	**Long Run Mean**
21_JANUARY_2000	Volkswagen South Africa	0.1728	-0.0476	0.0490	0.3443	0.5020	0.6157	0.1731
21_FEBRUARY_2000	Road Freight Employer's Association	0.0923	-0.0475	0.0490	1.1475	0.0804	0.9359	0.0924
18_SEPTEMBER_2000	Amplats	0.2110	-0.0476	0.0488	0.2567	0.8218	0.4113	0.2112

15_DECEMBER_2000	SEA	0.0110	-0.0475	0.0491	0.3301	0.0333	0.9734	0.0110
24_JULY_2001	Eskom	-0.1007	-0.0475	0.0491	0.6631	-0.1519	0.8793	-0.1009
6_AUGUST_2001	AMEO	0.0934	-0.0475	0.0490	0.2958	0.3158	0.7522	0.0935
13_AUGUST_2001	Northam Platinum	0.1133	-0.0476	0.0490	0.2507	0.4521	0.6512	0.1135
1_OCTOBER_2001	Samancor	0.0696	-0.0475	0.0490	0.2634	0.2643	0.7916	0.0697
16_MAY_2002	Randfontein GM	-0.3563	-0.0477	0.0486	0.3606	-0.9880	0.3232	-0.3566
20_MAY_2002	Simba	-0.0345	-0.0475	0.0491	0.1826	-0.1888	0.8503	-0.0345
2_JULY_2002	Salga	-0.2196	-0.0475	0.0491	0.3060	-0.7176	0.4730	-0.2199
15_JULY_2002	Team Puma	-0.0405	-0.0475	0.0490	0.1301	-0.3111	0.7558	-0.0405
17_MARCH_2003	Impala Platinum	-0.2871	-0.0474	0.0493	0.3608	-0.7958	0.4262	-0.2877
27_MAY_2003	Iscor	-0.0813	-0.0474	0.0491	0.2960	-0.2747	0.7836	-0.0814
8_SEPTEMBER_2003	Safsec	0.1936	-0.0474	0.0492	0.4021	0.4816	0.6301	0.1940
22_SEPTEMBER_2003	Delta Motor	-0.8402	-0.0485	0.0486	0.4286	-1.9603	0.0500	-0.8403
23_OCTOBER_2003	Shoprite	-0.3491	-0.0474	0.0489	0.3606	-0.9680	0.3331	-0.3496
27_OCTOBER_2003	Airports Company South Africa	-0.2374	-0.0477	0.0488	0.2957	-0.8029	0.4221	-0.2377
18_DECEMBER_2003	Equity Aviation	0.4032	-0.0474	0.0484	0.2865	1.4072	0.1595	0.4036
11_FEBRUARY_2004	Harmony GM	-1.4517	-0.0470	0.0484	0.6629	-2.1901	0.0286	-1.4538
26_FEBRUARY_2004	Contract Cleaning	0.0126	-0.0475	0.0491	0.2568	0.0492	0.9607	0.0127
7_MAY_2004	Rainbow Chicken	-0.2954	-0.0479	0.0492	0.2781	-1.0623	0.2882	-0.2958
16_SEPTEMBER_2004	Public Service and Administration	0.2856	-0.0475	0.0491	1.1472	0.2490	0.8034	0.2861
30_SEPTEMBER_2004	Impala Platinum	0.1495	-0.0475	0.0491	0.8114	0.1843	0.8538	0.1498
25_FEBRUARY_2005	Road Freight Employer's Association	-0.1155	-0.0474	0.0491	0.3607	-0.3202	0.7489	-0.1157
23_MARCH_2005	Harmony GM	-0.0239	-0.0474	0.0491	0.3801	-0.0628	0.9500	-0.0239
12_JULY_2005	Salga	-0.9355	-0.0477	0.0497	0.6630	-1.4109	0.1584	-0.9374
22_JULY_2005	Pick 'n Pay	-0.1599	-0.0476	0.0490	0.3797	-0.4212	0.6736	-0.1601
8_AUGUST_2005	Chamber of Mines	-0.0370	-0.0475	0.0490	0.5143	-0.0720	0.9426	-0.0371
23_FEBRUARY_2006	Transnet	0.2443	-0.0475	0.0491	0.6631	0.3684	0.7126	0.2447
13_MARCH_2006	Sansea	0.1477	-0.0477	0.0491	0.8117	0.1819	0.8557	0.1479
23_MARCH_2006	Sansea	-0.3579	-0.0477	0.0489	0.8113	-0.4411	0.6592	-0.3583
13_APRIL_2006	Sansea	0.2408	-0.0483	0.0484	0.1437	1.6754	0.0939	0.2408
31_JULY_2006	NCCA	0.2398	-0.0476	0.0491	0.2104	1.1397	0.2545	0.2401
10_AUGUST_2006	Shoprite Checkers	0.1905	-0.0479	0.0484	0.1685	1.1305	0.2584	0.1906
29_SEPTEMBER_2006	Sun International	-0.1519	-0.0478	0.0488	0.1723	-0.8819	0.3779	-0.1521
1_JUNE_2007	DPSA	-0.0061	-0.0475	0.0491	0.2705	-0.0225	0.9821	-0.0061
9_JULY_2007	MEIBC	-0.1920	-0.0476	0.0488	0.5142	-0.3735	0.7088	-0.1923
12_SEPTEMBER_2007	Retail Motor Industry	-0.3416	-0.0478	0.0490	0.4020	-0.8498	0.3955	-0.3420
4_DECEMBER_2007	Mining Industry	-0.1452	-0.0474	0.0491	1.1485	-0.1264	0.8994	-0.1454
5_MAY_2008	Tshwane Metro Council	-0.0206	-0.0475	0.0491	0.2568	-0.0801	0.9362	-0.0206
27_MAY_2008	Ekurhuleni Metro Council	0.1748	-0.0477	0.0490	0.2704	0.6462	0.5182	0.1750

22_AUGUST_2008	Lonmin Platinum	0.3138	-0.0475	0.0487	0.2704	1.1604	0.2460	0.3142
17_SEPTEMBER_2008	Woolworths	1.1344	-0.0517	0.0446	0.2153	5.2685	0.0000	1.1264
8_OCTOBER_2008	Pamodzi	0.3239	-0.0488	0.0479	0.5148	0.6293	0.5292	0.3236
7_APRIL_2009	Road Freight Employer's Association	-0.1399	-0.0477	0.0487	0.4293	-0.3259	0.7445	-0.1401
9_JULY_2009	Safsec	0.4554	-0.0474	0.0496	0.4658	0.9777	0.3283	0.4564
20_JULY_2009	Chemical Industry Bargaining Council	-0.3347	-0.0475	0.0493	0.4021	-0.8325	0.4052	-0.3353
27_JULY_2009	South African local Govt Authority	0.2476	-0.0474	0.0491	0.5146	0.4811	0.6305	0.2480
24_AUGUST_2009	Impala Platinum	-0.2625	-0.0477	0.0485	0.3607	-0.7279	0.4667	-0.2627
15_SEPTEMBER_2009	NBCCMI	-0.0741	-0.0475	0.0490	0.2705	-0.2739	0.7842	-0.0742
12_APRIL_2010	Salga	0.3684	-0.0475	0.0494	0.4289	0.8590	0.3904	0.3691
10_MAY_2010	Transnet	0.2526	-0.0475	0.0489	0.3606	0.7003	0.4838	0.2529
29_JULY_2010	DPSA	-0.0847	-0.0475	0.0490	0.3060	-0.2769	0.7819	-0.0849
11_AUGUST_2010	AMEO	0.1140	-0.0475	0.0491	0.4021	0.2836	0.7768	0.1142
1_SEPTEMBER_2010	Retail Motor Industry	-0.3580	-0.0477	0.0488	0.3442	-1.0403	0.2983	-0.3584
6_SEPTEMBER_2010	Northam Platinum	-0.2429	-0.0477	0.0487	0.2865	-0.8479	0.3966	-0.2431
13_FEBRUARY_2011	Road Freight Employer's Association	-0.2862	-0.0476	0.0489	0.4021	-0.7118	0.4766	-0.2866
4_JULY_2011	MEIBC	0.1887	-0.0473	0.0492	0.3608	0.5230	0.6010	0.1890
11_JULY_2011	NBCCI	0.0534	-0.0475	0.0490	0.2958	0.1806	0.8567	0.0535
28_JULY_2011	Chamber of Mines	0.3971	-0.0476	0.0490	0.5143	0.7721	0.4401	0.3976
8_AUGUST_2011	NCCA	0.0674	-0.0476	0.0489	0.2569	0.2623	0.7931	0.0675
15_AUGUST_2011	Salga	-0.1962	-0.0473	0.0493	0.3446	-0.5692	0.5693	-0.1966
20_JANUARY_2012	Impala Platinum	-0.1822	-0.0477	0.0489	0.2215	-0.8225	0.4109	-0.1824
10_AUGUST_2012	Lonmin Platinum	-0.0109	-0.0475	0.0491	0.2139	-0.0511	0.9592	-0.0110
27_AUGUST_2012	Agri SA	0.1106	-0.0476	0.0490	0.1950	0.5672	0.5706	0.1108
13_SEPTEMBER_2012	Anglo Platinum	0.1484	-0.0476	0.0489	0.1742	0.8519	0.3943	0.1486
20_SEPTEMBER_2012	Anglo Gold Ashanti	0.1640	-0.0477	0.0489	0.2138	0.7671	0.4431	0.1642
25_SEPTEMBER_2012	Goldfields KDC West Mine	0.1861	-0.0477	0.0489	0.2103	0.8851	0.3762	0.1864
25_SEPTEMBER_2012_	Road Freight Employer's Association	0.0264	-0.0475	0.0490	0.5141	0.0514	0.9590	0.0265
1_OCTOBER_2012	Bokoni Platinum	0.0951	-0.0475	0.0491	0.1621	0.5869	0.5573	0.0953
3_OCTOBER_2012	Harmony Gold Mine	0.1987	-0.0475	0.0491	0.2634	0.7545	0.4506	0.1990
14_OCTOBER_2012	Goldfields KDC East Mine	0.1285	-0.0475	0.0489	0.3798	0.3383	0.7352	0.1287

Table 6: Significant Intervention Analysis dummy variables

Significant Intervention Analysis Results							
Variable	**Coefficient**	**AR(5)**	**AR(7)**	**Std. Error**	**T-Statistic**	**Prob.**	**Long Run Mean**
22_SEPTEMBER_2003	-0.840178	-0.048506	0.048592	0.428597	-1.9603	0.0500	-0.84025
11_FEBRUARY_2004	-1.45173	-0.046962	0.048356	0.662853	-2.190125	0.0286	-1.45376
13_APRIL_2006	0.240779	-0.048263	0.048442	0.143714	1.675407	0.0939	0.240822
17_SEPTEMBER_2008	1.134441	-0.051739	0.044642	0.215327	5.268464	0.0000	1.126447

Table 7: Industry Results

Industry GARCH Results						
Industry	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**	**RESID(-1)^2**	**GARCH(-1)**
AUTOMOTIVE	-0.0154	0.0095	-1.6239	0.1044	0.0781	0.9066
EDUCATION	-0.0136	0.0203	-0.6706	0.5025	0.0777	0.9085
MINING	-0.0137	0.0082	-1.6654	0.0958	0.0803	0.9048
RETAIL	0.0167	0.0150	1.1116	0.2663	0.0775	0.9078
PUBLIC	-0.0140	0.0198	-0.7068	0.4797	0.0784	0.9080
TRANSPORT	0.0510	0.0267	1.9119	0.0559	0.0759	0.9103
TEXTILES	0.0036	0.0112	0.3244	0.7457	0.0779	0.9085

Industry Intervention Analysis						
Industry	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**	**AR(5)**	**AR(7)**
EDUCATION	-0.0309	0.2001	-0.1543	0.8774	-0.0475	0.0490
TEXTILES	-0.0472	0.1177	-0.4008	0.6886	-0.0475	0.0490
TRANSPORT	0.0238	0.1239	0.1918	0.8479	-0.0475	0.0491
PUBLIC	-0.0005	0.1345	-0.0034	0.9973	-0.0475	0.0491
RETAIL	0.1361	0.0868	1.5669	0.1172	-0.0476	0.0484
MINING	-0.0061	0.0723	-0.0847	0.9325	-0.0474	0.0491
AUTOMOTIVE	-0.1276	0.1533	-0.8325	0.4052	-0.0477	0.0489