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How South African banks and insurers have succeeded in estimating their interest rate sensitivity

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1. Introduction

The purpose of this paper is to study how the interest rate sensitivity analysis provided by the largest South African banks and insurers correspond with actual changes in the interest rates and company performance.

Banks and insurance companies are exposed to changes in interest rates, since a substantial part of their balance sheet and income statement items relate to interest rates. These include, for example, market values and net interest income (Rose & Hudgins, 2010, p. 212). In other words, financials are affected in two ways; through changing discount rates and interest related cash flows. Financial companies manage this risk by modeling effects of an interest rate shock and restructuring their balance sheet. Publicly traded financials also disclose some results of their internal models in annual reports, since they are required to give a realistic picture of their risk profile. These disclosures are part of the data used in this study.

An investor evaluating companies' risk exposure should be interested how companies evaluate their interest rate risk and does the sensitivity analysis in annual reports actually give good enough information for our investor. However, there have not been academic studies, especially in South Africa, that test exactly this problem. Most of the research papers discuss analyzing interest rate sensitivity for management purposes, i.e., they use internal data that is not available for outside investors (Kaufman, 1984). Accounting based interest rate sensitivity measures have been developed, for example, for German markets, but these papers usually focus on analyzing maturity buckets (Entrop, Memmel, Wilkens, & Zeisler, 2007). Sweeney et al. (1986) examined the ex-ante premiums that stocks are required for bearing interest rate risk. Prior to estimating the interest rate risk premiums, they calculated interest rate sensitivities for stock returns in various industries. This study uses the same regression model to calculate the actual interest rate sensitivity that companies' have faced during the research period.

This paper responds to the need by assessing the reliability of company sensitivity analysis. Given that the regression produces somewhat reliable results, an investor estimating companies' interest rate exposure can have some idea that are the estimates, provided by the companies themselves, usually in line with the actual interest rate risk. It will be done by gathering information from annual reports telling how a company thinks a change in interest rates would affect it. In practice, this means the amount of interest rate risk to which banks

estimate to have an exposure and how sensitive insurance companies evaluate their embedded value to be. This information will be compared to linear regression estimates that measure actual stock return sensitivity in respect of interest rate changes. If a company thinks that its equity and income will gain after a decline in interest rates, the same issue should be seen in the beta coefficient measuring the interest rate sensitivity for stocks. The empirical part includes some of the largest listed financials in South Africa, four banks and four insurers. Time period examined lasts from 2006 to 2010. The research should not have any major biases, because the stock markets have worked in South Africa and the regulations are usually influenced international standards. The annual reports are audited and comply with regulations, but because the interest rate sensitivity estimates represent management's view about their situation they might want to give as rosy picture as possible to lure investors.

This thesis has been divided into three main parts; theory, empirical part and results. The theory part defines the interest rate risk, what kind of effects interest rate fluctuations have on banks and insurers and how these financials manage their exposure to interest rate risk. The empirical part describes the data used and how the validity of interest rate sensitivity analysis is tested. Results are presented in the corresponding section.

2. Theory

2.1 Definition of interest rate risk

Interest rate risk stands for a possibility that movements in the yield curve might have adverse effects on a company. Interest rate risk can also be a significant source for revenue; therefore it may not be practical to get rid of all risk exposure (Basel, 2004). In addition to yield curve movements, basis risk may arise from using different reference rates, e.g. Libor and Euribor, if the spread between two reference rates widens or narrows.

Interest rate risks generally arise from structural differences between assets and liabilities, which, for example, can be estimated by calculating their durations. Bank's assets may reprice later in the future than liabilities', which causes borrowing costs to adjust earlier to interest rate fluctuations and thus squeeze net interest margin. In addition, market values change because they have to compensate the opportunity cost of holding that asset or liability i.e. their economic value is the value of cash flows discounted at current market yield. These market values are also likely to move more when their effective duration is longer.

Interest rate risk is a type of systemic market risk. A company can diversify its exposure to different maturities and reference rates, but due to interest rates' macroeconomic nature, rate changes tend to affect all market participants.

As mentioned earlier, interest rate risk realizes when the yield curve shifts, which represents the interest rates of different maturities at a certain point of time. These movements include, for example, a parallel shift, a shift in slope and a shift in curvature. Parallel shift is the simplest type of shift and it refers to a movement in all interest rates. In other words, interest rates change by the same amount regardless of maturity. This is the type of change that is often modeled for risk management purposes, since it is rather simple compared to other kinds of shifts. In reality short-term rates tend to move more than long-term and therefore make the analysis more complicated. This shift in slope implicates a change in the spread between short- and long-term yields. This affects companies, if they have not matched asset and liability side cash flows for each maturity. If the yield curve is positively sloped, banks can make money from accepting short-term deposits and making long-term loans. Shifts in curvature can be usually seen as a shift in mid-term yields relative to other. (Phoa, 2000)

2.2 Main characteristics of banks and insurance companies

A bank balance sheet comprises assets that often are interest earning, such as loans and investments. Liability side contains capital and borrowings such as deposits, which cause borrowing costs. Shareholder's capital or equity is usually the management's target for maximization. Income side is usually divided into interest and fee income. Interest related income is the item, which is exposed to changes in the yield, although fee income may correlate also with interest rates (Basel, 2004, p. 6).

Insurance companies receive premiums in exchange of covering possible claims and benefits in the future. Assets consist of investments that back liabilities and provide income as capital gains, interest and dividends. Liability side includes shareholder's fund and a technical reserve that represents the net present value of expected claims and benefits. The technical reserve is sensitive to changes in the discount rate, which used in the present value calculation. The sensitivity to a change in the discount rate grows when insurers' claims are expected to be further in the future, e.g. in life insurance, as the duration of liabilities increases. An important measurement for shareholder's value besides IFRS equity is the embedded value that consists of two parts: net worth and value of in-force. Net worth

represents the excess of assets over liabilities and the value of in-force the present value of future shareholder profits arising from covered business (Liberty, 2011, p. 28).

2.3 How interest rate fluctuations affect banks and insurers

The reader might recall from finance classes that one of the simplest valuation methods is the Gordon model that calculates the net present value of a fixed stream of cash flows that lasts to infinity. It can be reduced to:

— (1)

where *CF* represents the cash flow in one period and *r* is the rate used to discount the cash flows (Gordon, 1959). Increase in the cash flow component and a decline in the discount factor have a positive effect on the economic value of the company producing these cash flows.

Similarly, interest rate fluctuations affect financial companies' economic values through both of these same items; shifts in the yield curve have an effect on interest related cash flows while the discount factor works in the same way changing the present value of each cash flow. Cash flow component also represents what you earn from that investment whereas discount factor describes what you could earn from other investments. It might also help to reckon that changes in cash flows affect company performance through income statement, while changing discount factor affects the market values in the economic balance sheet. Furthermore, a change in cash flow might realize after a couple of years due to long fixed interest period, which means that the effect will not be seen in the next financial statement. This is why financial companies take a longer than one year view on their equity's interest rate sensitivity. For example, Standard Bank uses a five year horizon (Standard Bank, 2011, p. 178).

If the asset and liability side of the balance sheet are similar enough, risk managers should not have a lot of work to do with interest rate risks. A rise in interest rates will increase borrowing costs, but interest related income will jump for the same reason. Upward shifting yield curve will also cause a fall in the economic values, but it happens again on both sides of the balance sheet and the net effect, from a risk management point of view, is hopefully next to nothing.

A financial company becomes exposed to interest rate changes, when cash flow and present value effects are not equal on both sides of the balance sheet and income statement. One simple measurement to test such possibility is the duration gap, which involves calculating duration for both assets and liabilities, and then comparing them to each other. Duration represents weighted average maturity of all cash flows. A difference in duration leads to different sensitivities regarding interest rate fluctuations, which means that a change in interest rates may cause a gain or loss depending on the direction of the gap. At this stage it would be good to notice that if the net income worsens, it usually comes with decline in market values and vice versa. In other words, the direction of change is usually the same for both cash flow and market value effects. These will explained in greater detail later on.

The uneven effects causing adverse movements in company's financial performance are presented in the next two sections. The first one discusses changing discount rates and the latter effects on cash flows.

2.3.1 Changing discount factor

The change in discount rate describes the opportunity cost of investing. For example, instead of investing in bank and insurance shares you could earn the market yield represented by the discount rate. The change in discount can be seen immediately in stock prices i.e. the market value of equity, assuming that market participants have recognized the shift. The discount rate of a company might change due to, for example, shift in the risk free rate and in expected riskiness of its business. The actual cash flows do not change, only the factor used to derive its net present value.

The duration of assets and liabilities give quite a good picture of their sensitivity. If the duration is long and market yields happen to decline, the price of the investment increases a lot relative to other investments, since the holder of the investment can earn better yield for a longer time. Consequently, the same works for an increase in yields. The holder of the long-term investment is stuck with the lower-than-market yield for a long time and this should be seen in a large decline in price. Mathematically speaking, the net present value of cash flows is approximately inversely proportional to the power of its duration.

If the liability side has longer duration, its economic value is more interest rate sensitive than assets' and vice versa. Because capital is the residual claim of assets after liabilities, the

amount of capital may change after a shift in the yield curve, especially if the business is considerably leveraged. Therefore, the interest rate sensitivity of a financial institution can be estimated as the difference in duration between assets and liabilities, also known as the duration gap. The gap can be either positive or negative depending on which side of the balance sheet has longer duration. The disadvantage in duration gap is that it assumes that the yield curve is flat and makes only parallel shifts (Mishkin, 2004, p. 7). It also demands a lot of input data to give a thorough picture (Kaufman, 1984, p. 25).

Traditionally banks have been assumed to provide long-term loans from short-term deposits, which means that they have a positive duration gap. The bank would gain from a decrease in interest rates, because assets would increase more than liabilities and the net effect is positive. An increase in interest rates would hurt the bank's capital as a result, since assets decrease more in value than liabilities. Banks do not always have a positive duration gap, because granting variable-rate loans will shorten the effective duration of assets. Then the market value of loans move more like a loan that has as long maturity as the repricing period.

Insurance companies, especially in life insurance business, have liabilities that are expected to realize far in the future, such as policies covering death or retirement. Calculation of the liability includes estimating the expected claims and then discounting it to the present. The fluctuation of mortality is fairly stable compared to interest rates (Fleuriet & Lubochinsky, 2005, p. 103). A couple of reasons for stable outflows are that insurers have a lot of data about mortality and policyholders have a strong incentive not to die prematurely. This could suggest that it would be appropriate to invest in longer term fixed income products to match the long duration of liabilities. However, it might be hard to find investments that have as long duration as the expected claims and benefits, which could lead to a negative duration gap. Insurance companies also lean towards investing conservatively to preserve policyholders' funds and not taking excessive risks, which means that they like to have shorter term bonds in their portfolios. A decrease in rates will probably increase the value of the investment portfolios, but at the same time the present value of liabilities will increase more than the one of assets'. The net effect to the shareholder's funds is, in this case, negative. On the other hand, a parallel upward shift in the yield curve will hit investments, but it will strike the longer term liabilities more. The net effect is positive as the decline in liabilities exceeds assets'. The difference between assets and liabilities is not always negative in case of insurers. The company might have diversified its client base and have different aged people holding the life insurance policies, which could result in somewhat mid-term

duration. Insurers can also use interest rate derivatives to change their overall interest rate sensitivity.

Although it was concluded that a company can immunize its equity in a volatile interest rate environment by matching the characteristics of assets and liabilities, it needs to decide if it wants to fix the value of capital or the capital-asset ratio (Kaufman, 1984, p. 20). If the balance sheet has been structured in a way that the shareholder's equity remains constant after a decrease in the rates, the capital-asset ratio will decline, since the assets and liabilities increase in value. Same applies to a constant capital-asset ratio; to ensure that the proportional amount of capital remains, it has to take an active interest rate position in respect of the notional value of capital.

2.3.2 Effects on cash flows

The cash flow effect relates to different repricing dates in interest earning assets and interest paying borrowings that are the source for interest income and expense. If one side of the balance sheet has fixed rate instruments while the other side has variable rate during some arbitrary period, a shift in interest rates affects the net interest income.

After a shift in the yield curve, cash flows change when they are repriced while the change in discount rates affects directly the stock price. Of course, the present value of cash flows change instantaneously, but the actual changes in the income statement items occur later.

Let us use the bank with a positive duration gap, i.e. the one with interest sensitive liabilities, as an example. The deposits on the liability side are usually negotiated only for short periods of time or they can be withdrawn on demand. This means that the cost of borrowing is fixed on average only for the short period of time and if the deposits are rolled over in the same bank, the interest rate will match the market rates again. On the other hand, assets in our example are long-term loans, which mean that the interest earned remains stable until the end of the loan or next repricing date. If there is upward pressure on the yield curve, interest earnings and interest costs will increase, but costs on borrowings will increase earlier, since they have shorter duration. This squeezes the net interest margin. A downward shift will benefit the bank as interest costs drop earlier than income. The cash flow effects from interest rate changes are opposite to an institution whose assets are more sensitive than liabilities or, to be exact, a company with a negative duration gap. Assets will reprice earlier, which means the company has positioned itself into an increase in market yields.

The duration of deposits that can be withdrawn on demand is a little bit trickier to estimate. In theory they have one day duration, because if the bank does not adjust its deposit rates, depositors could redeem their funds and move the money to another bank. This would force banks to set their deposit rates in line with market yields. In reality depositors are not always so eager to search the best yield for their money. Quite often a lag between depositor reaction and a changed market interest rate takes place. To assess their interest rate sensitivity, banks need to estimate how large the spread between deposit rates and market yields has to be so that there is a significant outflow of money. (Kaufman, 1984, p. 26)

The main cash flow related interest rate risk concerning insurance companies comes from guaranteed products. An insurer might have sold a policy that provides a fixed stream or a minimum amount of benefits in the future. If interest rates decline, income from new investments might be insufficient to cover benefits (Fleuriet & Lubochinsky, 2005, p. 97). Therefore insurers try to match these products with a fixed income asset with similar duration. In addition, a large portion of shareholder income stems as asset management fees from policyholder investments, which are exposed to interest rates. Rising interest rates decrease therefore shareholder revenue indirectly through fee income.

Embedded options complicate the sensitivity analysis moreover. Companies and their clients might have an option to change the cash flows defined in contracts even after the contract has been signed. One of the most discussed embedded options is the prepayment of mortgages. A bank might sell, for example, a 15 year home loan that has an eight year duration. This would suggest that the interest rates will adjust on average after these eight years. If the lender has an option to prepay, he or she would do so when interest rates drop and there would be less expensive refinancing available. This reduces the effective duration of the mortgage. Although, the calculated duration is clearly long-term, the embedded option makes it more like a short-term investment. Some listed corporate bonds have similar call options, which cause investors to demand higher coupons to offset the value of the call option.

Embedded options in insurance relate to surrenders and terminations of policies. If interest rates rise significantly, other insurers might offer policies with lower premiums or higher benefits, which attract them to change their respective insurance provider. Amount of surrenders depend a lot on possible penalties given to policyholders. For example, German regulations penalize surrenders harshly whereas French are gentler (Fleuriet & Lubochinsky, 2005, p. 103).

The cash flows that financial companies receive can disrupt, for example, if the client has borrowed a loan with a variable rate interest and the repayments grow excessively large due to an interest rate increase. The repayments could jump more than the borrower can afford. This means that interest rate risks might appear indirectly through credit risk.

Table 2 in the Appendices summarizes the effects of interest rate changes.

2.4 Interest rate risk management

Since interest rate fluctuations might have adverse effects, companies try to optimize their exposure. Getting rid of all exposure may not be a good idea, since it can be a significant source for profit, but fluctuations should not threaten the liquidity and solvency of a company. Interest rate risk management can be divided into measuring the risk and restructuring the balance sheet towards preferred state.

Risk management is usually coordinated at group level to take advantage of group-wide diversification. Usually corporate groups have formed asset liability committees that oversee group's interest rate risk exposures. For example, FirstRand's board decides the risk appetite of the group while "Risk, capital management and compliance committee" approves risk management policies and monitors group's risk profile (FirstRand, 2011, p. 10). It has delegated responsibility for interest rate risk management to "Asset and liability committee", which "approves and monitors effectiveness of management policies and processes for interest rate risk in the banking book and liquidity risk" (FirstRand, 2011, p. 11).

Interest rate risk is not usually the largest risk that companies are facing; for example, Standard Bank has estimated that it needs about Rm 30,887 to support credit risk while Rm 1,641 is needed to cope with the interest rate risk in the banking book (Standard Bank, 2011, p. 136). The difference is about 19-fold.

The simplest form of interest rate sensitivity measurements are the following. Risk managers can group every asset and liability into buckets according to their maturity or repricing date. This would signal if the value of assets in certain maturity exceeds or falls below the value of liabilities. However, maturity does not catch the cash flows occurring before maturity, which can be significant e.g. in a normal home loan. A better measurement is the duration difference between assets and liabilities, which calculates the average maturity of cash flows and weighs the maturities by the present value of corresponding cash flow. The problem with using

duration is that it does not predict sensitivity to changes in the slope of the yield curve as it comes up with one number to present the asset side and liability side. To solve this issue, one could group securities on both sides of the balance sheet to duration buckets and see if there is a gap in value between assets and liabilities in any duration bucket. The complicated part is that the results are influenced heavily by how managers decide the limits of each bucket. Two cash flows might belong to a same bucket or two separate buckets depending on the wideness of groups. Although these measurements are simple in theory, they require a lot of data regarding all items and cash flows, so that the results are even somewhat accurate. Risk managers have to also take into account the fallacies of these metrics, embedded options and derivative positions. (Phoa, 2000, pp. 3-4)

Value-at-Risk is also a widely used risk measurement, especially in trading activities. The idea is to estimate how large is a loss, which has, for example, a one percent probability. Nedbank has calculated that the average 99^{th} percentile one-day VaR in 2010 regarding interest rate risk was a loss of Rm9 (Nedbank, 2011, p. 173). In other words, based on data collected from last twelve months there was a one percent chance of Rm9 one-day loss on average. Bank's risk officials have collected data from last 250 trading days, fitted it into a normal curve and figured the limit for the worst percentile of trading days. VaR assumes that daily profits are random, but the characteristics of volatility remain constant. In the previous case, the model assumes that the volatility of last 250 trading days stays fixed in the future. Therefore it is a practical measurement for normal market environment, but lacks use in extraordinary market conditions. This was a problem during the financial crisis and might become again an issue if global markets set to a "new normal", which refers to lower growth and increased volatility (Montier, 2010).

Perhaps the most interesting sensitivity analyses disclosed are the interest rate sensitivity tables that show, for example, the effect of an interest shock to equity and income. Insurers disclose similar information concerning their embedded value. The value of in-force part of embedded value is directly affected by an interest rate change as it is the present value of future profits. Companies use rather sophisticated statistical analysis to model the dynamic nature of a yield curve change. For example, Standard Bank has disclosed in their annual report that they use forward-looking dynamic scenario analyses and Monte Carlo simulations to provide a projection about interest sensitivity (Standard Bank, 2011, p. 180).

Risk management procedure is usually two-fold; companies first adjust the asset and liability mix towards desired risk level and then fine-tune the remaining exposure with derivatives if needed. It may not be a good business practice to manage all interest rate risk through changing the asset and liability mix, since this might lead to situation where, for example, a bank might not grant a mortgage to a person, because it would shift company's risk profile to undesirable direction. In other words, the client will suffer, although it is not his or her fault. This could lead to withdrawal of his or her deposits and bad publicity.

2.5 Regulations

The regulator for banks is the South African Reserve Bank (SARB, 2011). Corresponding insurance regulator is the Financial Services Board that supervises non-bank financial companies in South Africa (FSB, 2011). There are several regulatory processes going on to improve the management principles for banks and insurers. Banking and insurance regulation are heavily influenced by global regulatory trends, which focus currently on preventing a new financial crisis by enhancing capital levels. For example, banking management principles are based on Basel Accords. FSB is also drafting "Solvency Assessment and Management", which takes model from European Solvency II directive and aims at setting South African insurance regulations align with international ones (FSB, 2010).

2.6 Theoretical framework

In theory, there should be a strong link between projected interest rate sensitivity, fluctuating interest rates and actual changes in cash flows and capital; otherwise one could conclude that the results of internal interest rate risk models are irrelevant. Due to lack of sufficient publicly available data describing companies' cash flow structures, it would be hard to build any better models than the internal ones, but it should be possible to test how reliably these projections are in line with the actual changes.

There should be four possible outcomes in the research. 1. Projected interest rate sensitivity corresponds well with actual changes. 2. Projected interest rate sensitivity corresponds with changes in equity and income, but due to changes in other factors it is hard to draw any conclusions. 3. Projected interest sensitivity does not correspond with actual changes in equity

and income. 4. Interest rate fluctuations do not have a significant effect on companies, and therefore measuring interest rate risk is irrelevant.

The actual changes should be smaller than projected shocks where management is not assumed to intervene, because management has more time to react to those changes and restructure the balance sheet.

If the stock markets are efficient, movements in stock price should include all factors that affect companies' financial performance etc. Then, comparing stock returns to changes in the interest rate level would give an idea about the how sensitive a company is to shifts in the yield curve. Accounting data could be used in assessing the true sensitivity, but it might be hard to separate the effects of interest rates from other factors such as credit risk. Accounting variables could also show too high or low sensitivity, if all off-balance-sheet positions cannot be observed.

3. Empirical part

3.1 Data

This study uses three different kinds of data; interest rate risk data from annual reports, interest rates and stock prices for major South African banks and insurers. Yield curve and stock price data include daily observations whereas accounting data provides one data point in a year per company. The time period covers years from 2006 to 2010, which includes the financial crisis and large volatility in interest rates and equity prices. The four banks included in the paper are Absa Bank Limited, FirstRand Bank Limited, Nedbank Group Limited and The Standard Bank. Insurers include Discovery, Liberty Holdings Limited, Old Mutual Plc. and Sanlam. Table 1 summarizes the key financial information from annual reports for these companies in millions of rands.

Table 1 – Key financial information from latest annual reports

2010 Rm	Market Cap	Equity	Total Assets	Income from operations	Profit before taxes	Embedded value
Absa	100,500	52,630	680,923	30,453	9,265	
FirstRand	111,913	40,642	616,695	34,175	10,755	
Nedbank	67,100	47,814	608,718	23,635	6,499	
StdBnk	170,471	108,210	1,341,420	109,895	18,006	
Discovery	20,747	8,382	20,994	13,830	2,497	22,558
Liberty	20,737	14,379	237,841	51,366	4,356	21,504
Old Mutual	73,981	117,948	1,989,637	243,991	12,949	77,251
Sanlam	56,831	34,386	361,191	67,285	9,272	57,361
Average	*77,785*	*53,049*	*732,177*	*71,829*	*9,200*	*44,669*

On October 10th 2011 one euro traded at 10.8493 rands (Yahoo!, 2011). Market capitalizations in latest fiscal yearend vary from Discovery's Rbn 20 to Standard Bank's Rbn 170 while the average of the eight is Rbn 78. Standard Bank is also the largest financial group in Africa by market value (Ford, 2011, p. 20). Comparison between companies is a bit difficult, since the listed companies include various offshore operations, but the South African business is usually the largest one. For example, Old Mutual, which has insurance and asset management businesses in Europe and the United States, makes the most of its revenue and profit in South Africa (Old Mutual, 2011, p. 206). Another issue that should be recalled is that some companies own shares of each other. Especially, Liberty and Nedbank are subsidiaries of Standard Bank and Old Mutual, respectively. One possible outcome from this kind of structure is that the subsidiaries might have relatively large interest rate sensitivities, but the sensitivities offset each other in the group level.

Interest rate sensitivity data has the most important role in my research, because the study tests its reliability. The banks disclose a commentary about interest rate risk in the banking book for every audited fiscal yearend financial statement. This section includes information about repricing profiles and interest rate sensitivity analysis. The latter will be used in the study and it describes how the equity and net interest income would change after a parallel yield curve shift without management intervention and other factors kept constant. These figures are usually presented as millions of rands. Unfortunately, banks do not always disclose the sensitivity information for similar interest rate shocks, which makes it more challenging to compare companies with each other. Some companies disclose the effect of a 100bps shock while others show their estimate for a 200bps shock or both and some do it for

increases in the yield curve whiles others for decreases. Because the sensitivities are non-linear by nature, one cannot adjust the 2 % change to 1 % by just dividing the effect by two without weakening the accuracy of analysis. If a company discloses a sensitivity figure for a relatively large shift in the yield curve, it might signal that the management does not expect a relatively small shift to have a notable effect on the company. This is just speculation and there could be other reasons for the choice of reference shock, but it sounds logical that the management presents the effect of a probable or relevant shock.

The sensitivity of embedded value represents the interest rate sensitivity of insurer's equity in this study except for Liberty, which has disclosed its equity's sensitivity. This might be due to the fact that it is a subsidiary of Standard Bank. Embedded value sensitivity analysis provides information about how a parallel change in risk discount rates or in all interest rates would affect the company in rand terms. There is a possibility that the embedded value sensitivity is not intercomparable with equity sensitivity, but the research will be carried out despite this concern, because embedded value sensitivity is the best measurement available relating to equity sensitivity. Insurers disclose often in addition sensitivity estimates of other relevant changes such as changes in equity prices, exchange rates, mortality and morbidity. The effect of changing all interest rates will be used, because it includes changes in assumed risk discount rates, investment return and inflation. Discovery is a little bit problematic as its disclosure changed in 2009. It presents the effect of a change in all interest rates in 2009 and 2010 annual reports while the annual reports before that show the effect of a changing discount rate and expected return separately. The paper uses the sensitivity to a change in investment return and inflation prior to 2009, but this could be a considerable source for error.

FirstRand and Discovery have a fiscal yearend in the end of June, but that should not affect the comparison between sensitivity estimates and actual stock return sensitivity, which can be calculated for the same period. It is more of a problem when comparing the companies with each other in one year. The figures for these two companies are moved backwards by six months to match them with other companies. For example, 2010/2011 numbers are presented in the 2010 column. The information can be found in Table 3.

Thomson Reuters Datastream provides data for stock prices, indices and interest rates. The study uses daily total return data, since it catches return from dividends in addition to increases in stock price. The data has 1,305 quotes for every company, which averages to 261 data points per company per year. The total return index that represents the South African

market portfolio is the FINI15, which consist 15 largest financial companies in South Africa. Figure 1 in the Appendices presents how the banking shares have gained relative to FINI15 and Figure 2 the same for insurers. The total return quotations are rebased to one on January 2nd 2006.

Five data points were excluded from the data, because they are serious outliers and distort the regression. Stock return were plotted against index return and interest rate changes separately and examined if there are any observations that clearly do not fit in the overall pattern of the scatter plot. Dates excluded were October 22nd 2008, October 24th 2008 and February 17th 2009 for Discovery data, and May 28th 2008 and October 28th 2008 for Liberty data. For example, May 28th was the day after Standard Bank announced that it would acquire Liberty. This led to a 19% intraday jump in the total return data. Excluded data points are listed in Table 5.

10-year South African swap rate will be used as a benchmark for interest rate. InterCapital has calculated the interest rate from interest rate swaps as it acts as a major interdealer broker. Long-term rate is used, because it is important to separate at least somehow anticipated and unanticipated changes in the interest rate to see how unanticipated fluctuations affect financial institutions. If the yield curve is flat, one can assume that the anticipated change is zero and the observed variations are unanticipated, which is often the case in the long term end of the yield curve (Sweeney & Warga, 1986, p. 395). Figure 3 in the Appendices presents the 10-year interest rate from 2006 to 2010.

3.2 Methodology

The empirical part started by collecting the sensitivity data from annual reports. Because the banking and insurance interest rate sensitivities are usually presented in rand terms, they are divided by corresponding values of equity or embedded value. This takes into account the size of the company when comparing interest rate risks. The companies disclose their sensitivities to different sized interest rate movements, but a 100 basis point decrease was the most usual one and has the largest amount of data points. Standard Bank and FirstRand disclosed only the effect of a 200 basis point change, but the corresponding 100 basis point effect was approximated by making a slight linear assumption regarding the sensitivity and dividing the resultant change in equity by two. Table 3 in the Appendices contains the data for the estimated effects in response to a 1% decrease in all interest rates.

To test the reliability of sensitivity analysis, one has to have a measurement for actual interest rate sensitivity. Actual sensitivity will be measured by estimating a linear regression model with total stock returns as a dependent variable and changes in FINI 15 total return index and changes in the interest rate level as independent variables. The regression will be estimated for every company and for every year. First, the correlations between the changes in the interest rate and stock returns will be calculated and then the linear regressions that produce beta coefficients representing market and interest rate sensitivity. The model is presented in the article "The Pricing of Interest-Rate Risk: Evidence from the Stock Market" by Sweeney et al. (1986, p. 395). It is an extended version of capital asset pricing model that includes also a factor for interest rate changes, which makes it a type of arbitrage pricing theory model. Mathematically the equation looks like:

(2)

where is the return for company at time . is the intercept of the equation and can be interpreted as excessive return that the stock earns without a change in independent variables. represents the return on market portfolio, which in this case means the return on FINI 15 total return index. is the coefficient that describes the sensitivity regarding the market index. is the unanticipated change in interest rate level and the sensitivity to that factor. As mentioned before, this paper uses the change in long-term interest rates, which are assumed to be somewhat unexpected. is the error term that are represented by residuals in the regression analysis.

The daily return was calculated for shares and indices by taking a natural logarithm of the relative change between two subsequent days. In other words, daily return is presented as continuously compounded percentage. Changes in the level of 10-year interest rate, on the other hand, are measured by the absolute difference in daily quotes. These are the inputs for equation (2).

After the results for sensitivities are obtained from annual reports and linear regression, the companies are ranked from 1 to 8. This is done due to the nonlinear behavior of sensitivity analysis, which means that the sensitivity estimates cannot be extrapolated without weakening the accuracy. The direction of ranking is defined that after a decrease in interest rates, number one will face the largest losses and number eight gains the most. Consequently, an upward shift in the yield curve would cause number one to gain and number eight to lose at least

relative to each other. Finally, the rankings from disclosed sensitivity analysis are compared with the rankings from calculated betas.

4. Results

The results section contains three parts: the first one discusses disclosed estimates in annual reports and how the companies rank among each other. The second part presents results from the stock return and interest rate change regression. The third part compares these two measurements of interest rate sensitivity and concludes if they are in line with each other.

4.1 Sensitivity analysis in annual reports

As mentioned before, companies estimate how their financial position would change when yield curve makes a parallel shift. This sensitivity data is presented in Table 3 and graphically in Figure 4. The rankings of the sensitivities are shown in a numerical form in Table 4 and graphically in Figure 5. The number of observations differs between years. For example, six companies disclosed the sensitivity in 2006 while all eight did it in 2010. This variation was adjusted in Figure 5 by dividing the ranking of a company by the total number of observations during the corresponding year.

The data from annual reports tells that Standard Bank does not expect interest fluctuations to have an effect on its equity. The last disclosure from 2010 states that the bank is expecting a 6 basis point decrease in the value of equity if the level of interest rates decline by one percent. This is virtually next to nothing compared to other financials whose sensitivities vary from -0.92 % to +4.9 %. Absa Bank has been generally the most exposed to parallel shifts in the yield curve. Its exposure has grown from 2.5 % to 4.9 % during the time between 2006 and 2010. Visual review of sensitivities in Figure 4 expresses also a similar story. The projected effects of interest rate shocks are rather scattered in 2006, but without Absa the range of different estimates can be seen to narrow towards 2010. One reason for this could be that the late-2000s financial crisis and the consequential volatile interest rates have led to greater usage of interest rate hedging.

Absa Bank's large and grown interest rate risk exposure does not appear to stem from taking an active position on forecasted interest rates, since the bank stated in the 2010 annual report that it has "continued to manage its structural non-structural banking book interest rate risk to low risk appetite levels" (Absa, 2011, p. 93). Later on in the same paragraph Absa discloses that remaining interest rate risk arises from prime linked assets funded with liabilities with a

3-month post-hedge repricing profile. It comments also that the increased sensitivity is caused by purchases of statutory liquid assets and increase in interest rate swaps executed to hedge fixed rate exposure (Absa, 2011, p. 105).

It would make sense that banks and insurers consolidated in the same corporate group would diversify the interest rate risk exposure, which could result in lower group level risk. As mentioned in the "Characteristics of financial companies" section, they could have opposite interest rate risks, which could offset each other. This does not appear to be the situation in Standard Bank's case, where the banking book is stable, but Liberty's sensitivity has changed from year to year. Old Mutual and Nedbank, on the other hand, seem to react differently to interest rate fluctuations as Old Mutual's embedded value is expected to rise and Nedbank's banking book to decline if interest rates drop.

When the companies are ranked by the disclosed interest rate sensitivity, the ranks can be seen to change quite much from year to year. Absa is an exception, since it is almost throughout the sample period more sensitive than the other companies. Although Standard Bank's banking book looks quite hedged against interest rate fluctuations its relative ranking changes a lot. Its ranking changed from fifth to first place in 2008 while the change in the percentage term sensitivity remained small; from 0.01 % to 0.05 %.

4.2 How much interest rate changes explain stock returns

Correlations between daily total returns on stocks and returns on the FINI15 total return index are presented in Table 6 and in Figure 6. The linear regression model uses index as a market portfolio and it would be good to have some correlation between the returns so that the model would explain enough of stock movements. The results for FirstRand and Discovery are moved backwards by six months like were done in the previous part. For example, the 2007 estimate for FirstRand refers to the 2007/2008 fiscal period. Overall, the correlations are quite significant if Discovery and Liberty would be excluded. The correlations for the two regarding the index are both 0.4 on average while others have correlations between 0.67 and 0.88. This might suggest that Discovery and Liberty could be better choices for diversification, but it weakens the explanatory power of the linear regression model. The high 0.88 correlation between Standard Bank's stock return and the FINI 15 index could imply that Standard Bank has too large weight in the index and as if the model has the same variables as independent and dependent ones. The correlations stay roughly in the same level from year to

year except for Liberty, which experiences a period of low correlation in 2008. That was the year when Lehman Brothers went underwater and financial markets were extremely volatile. Liberty was also acquired by Standard Bank, although the outlier jump in the stock price on May 28th was excluded in this study.

The correlations between stock returns and interest rate changes provide the first measurements of actual sensitivity. The numbers can be found in Table 7 and graphically plotted in Figure 7. These correlation coefficients have more variability than correlation with the index. Generally insurers have lower correlations than banks and the least correlated are Liberty and Old Mutual with average coefficients of -0.084 and -0.095, respectively. However, these two companies had relatively high correlations in 2010; -0.23 and -0.24. In addition to a low correlation with the FINI 15 index in 2008, Liberty is having low correlation also in respect of interest rate changes. Absa has been the most correlated, which fits in with the interest rate sensitivity analysis in annual reports. For some reason, the stocks and the index have been somewhat less correlated in 2009 with shifts in the 10-year rate than in other years. One can see in Figure 1, Figure 2 and Figure 3 that in 2009 interest rates were clearly less volatile than in 2008 and asset prices rose rather well. Graphical interpretation of Figure 7 describes the movements similarly. Correlation coefficients mainly decreased from 2006 to 2009, but jumped back in 2010. One reason for the low correlation in 2008 and 2009 could be that the stock market's pricing mechanism did not work properly during the financial crisis, which could have led to price changes without connection to market variables such as interest rates. Some kind "normalization" in 2010 might have resulted in higher correlation with the conventional market variables. The index rose 14 % in 2010 compared to 24 % in 2009 while interest rates were generally declining.

The results for linear regressions are presented in Tables 9, 10, 11, 12 and 13. Each table contains the outputs for a single year. Companies are presented in rows and regression statistics in columns. represents the beta regarding the FINI 15 index and the beta in respect of interest rate changes. R^2 is the coefficient of determination, SE the standard error of the regression and Sig F the statistical significance of each model. Last two columns show the statistical significance of beta coefficients. The low correlations that Discovery and Liberty had regarding the changes in the 10-year rate and the total return index can be seen also in weak coefficients of determination. The connection between correlation coefficient and coefficient of determination is that in a simple regression the latter is the first coefficient raised to the power of two. Unfortunately, the linear regression does not explain very well

how much interest rate changes affect stock returns of these two companies. The portion of variance that the model can explain varies greatly throughout the research period, but is often around 20 %. Others are having fairly good R^2-values ranging from 50 % to 80 %. The significance of the F-value tells that the linear models as a whole are statistically significant as well as the betas in respect of changes in the market index. However, betas representing interest rate sensitivity are mostly insignificant, which can be seen from the p-values in each row. The magnitudes of the betas differ greatly from the results in previous interest rate sensitivity research. Sweeney et al. (1986, p. 395) found coefficients as large as -70.0 for utilities with a significant t-statistic. On the other hand, they too had large variability in the sizes of betas between different time periods.

Table 14 and Figure 8 summarize the beta coefficients for interest rate sensitivity. 24 out of the 40 coefficients are negative, which means that stocks gained in value when interest rates dropped. This is a little bit inconsistent when compared to correlations where only two correlations were positive. Figure 8 shows that the range of beta coefficients narrowed from 2006 to 2010. In 2006 the largest positive and negative values were Absa's and Old Mutual's; -4.05 and 4.79, respectively while in 2010 the extreme values were -1.27 and 0.79 for FirstRand and Absa. The latter has stood out in every comparison and in this stage it would be fair to say that Absa has had the largest interest rate risk exposure. The beta coefficients seem to be larger in 2008 and 2009, which would mean that interest rate changes had a larger effect on stock prices during that period. Interest rates were also more volatile during that period, so one explanation could be that the events of the financial crisis affected interest rates and stock returns, but the effects on equity prices were far larger than on the yield curve. The betas experience quite large variability between different years. For example, FirstRand's coefficient changed from negative to positive and back every year during the sample period, which questions the reliability along with the statistical insignificance.

The rankings of the interest rate change betas are calculated in Table 15 and Figure 9. Standard Bank, which estimated itself to be fairly hedged against interest rate changes, has stayed most of the time in the middle section of the ranking table. Others have had quite volatile positions especially in 2010. For some reason, almost all betas changed from positive to negative and vice versa during that year. During the 2006-2010 period Absa was the company that gained the most when interest rates dropped and Old Mutual was the one that rose in value when the yield curve shifted up. However, Old Mutual had one of the lowest correlations with changes in interest rates and the beta fluctuates vastly from year to year,

which could mean that the model has not caught the relationship between Old Mutual's stock returns and interest rate changes.

4.3 The comparison between annual report and regression estimates

The interest rate sensitivity estimates from annual reports and linear regression were compared by calculating the difference between company rankings in different years. The rank for the annual report estimate was subtracted from the corresponding ranking of beta coefficient. For example, if a company was sixth by annual report sensitivity analysis rankings and fourth by beta coefficients, the difference would be a negative two. Three results from regression were excluded in this phase, because corresponding estimates from annual reports were not available. These include Standard Bank 2006 and Sanlam 2006 and 2007.

Table 16 contains the numbers regarding the differences. The largest single differences are in the following rankings, Absa and FirstRand in 2010, Nedbank in 2009 and Discovery in 2007. The biggest more or less consistent deviations between the annual report figures and regression estimates are in Old Mutual's and Sanlam's rankings whose ranks frequently differ from the other ranking.

5. Conclusions

In this paper the interest rate sensitivity analysis, which is disclosed in annual reports and the stock return sensitivity regarding long term interest rate changes were compared together for eight South African financial companies. The comparison was non-parametric and was carried out by comparing the rankings of each year. It is hard to make straight forward conclusions about the soundness of disclosed sensitivity analysis, because the linear regressions provided insignificant coefficients, which made the measurement of actual interest rate sensitivity challenging. Nevertheless, results that stood out were, for example, that Absa has been the most sensitive in respect of interest changes and its ranking was consistent when measured by companies' own internal interest rate sensitivity analysis and linear regression. If an investor wants to start limiting its interest rate exposure in his or her portfolio, this company could a good place to start. The largest differences between the ranks of annual report data and regression estimates were in Old Mutual's and Sanlam's estimates. Liberty had also large deviations in several years. One reason for this is probably the low correlation between the stock returns of these three companies and the interest rate changes.

An important thing that an investor should bear in mind when evaluating how a company's market value would change in a volatile interest rate environment is that in addition to calculating a projection for an effect, the investor should also take into account how correlated the stock returns are with interest rates. Mathematically speaking, one should give a thought to both the correlation coefficient and the regression coefficient. Two companies might have similar estimates of how the equity would be affected after a yield curve shift, but if the first is somewhat uncorrelated with interest rates the estimate might be rather useless. On the other hand, if the latter has a high correlation the actual effects might work out as estimated more often. This phenomenon can be seen in the results of this research since the estimates and calculated betas for Old Mutual and Liberty were not really consistent and the two had also low correlations in respect of interest rate changes.

Potential topics for future research could be a similar study, but with improved measurement for actual interest rate sensitivity. This could be done by using more statistical tools to fix possible problems arising from heteroscedasticity and autocorrelation. Another way to improve the measurement could be figuring out a thorough method to observe the effects of interest rate changes in financial statements. This is limited by the level of disclosure and how well the off-balance sheet exposures can be assessed.

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Table 2 – The effects of a interest rate change

	Interest rates rise	Interest rates decline
Long term assets Short term liabilities	Interest expenses rise faster than interest income. Market value of assets decline more than market value of liabilities	Interest expenses decline faster than income. Market value of assets rise more than liabilities'
Short term assets Long term liabilities	Interest expenses rise slower than interest income. Market value of assets declines less than market value of liabilities'	Interest expenses decline slower than income. Market value of assets rise less than liabilities'

Net interest margin rises Net interest margin declines
Economic value rises Economic value declines

Table 3 – The projected sensitivity of equity in response to a 1% decrease in interest rates. *Company annual reports*

-100bps

	2006	2007	2008	2009	2010	*Avg.*
Absa	2.54 %	2.51 %	3.80 %	4.30 %	4.90 %	*3.61 %*
FirstRand*	0.82 %	-0.24 %	0.21 %	0.20 %	-0.26 %	*0.14 %*
Nedbank	-0.95 %	-0.28 %	0.59 %	-0.50 %	-0.92 %	*-0.41 %*
StdBnk*		0.01 %	0.05 %	-0.06 %	-0.06 %	*-0.02 %*
Discovery	-2.32 %	-2.51 %	1.28 %	1.42 %	1.59 %	*-0.11 %*
Liberty	-3.04 %	-2.40 %	0.83 %	3.14 %	1.19 %	*-0.06 %*
Old Mutual	2.76 %	0.86 %	1.13 %	0.81 %	0.88 %	*1.29 %*
Sanlam			1.76 %	1.68 %	1.57 %	*1.67 %*
Avg.	*-0.03 %*	*-0.29 %*	*1.21 %*	*1.37 %*	*1.11 %*	***0.74 %***

*The projected effects of a 2 % shock for FirstRand and Standard Bank are divided by two to match them with other companies' projections

Table 4 – Ranking of projected sensitivity of equity in response to 1% decrease in interest rates.
Company annual reports

	2006	2007	2008	2009	2010	*2006-2010*
Absa	5	7	8	8	8	*8*
FirstRand	4	4	2	3	2	*5*
Nedbank	3	3	3	1	1	*1*
StdBnk		5	1	2	3	*4*
Discovery	2	1	6	5	7	*2*
Liberty	1	2	4	7	5	*3*
Old Mutual	6	6	5	4	4	*6*
Sanlam			7	6	6	*7*

Table 5 – Excluded data points

Date	Discovery	FINI 15	ΔI
22.10.2008	0,00 %	-5,30 %	0,46 %
24.10.2008	-4,46 %	0,24 %	-0,42 %
17.2.2009	-6,10 %	-3,83 %	0,40 %

Date	Liberty	FINI 15	ΔI
28.5.2008	18,74 %	-0,27 %	0,01 %
28.10.2008	22,43 %	3,58 %	-0,31 %

Table 6 – Correlations between stock total returns and the FINI 15 total return index

FINI15 Correlation	Absa Grp	FirstRand	Nedbank Grp	Standard Bank Grp	Discovery	Liberty	Old Mutual	Sanlam
2006	0.8125	0.8414	0.7408	0.8763	0.2788	0.5595	0.7206	0.7423
2007	0.7835	0.8288	0.7462	0.8834	0.4454	0.4994	0.7543	0.5867
2008	0.8066	0.8389	0.7897	0.8872	0.4250	0.1823	0.6634	0.7017
2009	0.8222	0.8361	0.8149	0.8821	0.3872	0.4944	0.7950	0.5999
2010	0.8488	0.8538	0.7529	0.8935	0.4179	0.6255	0.7801	0.7147
2006-2010	***0.8117***	***0.8362***	***0.7790***	***0.8825***	***0.4058***	***0.4083***	***0.7172***	***0.6719***

Table 7 – Correlations between stock total returns and changes in the 10-year interest rate

ΔI Correlation	Absa Grp	FirstRand	Nedbank Grp	Standard Bank Grp	Discovery	Liberty	Old Mutual	Sanlam	FINI15
2006	-0.3605	-0.2458	-0.3099	-0.3704	-0.0582	-0.2633	-0.0611	-0.2424	-0.2999
2007	-0.2670	-0.2883	-0.2219	-0.2918	-0.2400	-0.1964	-0.1939	-0.1188	-0.2939
2008	-0.3727	-0.2355	-0.2497	-0.3120	-0.1541	0.0200	-0.1281	-0.1964	-0.2983
2009	-0.1742	-0.1995	-0.1349	-0.0916	-0.1233	-0.0413	-0.0003	0.0022	-0.1008
2010	-0.2216	-0.1043	-0.1815	-0.2512	-0.1134	-0.2294	-0.2422	-0.1836	-0.2968
2006-2010	***-0.2910***	***-0.2265***	***-0.2163***	***-0.2549***	***-0.1501***	***-0.0840***	***-0.0945***	***-0.1484***	***-0.2461***

Table 8 – Total return (continuously compounded) during period and 10-year interest rate quote at yearend.

Return	Absa	FirstRand	Nedbank	StdBnk	Discovery	Liberty	Old Mutual	Sanlam	FINI15		10Y
2006	24.7 %	32.7 %	32.2 %	25.7 %	38.5 %	20.8 %	31.8 %	22.7 %	30.7 %		8.36 %
2007	-8.2 %	-41.9 %	6.3 %	9.1 %	-27.4 %	12.3 %	-0.6 %	25.2 %	0.5 %		9.24 %
2008	3.1 %	11.2 %	-29.6 %	-8.7 %	30.1 %	-56.0 %	-101.9 %	-24.7 %	-29.7 %		7.83 %
2009	22.9 %	28.1 %	31.6 %	24.6 %	32.6 %	17.4 %	55.1 %	35.0 %	24.3 %		9.20 %
2010	11.9 %	28.1 %	8.1 %	8.8 %	11.5 %	10.8 %	0.7 %	24.7 %	13.8 %		8.22 %

Table 9 – Regression results for 2006

2006			R^2	SE	Sig F	Sig	Sig
Absa	1.0554	-4.0524	0.6751	0.0116	0.0000	0.0000	0.0007
FirstRand	1.3848	-1.8258	0.7112	0.0101	0.0000	0.0000	0.0876
Nedbank	0.9356	-2.9346	0.5573	0.0130	0.0000	0.0000	0.0276
StdBnk	1.1776	-3.8357	0.7805	0.0098	0.0000	0.0000	0.0001
Discovery	0.3530	0.1156	0.0777	0.0136	0.0000	0.0000	0.9359
Liberty	0.5344	-2.4598	0.3231	0.0124	0.0000	0.0000	0.0522
Old Mutual	0.9364	4.7866	0.5456	0.0122	0.0000	0.0000	0.0001
Sanlam	0.9775	-0.6670	0.5515	0.0132	0.0000	0.0000	0.6210

Table 10 – Regression results for 2007

2007			R^2	SE	Sig F	Sig	Sig
Absa	1.0506	-1.3803	0.6154	0.0111	0.0000	0.0000	0.3216
FirstRand	1.1508	0.1283	0.6868	0.0123	0.0000	0.0000	0.9178
Nedbank	0.9826	-0.0919	0.5568	0.0115	0.0000	0.0000	0.9493
StdBnk	1.3214	-1.3438	0.7815	0.0093	0.0000	0.0000	0.2497
Discovery	0.5017	-2.7842	0.2063	0.0171	0.0000	0.0000	0.1102
Liberty	0.5412	-1.5353	0.2521	0.0127	0.0000	0.0000	0.3363
Old Mutual	0.9472	0.9567	0.5698	0.0107	0.0000	0.0000	0.4759
Sanlam	0.6940	1.7058	0.3473	0.0122	0.0000	0.0000	0.2655

Table 11 – Regression results for 2008

2008			R^2	SE	Sig F	Sig	Sig
Absa	0.9780	-3.7541	0.6698	0.0163	0.0000	0.0000	0.0001
FirstRand	1.1077	-1.8169	0.7078	0.0180	0.0000	0.0000	0.0594
Nedbank	1.0326	-0.4116	0.6238	0.0179	0.0000	0.0000	0.6984
StdBnk	1.1152	-1.3424	0.7896	0.0130	0.0000	0.0000	0.0832
Discovery	0.3998	-1.8563	0.1877	0.0216	0.0000	0.0000	0.1362
Liberty	0.2278	1.7830	0.0389	0.0241	0.0061	0.0015	0.2192
Old Mutual	1.2098	2.7290	0.4454	0.0291	0.0000	0.0000	0.1152
Sanlam	0.8932	0.3630	0.4926	0.0200	0.0000	0.0000	0.7596

Table 12 – Regression results for 2009

2009			R^2	SE	Sig F	Sig	Sig
Absa	1.0672	-2.5543	0.6844	0.0134	0.0000	0.0000	0.0092
FirstRand	1.1819	0.7663	0.6998	0.0095	0.0000	0.0000	0.4328
Nedbank	1.0910	-1.5144	0.6669	0.0141	0.0000	0.0000	0.1412
StdBnk	1.1570	-0.0751	0.7780	0.0112	0.0000	0.0000	0.9267
Discovery	0.4113	-0.4327	0.1503	0.0122	0.0000	0.0000	0.7319
Liberty	0.6329	0.2333	0.2445	0.0201	0.0000	0.0000	0.8736
Old Mutual	1.5749	3.3335	0.6384	0.0214	0.0000	0.0000	0.0330
Sanlam	0.6333	1.3949	0.3638	0.0151	0.0000	0.0000	0.2055

Table 13 – Regression results for 2010

2010			R^2	SE	Sig F	Sig	Sig
Absa	1.0869	0.7948	0.7215	0.0078	0.0000	0.0000	0.3346
FirstRand	1.2882	-1.2706	0.7325	0.0073	0.0000	0.0000	0.0633
Nedbank	1.0298	1.1661	0.5688	0.0103	0.0000	0.0000	0.2839
StdBnk	1.1921	0.3828	0.7985	0.0069	0.0000	0.0000	0.6022
Discovery	0.3884	-1.2069	0.1831	0.0079	0.0000	0.0000	0.1038
Liberty	0.7091	-1.0518	0.3934	0.0105	0.0000	0.0000	0.3452
Old Mutual	1.0862	-0.3102	0.6087	0.0102	0.0000	0.0000	0.7735
Sanlam	0.7762	0.6331	0.5117	0.0087	0.0000	0.0000	0.4930

Table 14 – Summary of beta coefficients in respect of interest rate changes

	2006	2007	2008	2009	2010
Absa	-4.05	-1.38	-3.75	-2.55	0.79
FirstRand	-1.83	0.13	-1.82	0.77	-1.27
Nedbank	-2.93	-0.09	-0.41	-1.51	1.17
StdBnk	-3.84	-1.34	-1.34	-0.08	0.38
Discovery	0.12	-2.78	-1.86	-0.43	-1.21
Liberty	-2.46	-1.54	1.78	0.23	-1.05
Old Mutual	4.79	0.96	2.73	3.33	-0.31
Sanlam	-0.67	1.71	0.36	1.39	0.63

Table 15 – Rankings of beta coefficients

Rankings:	2006	2007	2008	2009	2010
Absa	8	6	8	8	2
FirstRand	4	3	6	3	8
Nedbank	6	4	4	7	1
StdBnk	7	5	5	5	4
Discovery	2	8	7	6	7
Liberty	5	7	2	4	6
Old Mutual	1	2	1	1	5
Sanlam	3	1	3	2	3

Table 16 – Differences between interest rate sensitivity ranking estimates from annual reports and beta coefficients

	2006	2007	2008	2009	2010
Absa	1	-2	0	0	-6
FirstRand	-1	-2	4	0	6
Nedbank	2	0	1	6	0
StdBnk		-1	4	3	1
Discovery	0	6	1	1	0
Liberty	3	4	-2	-3	1
Old Mutual	-5	-5	-4	-3	1
Sanlam			-4	-4	-3

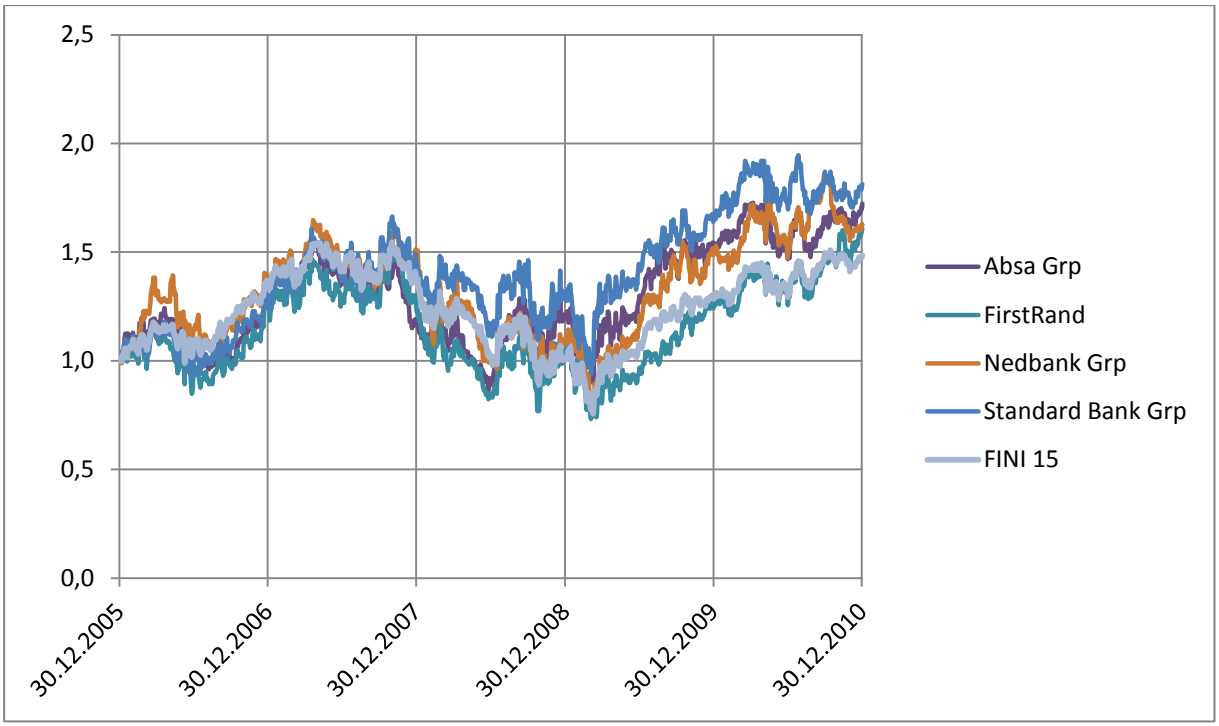

Figure 1 – Total return chart for the banks and the FINI 15 index. *Thomson Reuters Datastream*

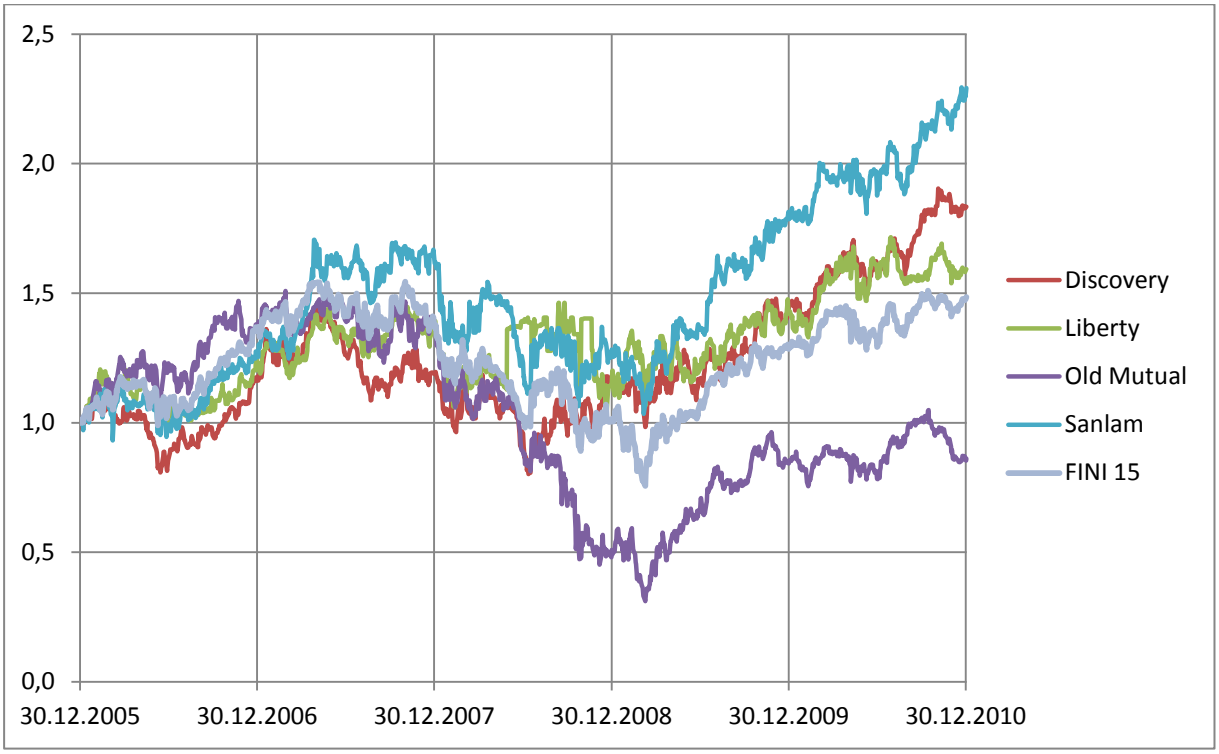

Figure 2 – Total return chart for the insurers and FINI 15 index. *Thomson Reuters Datastream*

Figure 3 – Quote of South African 10-year swap rate. *InterCapital*

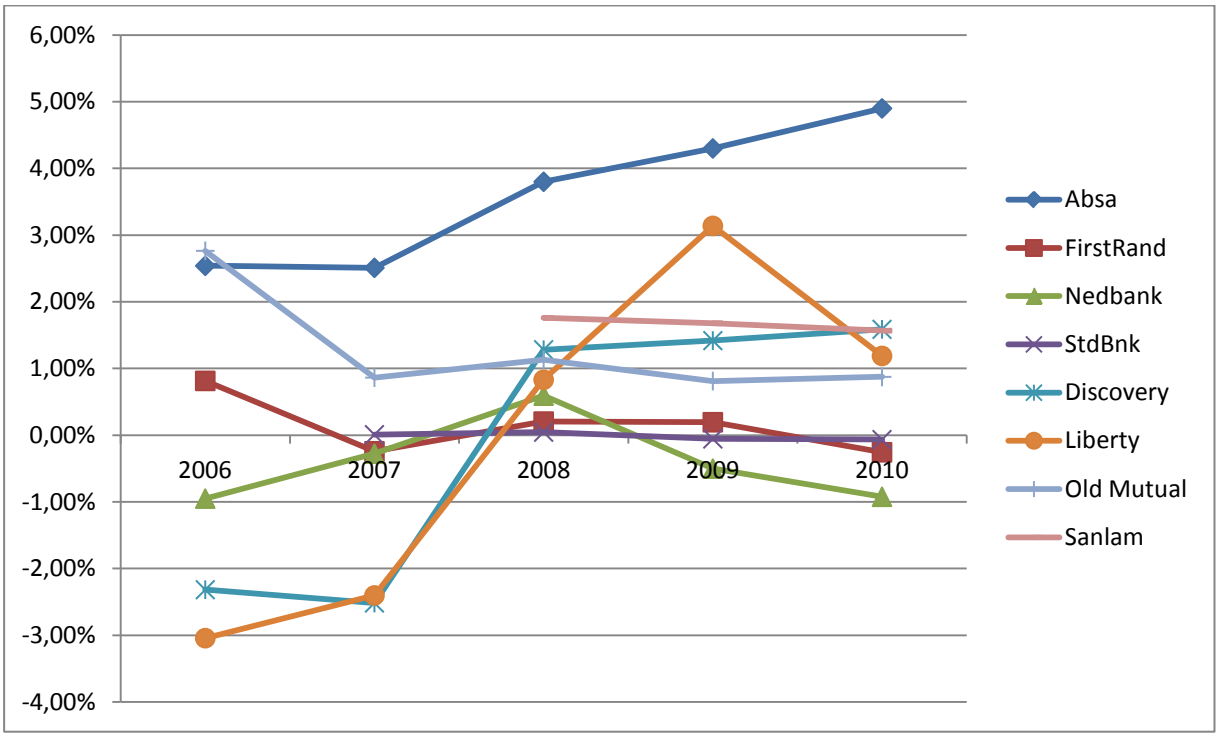

Figure 4 – The projected sensitivity of equity in response to 1% decrease in interest rates. *Company annual reports*

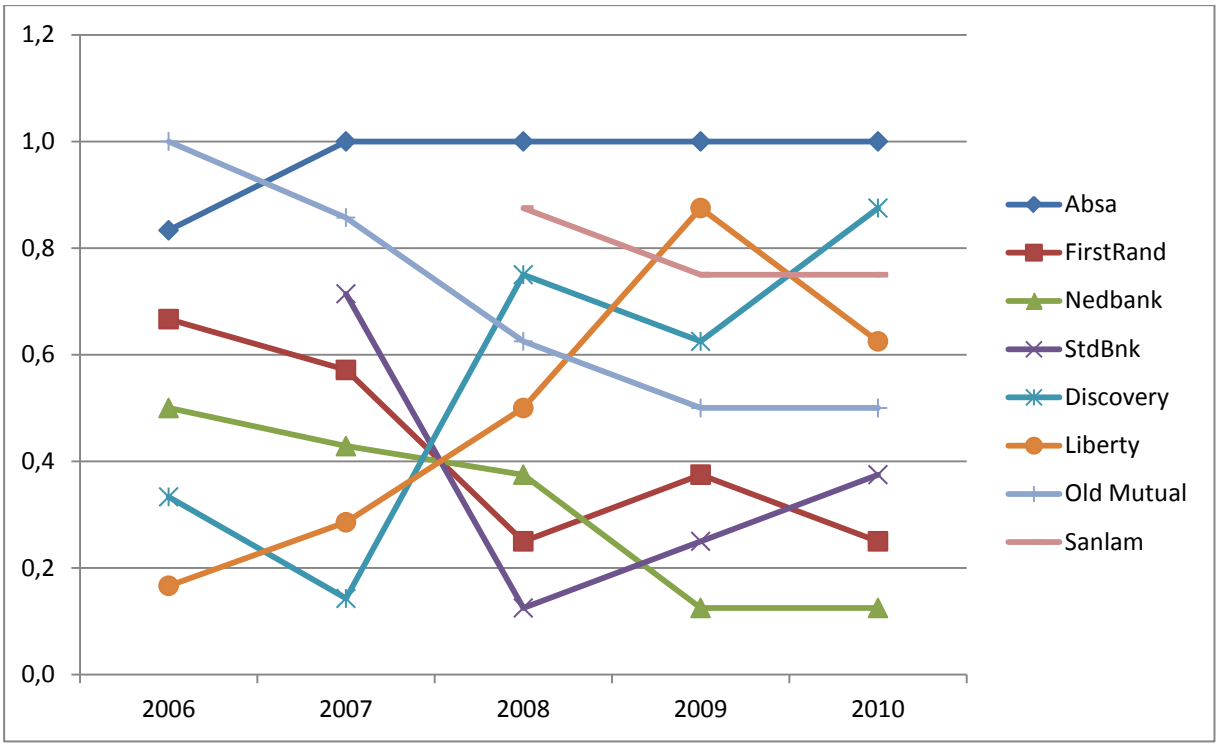

Figure 5 – Ranking of projected sensitivity of equity in response to 1% decrease in interest rates. (adjusted for varying number of observations). *Company annual reports*

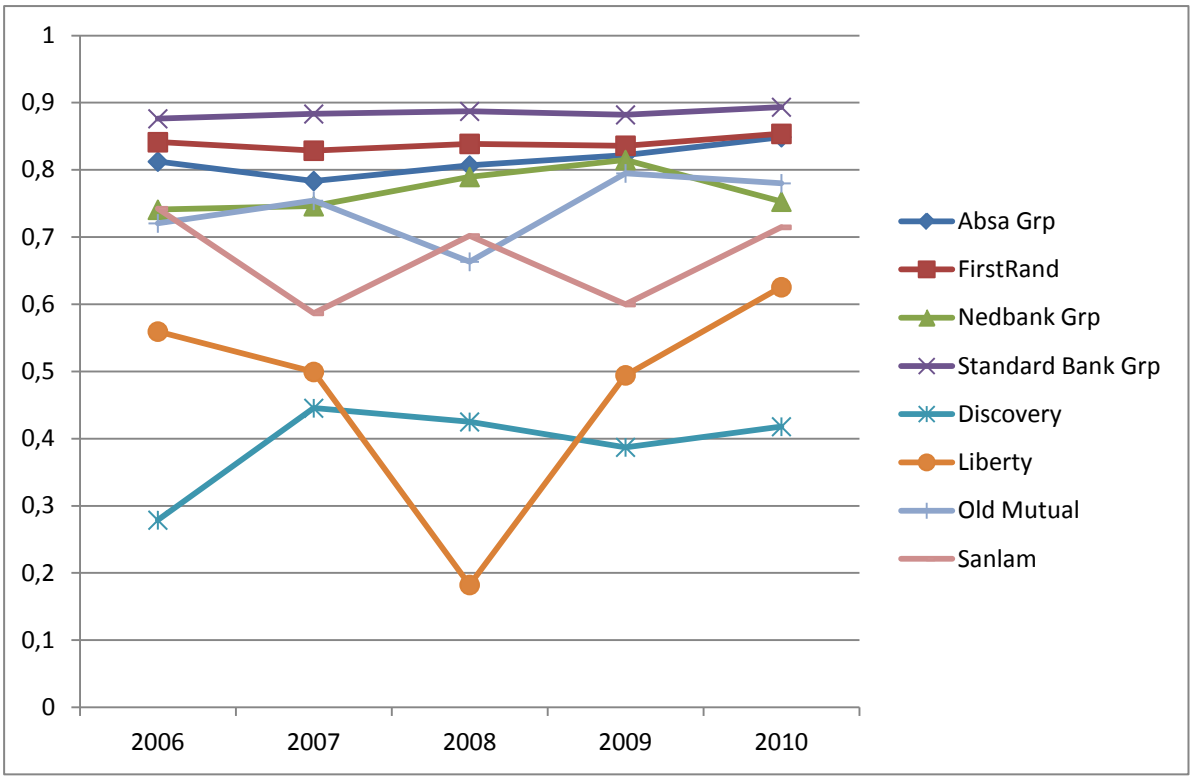

Figure 6 - Correlations between stock total returns and the FINI 15 total return index

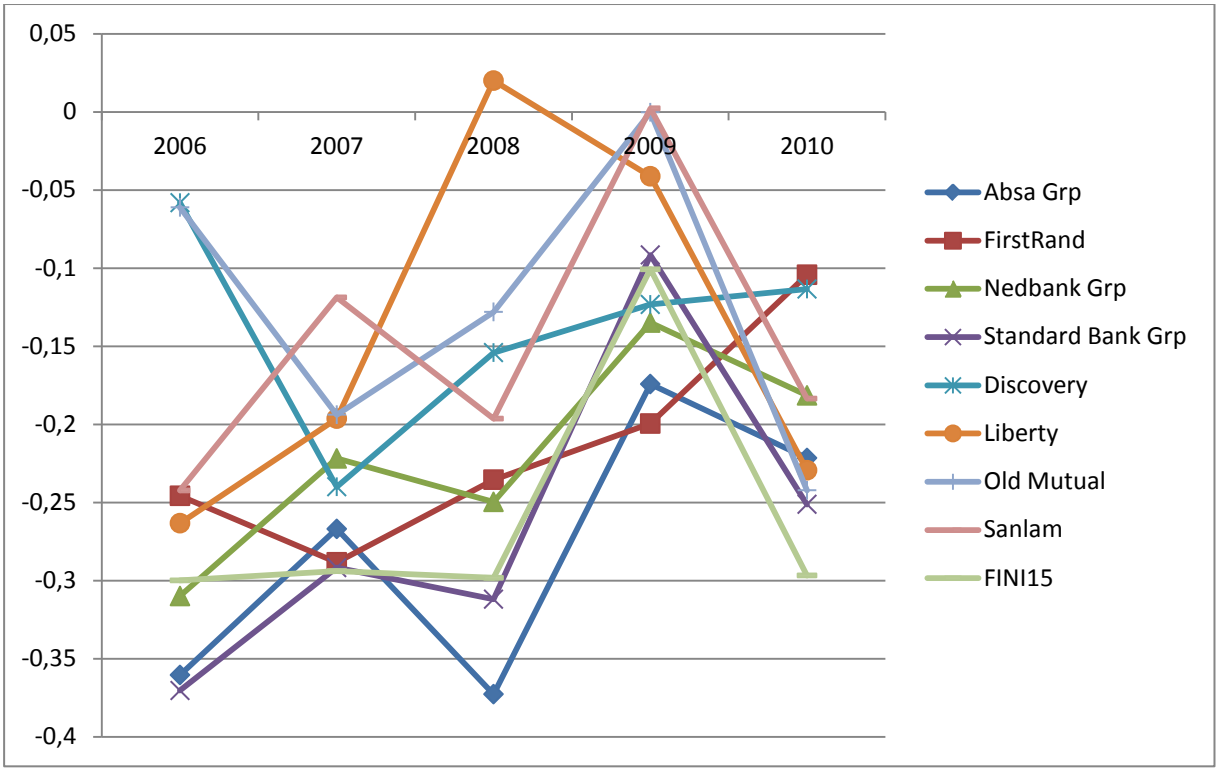

Figure 7 - Correlations between stock total returns and changes in the 10-year interest rate

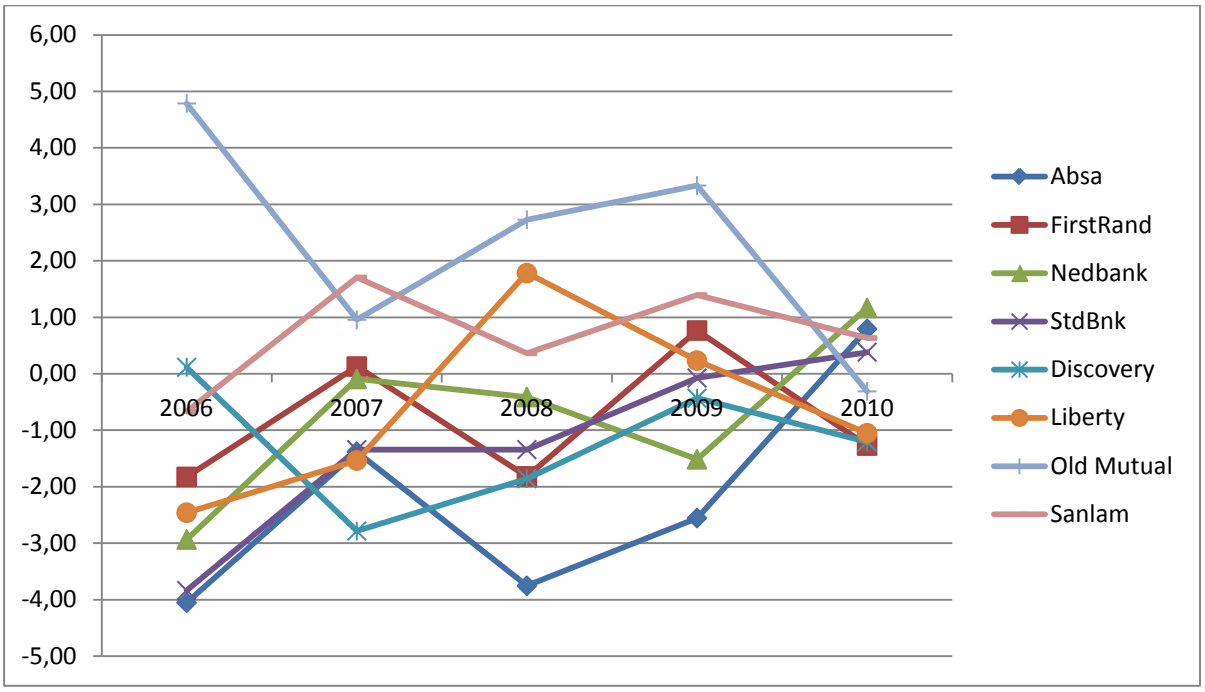

Figure 8 – Beta coefficients regarding interest rate changes

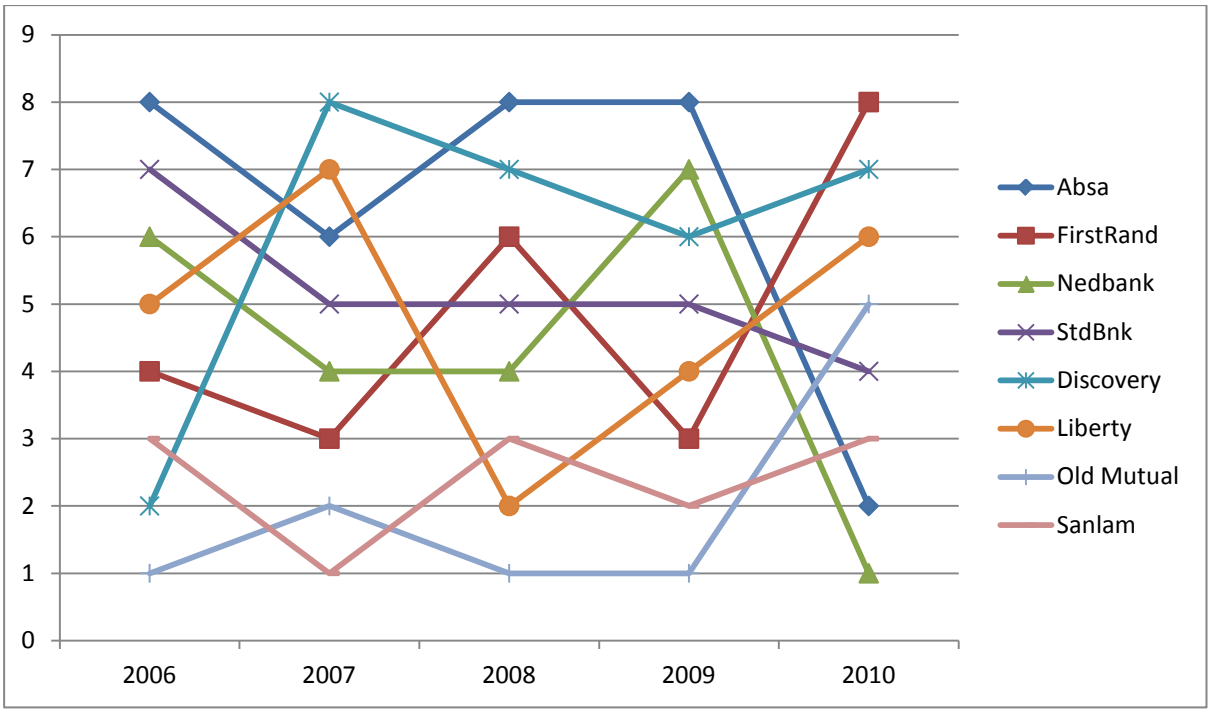

Figure 9 – Rankings of interest rate beta coefficients