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The Effect of Interest Rate Risk on the Stock Prices of UK Financial Institutions

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Abstract: There is vast research on the effect of interest rate risk on the US stock returns of financial institutions; however, there has been limited research on British bank stock returns and interest rate sensitivity. The aim of this paper is to investigate the effect of interest rate risk on the stock prices of UK financial institutions and the effect interest rate risk has on policy makers. This paper considers 8 (eight) UK financial institutions between the years 1997-2014.

The methodology uses the Stone's Two Index Model to test for the significance of such risk. The results found several structural breaks in the data; however there still remains a strong correlation between stock price returns and interest rate risk, particularly those involved in sub-prime mortgage operations. The evidence shows that interest rate risk has a significant impact on the stock prices returns through monetary policy transmission. It also indicates that interest rate risk affects the decisions of policymakers at the strategic level.

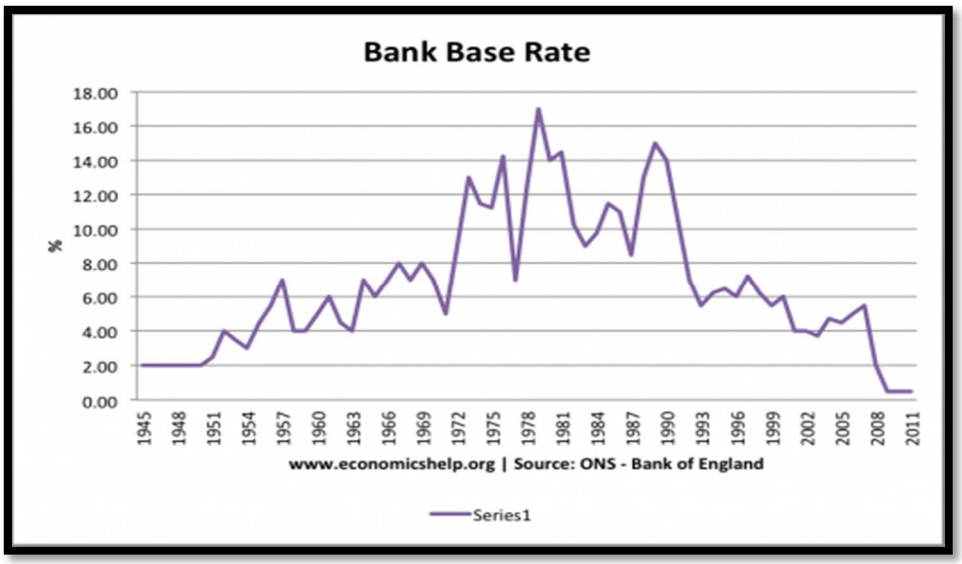
Keywords: Interest Rate Risk, Stock Prices, Monetary Transmission Mechanism, Credit Channel, Balance Sheet Channel, Stone's Two Index Model.

Introduction

The aftermath of the 2008 Financial Crisis aroused a growing concern on the health and stability financial systems. Collateralized debt obligations, sub-prime mortgaging, highly leveraged financial institutions, and lousy business ethics have been deemed as the roots to the demise of the international financial system. Once again, and as it has always been the case, policy makers are utilizing interest rates to increase and control economic stability. Their decision is to keep interest rates low which, according to economic theory, should encourage individuals and firms to willingly borrow from banks. The result of the monetary contraction should increase consumption and spending to spark the dismal economy. However, evidence has revealed a different perception; the manipulation of interest rates indirectly impacts a number of other channels which hinder policy maker's objective to combat inflation.

Fig 1: Bank Base Rate

Source: Bank of England



The Figure - 1 illustrates UK interest rate movements since 1945. Interest rates were at its peak in the late 1970s, hovering around 17% to suppress high inflation caused by oil prices and rising wages. In the beginning of the 1990s interest rates expanded to 15% to combat the value of the pound fixed in the ERM and reduce inflation. In 2008, prior to the financial crisis, there was a steep decline in interest rates from nearly 6% to .5%.

In the UK, the Bank of England influences interest rates through the Repo rate. The Repo rate, known as the bank base rate, is the percentage at which the central bank of England lends cash to commercial banks during cases where banks are short in funds, and is utilized by the Bank of England to stabilize inflation. The Bank of England typically expands the repo rate during a period of inflation because commercial banks are less likely to borrow from the central bank. The money supply contracts in the economy and inflation is then stabilized. The repo rate sets off a ripple effect through the economy on a number of different channels including the credit channel, interest rate channel, exchange rate channel, and the asset price channel.

The monetary transmission mechanism illustrates the progression through which monetary policy decisions are transmitted into changes in real GDP and inflation. Moreover, it demonstrates how the manipulation of the Repo rate affects a number of channels. The Repo rate impacts open market operations, "where the buying and selling of government securities in the open market occur to expand or contract the amount of money in the banking system" (England, 2012). An increase in purchases infuses money into the financial systems which motivates growth while dales and financial instruments do the opposite. Open market operations and the repo rate are the primary tools of used in monetary policy. The manipulation of the open market operations and repo adjusts the LIBOR rate – the rate at which banks borrow reserves from each other. The amount of reserves a bank holds surges through a several channels, including the credit, exchange rate, interest rate, and asset (portfolio balance) channel which should impact aggregate demand and therefore inflation.

The primary objective of policy makers is to control inflation through monetary policy tools such as the central bank rate and/or open market operations. Conventional monetary transmission model would not agree with this concept because conventional monetary

transmission theory suggests the interest rate channel is only one channel that affects inflation through aggregate demand. However, contemporary theories of monetary transmission reveal three other channels that are affected by interest rates, which in turn influence inflation through aggregate demand. These indirect amplifications reveal the main goal of policy makers to control inflation is dependent on how interest rate changes react not only through the interest rate channel, but to the other three channels as well.

Moreover, the manipulation of interest rates or interest rate risk is considered a major financial risk that institutions must manage. A substantial portion of research has been on financial institutions' vulnerability to interest rate risk because of the highly sensitive interest rate nature of the banking business. The combination of highly leveraged financial companies and the recent high unpredictability in interest rates have contributed to the increased significance of interest. The risk of interest rate volatility affects a firm's value because it impacts both the expectations of future cash flows and the rate at which these firms' expected future cash flows will be discounted in the traditional valuation models. Furthermore, the existence of a maturity disparity between financial assets and liabilities in the balance sheets of banks has been proven as fact. The asset-liability maturity mismatch has been usually identified as the key factor responsible for the high interest rate sensitivity. These effects on the value of a firm and its balance sheets are impacted through the credit channel, specifically the balance sheet channel.

There is increasing evidence on the effect of interest rate changes on stock returns of financial companies. This seems intuitive because there is a strong relationship between the value of the firm and its stock returns. But the strength at which interest rate changes affect both the value of the firm and its stock returns is debatable. Sharpe and Litner used the traditional market model, labelled the Capital Asset Pricing Model, to clarify the relationship between market portfolio return and market risk. Stone further developed this model and instituted an interest rate change factor to the Capital Asset Pricing model in order to explain stock returns. Studies have revealed by adding the interest rate factor, the model becomes more significant to financial institutions' stock returns.

The Stone model derived three distinct conclusions in relation to interest rate risk and bank stock returns. First and foremost, the evidence that there is a significant and negative relationship between interest rate risks and bank stock returns. Secondly, bank stock returns experience increased sensitivity to a manipulation in long-term interest rates than to changes in short-term rates. Lastly, the interest rate sensitivity of stock returns of banks has declined over time mainly due to the increased availability of more advanced tools for measuring and managing interest rate risk.

This paper aims to demonstrate how strong the influence of interest rates on financial instruments by applying them to certain financial institutions using Stone's Two Index Model. The objectives are to measure the effect of interest rate changes on the value of the firms and hence the impact that these changes have on policymakers.

After applying the Stone's Two Index Model, comparisons can then be drawn between findings of other authors to test the consistency of interest rate risk on bank stock returns. Moreover, revealing a significant relationship between interest rate risk and bank stock returns would lead to confirmation of a credit channel. This confirmation will prove interest rate risks affect policy makers because as they control inflation through monetary policy, they must assess how the change in interest rate will affect the other channels.

Contemporary Monetary Policy and Its Channels

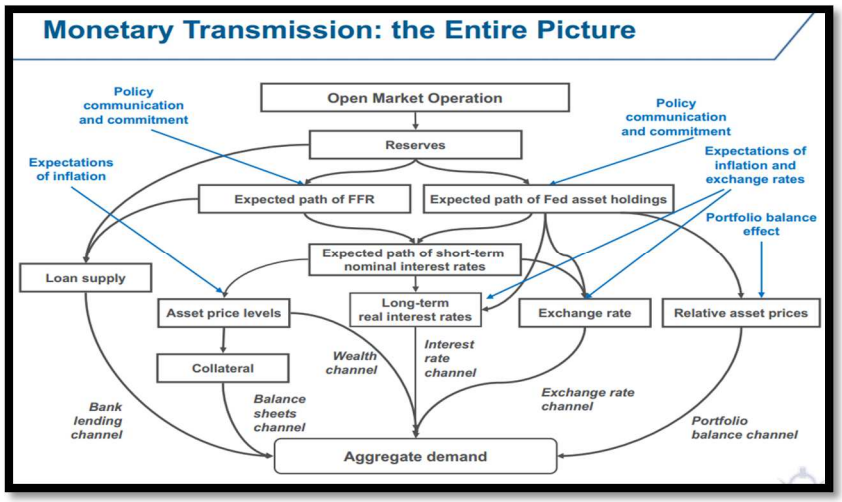
Conventional monetary mechanism theory suggests there is only the interest rate channel, where prices are presumed to be sticky and regulates to an interest rate shock with a delay. However, scholars have revealed other channels to impact aggregate demand. The focus will be the credit channel, particularly the balance sheet channel where the balance sheets of firms and assets are affected.

The credit channel in the monetary policy transmission mechanism (see Figure -2)works through two areas: the demand for loans and the supply of loans. Therefore the channel is split into two sub-channels, the banking lending channel and the balance sheet channel, respectively. In reference to the bank lending channel, a decrease in interest rates due to increase demand of reserve standards or the Central Bank buying commercial bank reserve assets translates to a decrease of useable reserve assets in financial institutions. Furthermore, a contracting monetary policy decision can impact economic activity and contraction will likely lead to lower deposits at commercial banks. Consequently, these determinants lower the availability of banks loans to small firms which negatively impacts investment activity.

The balance sheets of firms are directly affected by monetary policy decisions because the firm's assets depreciate. For instance, if policy makers decide on the expansion of interest rates, this would reduce the firm's cash flow and negatively impact financial assets by decreasing their prices. Moreover, this would ultimately translate to a depreciation of the firm's net worth, thereby lowing investment spending. Scholars have found moral hazard and adverse selection problems to have a strong correlation to weak balance sheets and leads borrowing firms to lower access of funds.

Fig 2: Monetary Transmission

Source: Bank of England



The four channels lead to an effect on aggregate demand. By definition, aggregate demand is "the total amount of goods and services demanded in the economy at a given overall price level and in a given time period" (Taylor, 1995). Therefore, this relationship will affect the rate of inflation in a given economy due to the "demand-pull inflation" theory. This theory is coined in Keynesian economics to illustrate a situation where the level of price increases because of a disparity between aggregate demand and aggregate supply. When there is an overwhelming pull on aggregate demand than aggregate supply, prices will increase.

The Credit Channel

The implementation of the credit channel finds monetary policy changes to impact the short-term interest rate which exponentially manipulates the external finance premium. By definition, the external finance premium is "a wedge reflecting the difference between the retained earnings of a firm compared to the firms' cost of raising capital through equity and debt markets" (England, 2012). Firms prefer to finance internally because external finance is more expensive and the disparity in the external financial premium will continue to exist until external finance is fully collateralized. The implication of fully collateralized finance states the money loaned to pay off a project is guaranteed its full repayment, regardless of the circumstance. Frictions in the financial market such as imperfect information or costly contract enforcement may affect the significance of the external finance premium because of policy actions. As noted earlier, the credit channel is divided into two sub-channels, the balance sheet channel and the bank lending channel. To keep focus, this paper will direct its attention to the balance sheet channel, where the value of a firm and its assets are impacted by interest rate changes.

Balance sheet channel

The balance-sheet channel of monetary policy transmission illustrates the how the financial position of private agents are affected by monetary policy decisions. This occurs due to a manipulation in policy that impacts both market interest rates and private economic agents' financial position because interest rate risk influences the value of firms, consumers, the balance sheet of banks, and future cash flows. An expansion of monetary policy will decrease cash flows, depreciate net worth, reduce loans, and negatively shock aggregate demand.

Studies have drawn consistent conclusions on how the balance sheet channel affects the economy and findings are. Monetary policy affects households' and firms' balance sheets. The assets and liabilities of both households' and firms' decline in sequence with an increase of outstanding credit market debt, due to an increase in interest rates. The changes in these balance sheets are influenced by financial frictions reflected in changes in the external finance premium as well as in asset prices.

Furthermore, the credit channels are statically and economically significant. Financial intermediaries – including banks, asset-backed – security issuers, money market funds, and security brokers and dealers – are sensitive to interest rate changes, at vary degrees where banks are the most responsive.

Evidence

Most of the evidence on the effect of interest rate changes on stock returns has been based on the extension of the CAPM (Capital Asset Pricing Model), with the addition of an interest rate change factor. Developed by Stone (1974) the two-factor model adds an interest rate variable to better explain the relationship.

There are three conclusions that have resulted from Stone's work. First, there is a significant negative correlation between the movements in interest rates on banking firms' stock returns (Martinez-Moya, Ferrer-Lapena, and Escribano-Sotos, et al. 2011). This is generally formed due to maturity mismatches between banks assets and liabilities. This significant interest rate sensitivity has been usually explained by the traditional role of financial intermediation played by these institutions which hold primarily in their balance sheets financial assets and liabilities. Therefore, maturity transformation suggests that the banks will be exposed to losses in the event of a sudden increase in interest rates. The longer the maturity mismatch between the financial assets and liabilities of banks, the greater is their interest rate risk.

Secondly, bank stock returns tend to be more reactive to sudden manipulation in long-term interest rates than to changes in short-term rates (Foerster and Sapp et al. 2009). Thirdly, the interest rate sensitivity of stock returns of banks has declined over time mainly due to the increased availability of more advanced tools for measuring and managing interest rate risk (Ballester, Ferrer, and Gonzalez et al. 2011)

Methodology

Stone (1974) instituted a model called the Two-Index Model to better reflect how risk impacts stock returns. After critical analysis, he found that the CAPM to be a magnificent starting point to understand the relationship between risk and returns; however there were several problems and a key variable missing (Stone, 1974). Stone's two-index model extends the CAPM model by incorporating interest rate risk as a second determinant of stock returns. The model is as follows:

$$Rj = Aj + BjRe + CjRd + ej \text{ where:}$$

Rj is the expected return of the bank j at time t, Aj is the parameter to be estimated that indicated deviations from equilibrium pricing, Bj measures the responsive of the security to movements on the index , Re is the expected return on the market of stock in time t, Cj is the sensitivity of the unexpected changes in the interest rates on stock returns of bank j given its relation to the market index , Rd measures the unanticipated changes in interest rates over time t (and ej is the residual error.

Data sets

This research paper accounts for a sample of the most representative 8 (eight) commercial and investment banks in the United Kingdom. The motivation behind choosing banks specifically for the given data set is due to the important role these banks have acting as financial intermediaries. Moreover, the large number and behaviour of activates induced in the overall financial system allows banks the priority to be sensitive to a number of different risk variable which experience different categories of obstacles and leads to imbalance in their financial structure. The sample covers a period that includes 17 (seventeen) annual financial years, 1997-2014, inclusive, all on monthly intervals.

Descriptive Statistics

Preliminary analysis of data (ignoring any market irregularities and structural breaks) produced some variation of positive and negative correlation coefficients which was not quite as expected.

For example, Abbey National produced a negative correlation coefficient of -.208, Alliance and Leister revealed a strong positive correlation of .606, the strongest coefficient there is in the data set. The Royal Bank of Scotland instituted a high positive correlation coefficient of .467. Where Barclays produced a coefficient of .260; HBOS, -.064; HSBC, .037; Lloyds, .184; and Standard and Charter with a correlation coefficient of .008. For the sake of repeating similar results, the analysis will be conducted analyzing the three most interesting coefficient behaviours, namely Alliance and Leister, Royal Bank of Scotland, and Abbey National

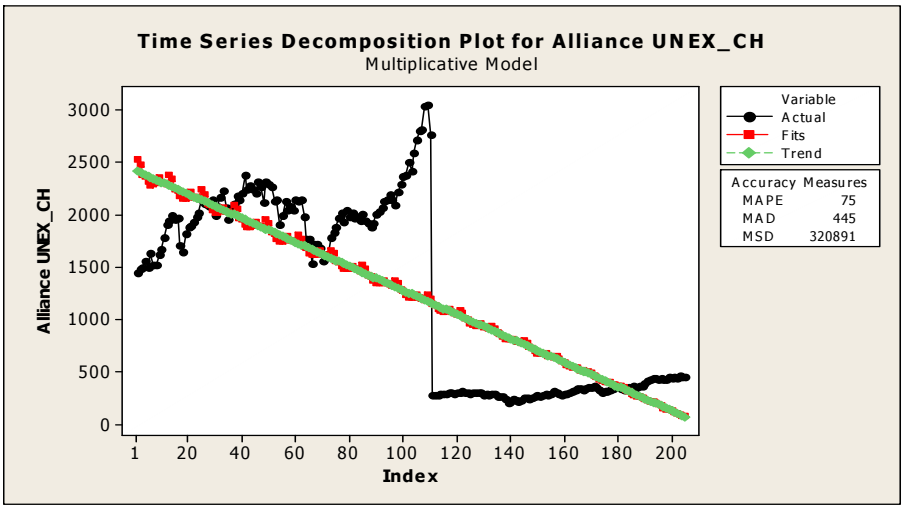
Study – Case – 1

Alliance and Leister

In 1990, Alliance and Leister expanded its position in the financial services markets with the acquisition of Girobank, allowing the bank to gain access to the nation's post office. By 2007,

the financial institution gained national presence, with 4.4 million customer accounts, a banker to 92,000 businesses with 55 billion out mostly in mortgages where is had more than 3% of the UK market. Graph - 1 displays time-series decomposition for Alliance and Leister based on unexpected interest rate changes.

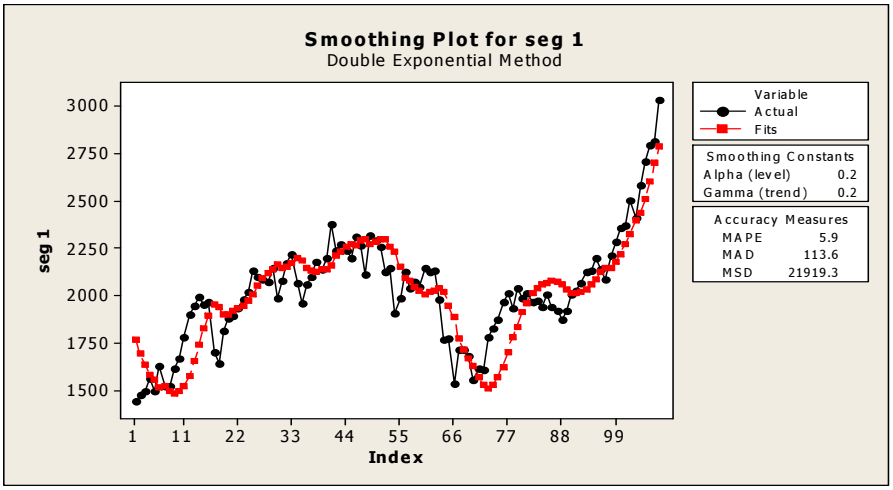
Graph 1: time Series Decomposition



The model clearly shows an increase to interest rate sensitivity in mid 2006 followed by a drastic decline and finally stabilizing. In order to completely understand how Alliance and Leister's stock returns are impacted by interest rate risk, the data must be divided into two segments, before and after the structural break. The structural break indicates an unusual traumatic event that does not normally happen therefore, the method would not be able to replicate the relationship between interest rate risk and bank stock returns accurately. By separating the data into two segments, an analysis can be conducted to investigate the relationship between the two variables in normal settings excluding peculiar events. The data is divided from 1997 -2006 and 2006 – 2014.

Graph - 2 displays the coefficient in the first segment produced a negatively relationship of -.067. These results are consistent with the literature whereby an increase in interest rates will lead to a decrease in bank stock returns. This may indicate there was a long maturity mismatch between assets and liabilities.

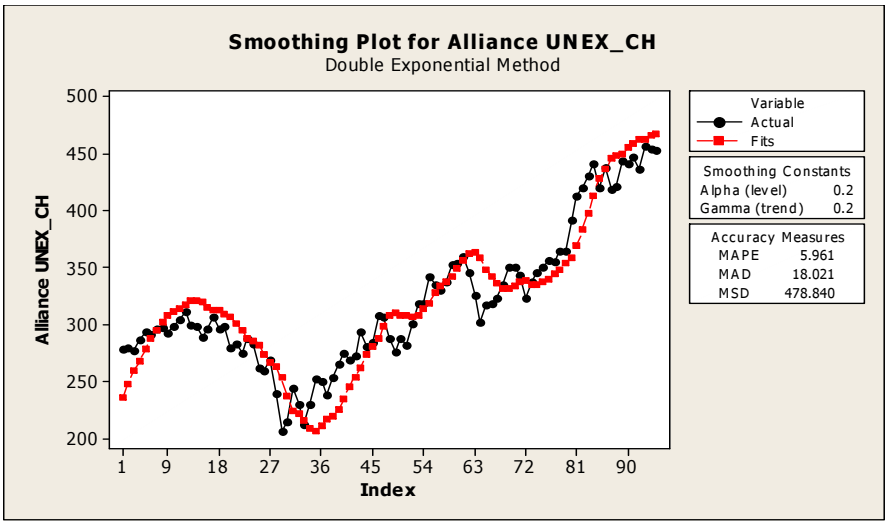
Graph 2: Smoothing Plot for Seg 1



The second segment mid 2006 – 2014 demonstrates peculiar nature. The correlation coefficient becomes positive with a coefficient of .068. There are several reasons that can explain why this occurred. The banks may have realized the long maturity mismatches between assets and liabilities and therefore shortened the length of maturity. There are other approaches as to how banks can reduce the risk of unanticipated interest changes in the market. One approach is to decrease the difference between the duration of bank's assets and duration of its liabilities.

Another tool the management of a bank can employ is the use of financial derivatives to hedge interest rate risk. The loans that have accumulated unwanted asset structures can be distributed in the secondary market and desirable asset structures can be achieved through loan participation. The merging with Santander bank allowed the company to change the effect interest rate risk has on its stock returns. Investors began to feel more confident about Alliance and Leister because it was absorbed by a strong national bank.

Graph 3: Smoothing Plot for Alliance UN EX_CH



The most interesting investigation is the structural break that occurred between mid 2006 and late 2007. Alliance and Leister started as one of Britain's largest building societies and made investor's quite confident of their financial stability. However, the catalyst that caused this structural break is considered to be the effects of the subprime mortgage crisis.

To get a better understanding of how the subprime mortgage crisis influenced Alliance and Leister, there must be an elaborate investigation of the institutions history. Alliance and Leister was one of the main mortgage lenders in the UK before the subprime mortgage crisis. Mortgage lending increased from £12.6 billion in 2006 to £13 billion in 2007. However, during this time frame there was what is now infamously known as the "credit crunch", where banks were searching for loans in order to remain afloat. Alliance and Leister confirmed it was struggling when it requested a £4 billion loan from Credit Suisse to fund its mortgages through 2008. In July 2007, Alliance and Leister informed the public that its profits fell due to a detrimental loss of £55 million of mortgage assets it held in structured investment vehicles. Operating profits for2007 missed its expectations of £59 million.

In September 2007, news confirmed that the Northern Rock bank has approached the Bank of England for financial support. The shockwaves from the bailout of Northern Rock saw shares in Alliance and Leister to plunge more than 30%. The last event to take down the mortgage lending giant was a £7 million fine in late 2007. The financial institution was fined due to serious failings in telephone sales of payment protection insurance (PPI). Between January

2005 to December 2007, Alliance and Leister sold nearly 210,000 PPI policies to customers seeking a personal loan at an average price of £1,265. However, the advisers failed to inform the customers of the details of the PPI. Moreover, Alliance and Leister sold PPI without having in mind what the customers needed. It was also uncovered that Alliance and Leister trained its staff to pressure when they questioned the inclusion of PPI.

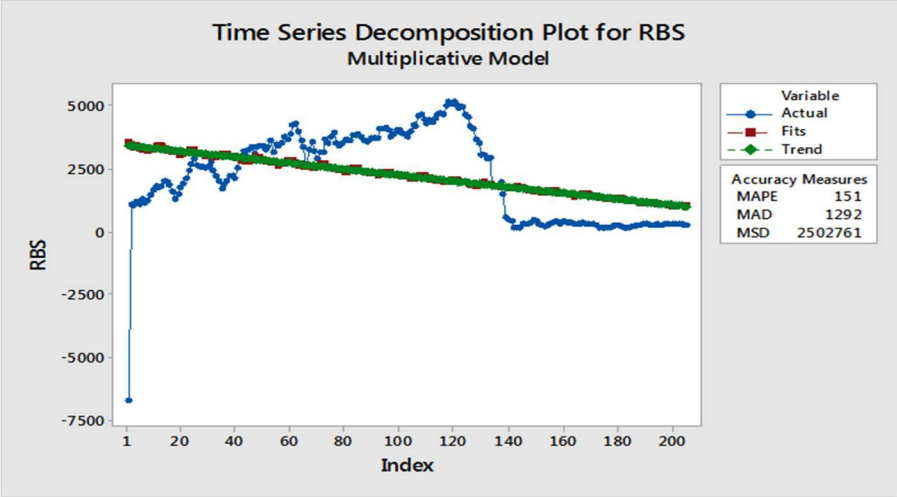
After all of the market movements, Alliance and Leister was on brink of collapse. However, in 2008, Spanish bank Santander absorbed the mortgage lending sector of A&L for £1.2 billion. The merger rescued Alliance and Leister from bankruptcy, but it still has not recovered from the initial hit of the subprime mortgage crisis.

Case Study – 2

Royal Bank of Scotland

For the case of Royal Bank of Scotland, the data reveals a structural break and a sharp decline in interest rate sensitivity. Therefore, similar to the case study of Alliance and Leister, the data will be studied in three segments: the cause of the sharp incline in interest rate sensitivity in 2000, the gradual increase of interest rates sensitivity towards 2007 and the detrimental decline from 2007-2010. In the years 1997-2014 the correlation efficient of interest rate risk and stock returns was .571. Between the periods of 1997 to 2007 RBS produced a correlation coefficient of -.567. Moreover, after the sharp decline, the coefficient shifted to .849. Graph - 4 models the years 1997-2014.

Graph 4: Time Series Decomposition

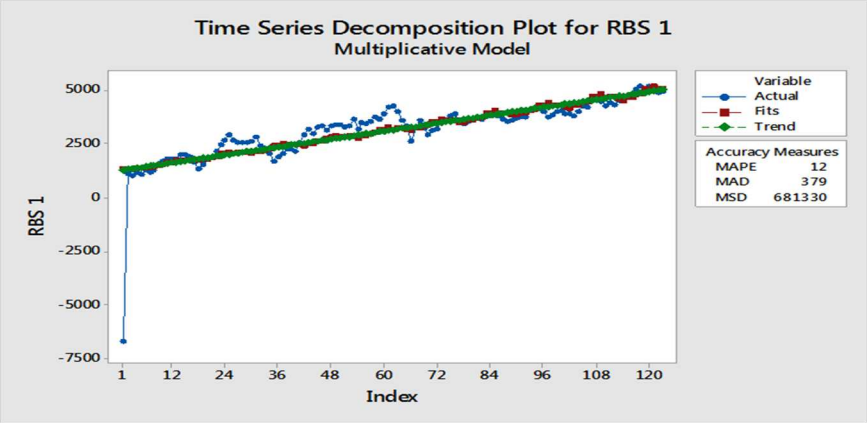


The key reasons why interest rate sensitivity towards bank stock returns increased dramatically from 1999-2000 is due to the merger with Legal and Capital in 1999 and Royal Bank of Scotland's acquisition of NatWest in 2000. Legal and General were the largest insurers in the United Kingdom. The acquisition of NatWest made the Royal Bank of Scotland the second largest bank in the UK and Europe and maintained the fifth largest in the world in market capitalisation. The aftermath of the deal set the stage for a round of consolidation in the finance industry, where the era of fierce global competition arose. Moreover, Post-NatWest brought to surface a number of trends in the Royal Bank of Scotland.

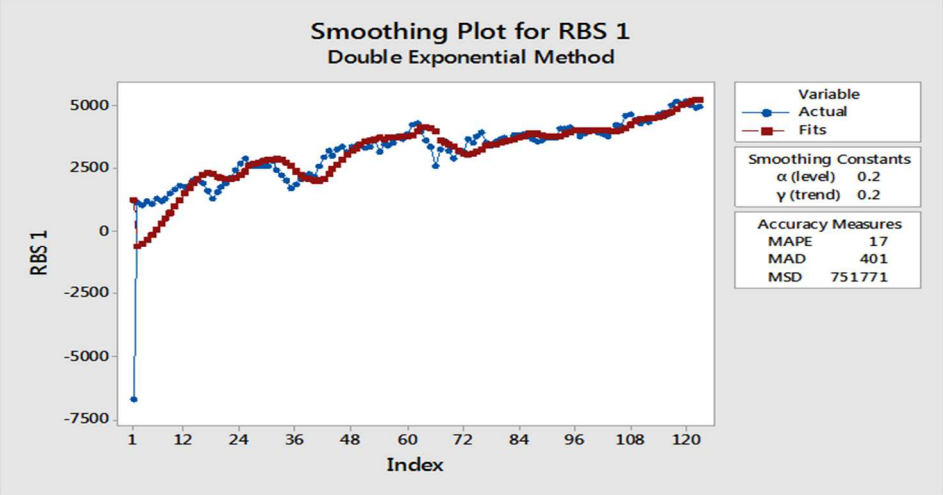
In 2011, the Financial Security Authority closed the investigation on the collapse of the Royal Bank of Scotland. There were many factors discussed including the lack of internal governance, the unaccountability of the decisions made by the chief executive, the general

atmosphere of United Kingdom plc which the government insisted on the expansion of banks complied with a lack of regulatory oversight. Graph-5 illustrates the positive structural break followed by a period of gradual increasing stability. Graph - 6 displays how strong the correlation of interest rate is on bank stock returns using the double exponential method.

Graph 5: Time Series Decomposition Plot for RBS 1



Graph 6: Smoothing Plot for RBS 1



From 2000 – 2007 there is a clear incline in the interest rate sensitivity of the Royal Bank of Scotland. This was mainly due to the decisions made by chief executive Sir Fred Goodwin. In 2005, Sir Fred Goodwin received criticism by shareholders on his decision of acquiring Charter One in the US for £5.8 billion. In 2006, he responded to the demands of shareholders by releasing RBS's until then relatively slow-growing investment bank. GBM (Global Banking and Markets) and United Kingdom Corporate Banking ballooned over the next two years and assets increased from £500 billion to £830 billion. In 2008 Global Banking and Markets accounted for nearly half of total risk-weighted assets in the bank at £195 billion of a total £482 billion. In its simplest form, Sir Fred had put all of RBS' money on GBM prior to the fatal flaw of acquiring ABN Amro. Initially the expansion of GBM delivered as expected and Sir Fred's poise doubled and his infamous ego grew larger.

The acquisition of ABN is responsible for the sharp decline in interest rate sensitivity on the stock returns of the Royal Bank of Scotland. In 2007, analysts believed ABN would produce fruit full results for RBS and Merrill Lynch advised a plan to keep RBS in the forefront of the bid. A day later Barclays announced it was in exclusive preliminary discussions with ABN. This began the race of acquiring ABN between RBS and Barclays. By late September,

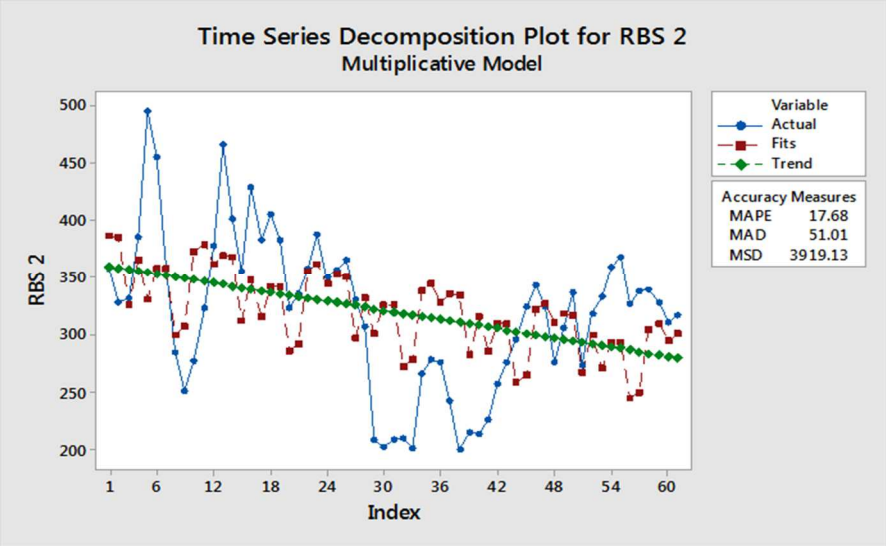
Barclays withdrew from its offer and RBS acquired ABN. One trader remarked on the acquisition, "Once you started to look around ABN's trading books you realised that a lot of their businesses, particularly what you would call model businesses where valuations were based on assumptions, were based on forecasts that were super aggressive". The acquisition was a disaster as RBS attempted to value ABN's assets during a "freefall" in valuations.

The complexity of the deal was fierce as Dutch Authorities insisted that business should be separated out of ABN due to its reporting structure before integrating with RBS. In 2008, quarrels persisted between RBS and Fortris as to how the separation should progress. Moreover, Fortris was also feeling the credit crunch due to financial difficulties and the strain did not help the relationship between the two banks. Two months later, as the financial crisis was in full swing. Fortris became partially nationalized with the Netherlands and Belgium and Luxembourg injected nearly £11.3 billion to keep the bank afloat.

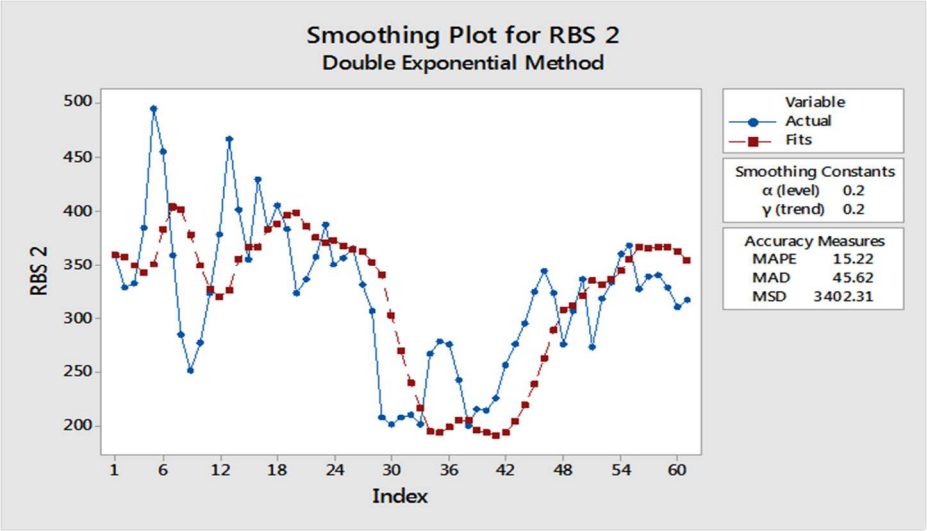
ABN was a busted flush when Fortris was forced to sell its stake in the acquisition. This left Royal Bank of Scotland with a load of nothing and the bank questioned whether they can survive such a gaping hole in the balance sheet. The most worrisome area for RBS was its enormous leveraged finance and commercial real estate lending businesses. The market for leverage was closed and RBS was unable to fund the lending books. It became clear RBS was having difficulty with funding more than ABN.

Just like most investment banking businesses, RBS found itself in real trouble because their wholesale banking arms were mostly funded by short-term loans, overnight borrowing from banks and corporate deposits and were costly on a daily basis. In 2006 RBS's total assets were just above £87 billion, but the acquisition with ABN a year later increased assets by £1.9 billion. The rise in cost of attracting new funds and wholesale banking asset losses shocked RBS's core tier 1 capital into emergency territory. In 2008 RBS issued a £12 billion issue, the largest cash call in British equity market history. Later in 2008 a giant oil group pulled out billions of pounds from the bank in a single transaction, crippling RBS and causing a virtual run by customers. The morning of October 7th, RBS shares crashed to 20pc. It took until 2010 for RBS to stabilize as the government increased their tier 1 capital by £25 billion in 2008. Graphs - 7 and 8 illustrate how RBS began to stabilize after the crisis.

Graph 7: Time Series Decomposition Plot



Graph 8: Smoothing Plot for RBS 2



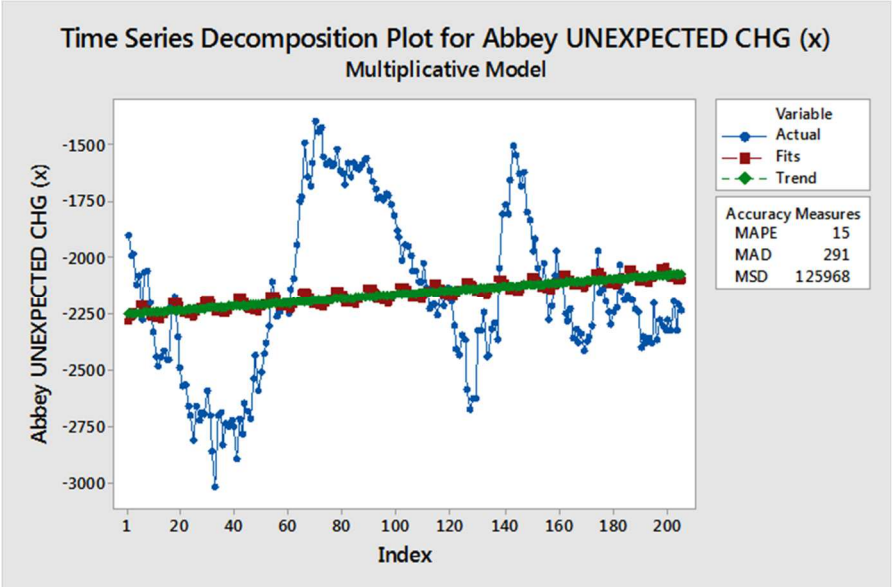
Case Study 3

Abbey National

Abbey National was the first UK building society to demutualise in July 1989. During the 1990s the bank engaged in several acquisitions, including the rail leasing company Porterbrook. In 2004 the bank merged with Spanish Santander group and in 2008 Santander acquired Alliance & Leister and Bradford & Bingley.

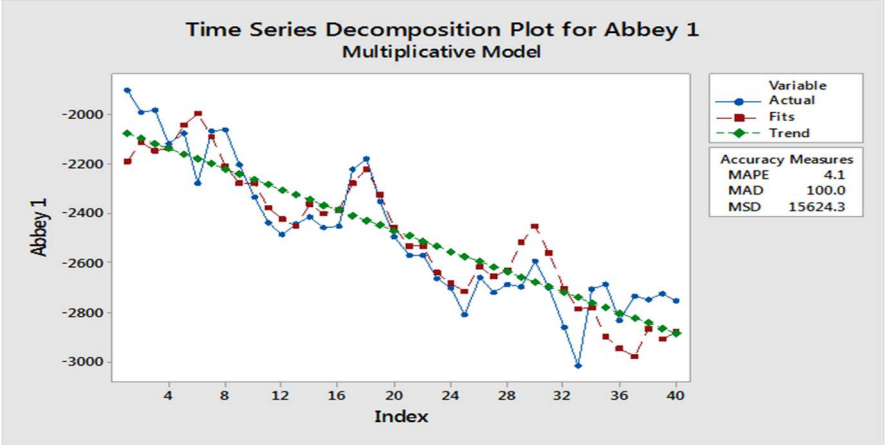
The large increases and decreases in the decomposition below encourage the data to be studied in four segments: the decline from 1997-2000, the increase from 2000-2003, decrease from 2003-2007, and the upsurge in 2008-2009 before stabilizing in 2009 to present. The correlation coefficients offered interesting insight on the impact of interest rate risk on Abbey National. All the results indicate a strong correlation between the two variables, with 1997-2003 producing .545, 2000-2003 issuing the strongest correlation of -.870, 2003-2007 reflecting a strong negative correlation of -.817, and 2008-2009 instituting another significant correlation of -.726. Graph - 9 illustrates the trends from 1997-2014.

Graph 9: Time Series Decomposition for Abbey

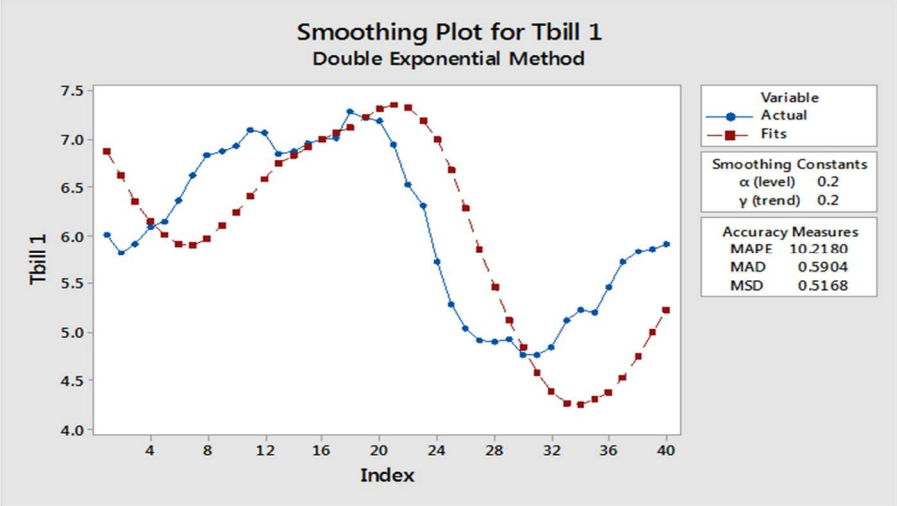


In 1997, home ownership accounted for over 70% and was static; there was a growing concern of an atmosphere of deregulation in the market. Abbey pursed another business to diversify from savings and mortgages. They created a treasury business in bonds, derivatives and foreign exchange and acquired other businesses. All of the acquisitions were successful, except from an estate agency chain and profits were steadily increasing regardless of the tough housing market in the 1990s. Dividends expanded and the share price increased to £14; Abbey National was viewed by the stock market more highly than Citibank and the Royal Bank of Scotland. However, in 1999 Abbey experienced turbulence when the bank realized the treasury business expanded too rapidly and used more £2 billion of capital and in 2000, the bank lost £500 million. Panic surfaced and the business began to dispose of a few very profitable assets which were sold very cheaply. The treasury business should have regrouped and assets should have been disposed of cautiously and gradually. Though Abbey was the 12th largest company with a market capitalization of £19 billion the stock market took fright and the bank fell out of favor. Graph - 10 is the decomposition mode and graph - 11 displays the double exponential model to highlight the downward trend.

Graph 10: Time Series Decomposition Plot for Abbey



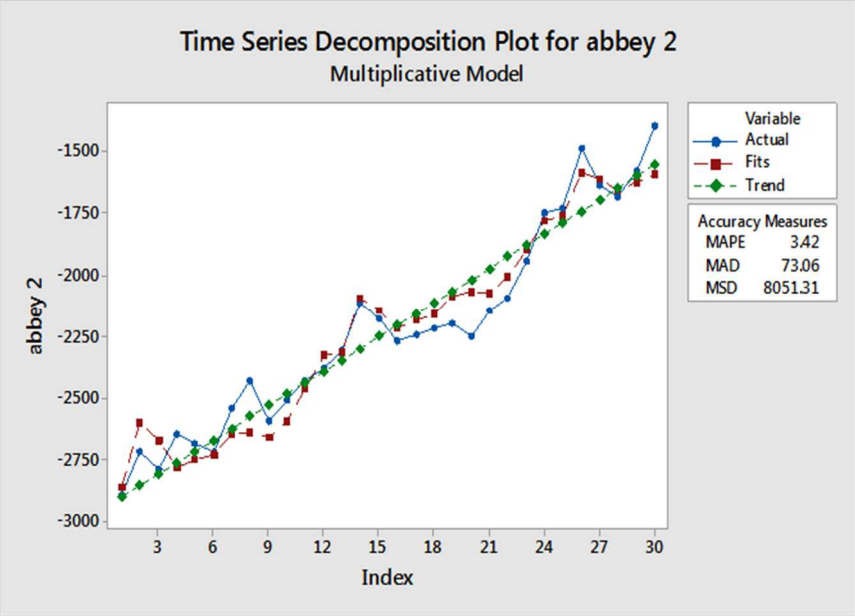
Graph 11: Smoothing Plot for Tbill 1



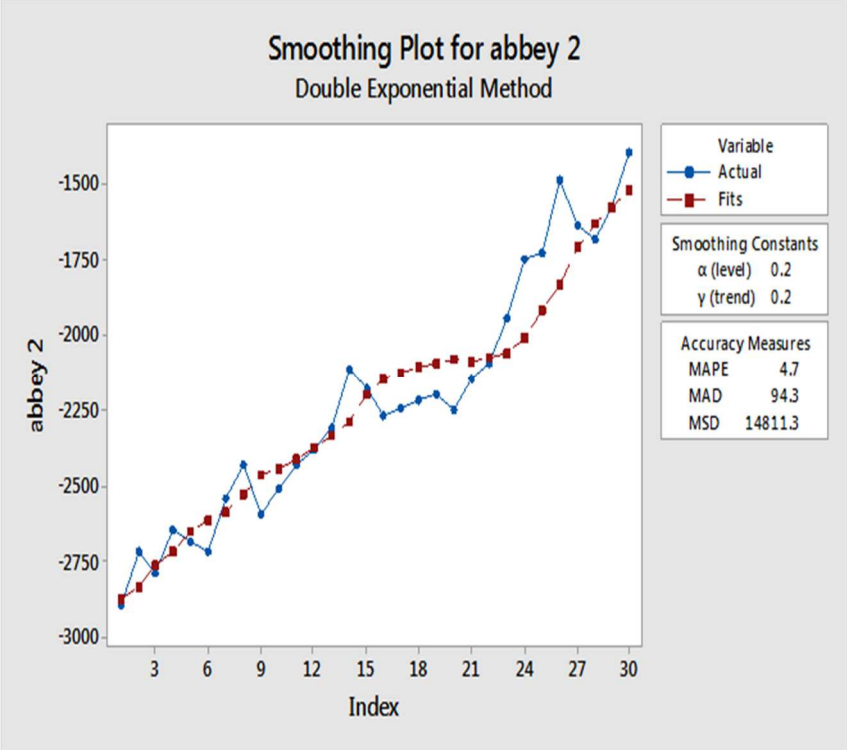
In 2000-2003 Abbey experienced an increase in interest rate sensitivity. The bank acquired Porterbank from Stagecoach for £773 billion in 2000. At the time, Porterbrook was one of the three railway rolling stock operating companies. The railway company documents more than £1.5 billion on new rolling stock in the UK and also retained leases to freight companies

Freightliner, GBRf, and DB Schenker. During this time period mortgage lending increased to £3.2 billion, giving Abbey control over 8% of the market. In 2002, the bank reported a 17% increase in pre-tax profits. Graph - 12 illustrates the decomposition and graph - 13 the double exponential model to highlight the upward trend and correlation.

Graph 12: Time Series Decomposition Plot for Abbey 2



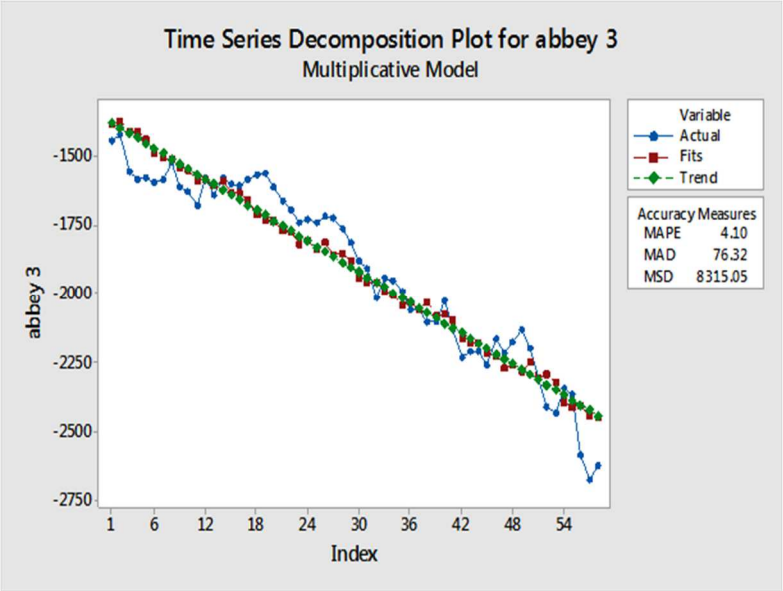
Graph 13: Smoothing Plot for Abbey 2



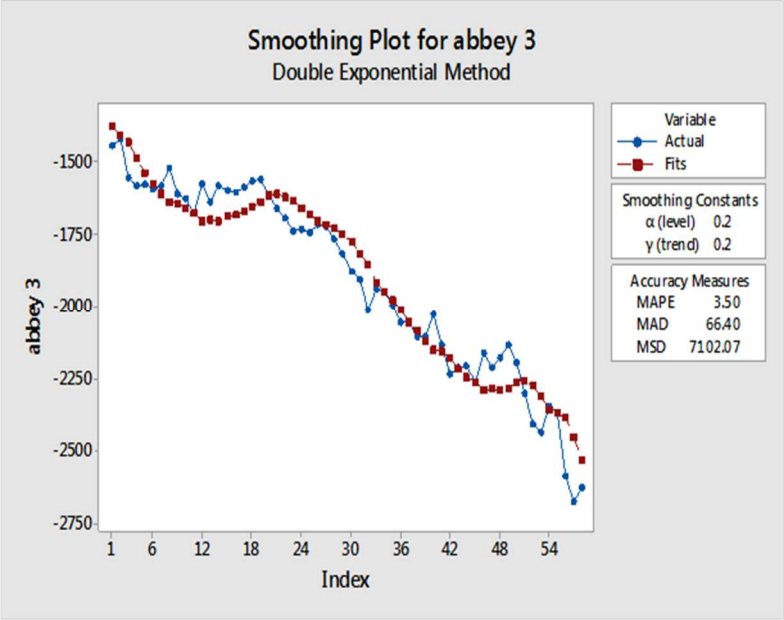
From 2003-2007 Abbey experienced clear turmoil. Its horrendous financial performance due to the disastrous attempt to move into corporate banking is responsible for the decline. It entered the whole sale loan business and produced a steady stream of profit in the beginning. This eventually crippled the company when energy giant Enron collapsed and Abbey's £15

million exposure to Enron caused profits to drop by 2%. Abbey suffered two straight years of major losses- £984 million in 2003 and £686 million in 2004. However, even when they experienced grand losses, the main structure of the bank remained concrete, with 16 million customers and £177 billion in assets. The trend is clearly illustrated in graphs - 14 and - 15. In 2004 Santander acquired Abbey national for £8.5 billion.

Graph 14: Time Series Decomposition Plot for Abbey 3

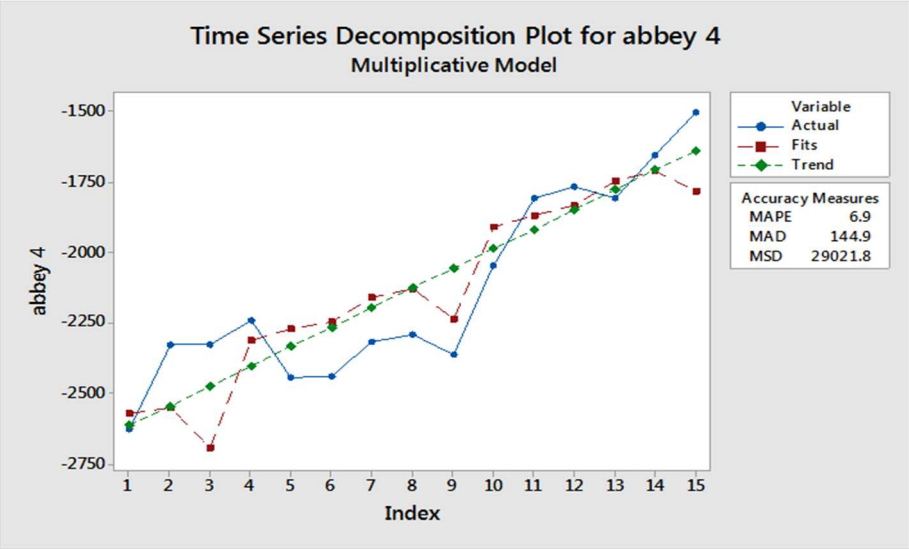


Graph 15: Smoothing plot for Abbey 3

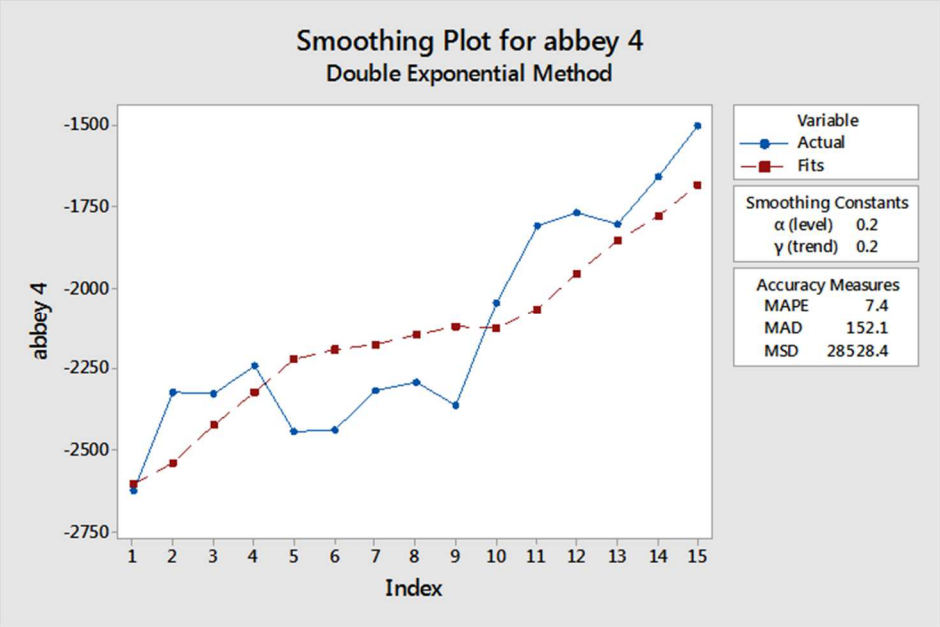


The last important climb analyzed is the period of 2008-2009. In 2008 Santander acquired Alliance & Leister and Bradford & Bingley. All three absorbed institutions formed a large conglomerate named Santander UK Plc. Santander UK plc became the third largest bank in the UK in terms of deposits, the 2nd largest in mortgages and fourth largest in the number of branches with over 25 million customers. Graphs - 16 and 17 illustrate the upward trend.

Graph 16: Time Series Decomposition Plot for Abbey 4



Graph 17: Smoothing Plot for Abbey 4



Conclusion

The corporation of Stone's Two Index model helps explain how interest rate risk affects the returns of financial institutions. The correlation between interest rate risk and equity is significant in all the UK companies addressed in the analysis. The correlation between the two variables indicates a strong relationship between the manipulations of interest rate changes from the Bank of England to the balance sheet channel. Furthermore, the relationship proves interest rate risks affect policymakers because they must consider how changes in interest rates will impact the entire economy.

When the decomposition models were constructed there was clear evidence of several structural breaks and sharp inclines and declines in the relationship between interest rate risk and stock returns. These "unforeseen circumstances" interrupted the melody of the correlation between the two variables and consequently introduced boundary problems which

caused imperfections in the model. First and foremost six out of the eight banks analyzed produced positive coefficients. Past literature found interest rate risk to have a negative impact on financial institution equity returns. The random correlation increases and decreases caused by unusual events are responsible for the volatility. The subprime mortgage crisis is the prime catalyst that induced such unusual volatility. The subprime mortgage crisis introduced a number of externalities, including government injections, mergers and acquisitions, and the substantial increase of subprime mortgage assets reflected on balance sheets.

The atmosphere in the financial industry during 1996-2008 experienced an overwhelming attitude to expand and become larger. This attitude influenced financial institutions to make decisions that either jeopardized or saved the bank. Maturity mismatches between assets and liabilities are responsible for this effect. When banks began to merge, the assets on their balance sheets ballooned, therefore overpowering the amount of liabilities due. This effect caused an increase in the relationship between interest rate risk and equities returns because there were large influxes of assets being acquired. Moreover, the banks involved in subprime mortgages saw a steep decline in the relationship between the two variables because banks were too involved in acquiring more loans. During 1996-2008, interest rates in the United Kingdom hovered over 5% and was advantageous for financial institutions issuing subprime mortgages because interest on loans were gained; however, borrowers were forced to absorb high interest rate risk. As subprime mortgage owners began to default on their loans, assets and net income in the balance sheets exploded. This left banks with billions of pounds of unpaid loans that they must recover in order to properly function.

Banks were able to stabilize after the subprime mortgage crisis if they were involved in a merger or bailed out by the government. These money injections from mergers and bailouts revived the poor balance sheets. After the crisis, the bank of England drastically cut the interest rate to .5% which banks benefited from because trances that were traded at a discount now must make prepayments at par faster. The money injections and low interest rates collectively saved the banks from bankruptcy.

The late 90s and early 2000s displayed an attitude of rapid expansion that created a detrimental atmosphere in the finance industry. Banks were eager to increase balance sheets with subprime mortgages and merging with other larger companies. The rapidly growing atmosphere of the mortgage lending sector put many banks in risk, particularly interest rate risk. Some banks, including Alliance & Leister, The Royal Bank of Scotland, and Abbey National were fortunate to receive money injections from the government or through mergers, allowing them to survive the ailing economy. The crisis evidently shows the significant of interest rate risk and the detrimental impact it can have on banks, and economies if not managed properly.

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