Survey Data and the Interest Rate Sensitivity of US Bank Stock Returns

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In this paper, we provide empirical evidence on the interest rate sensitivity of the stock returns of the twenty largest US bank holding companies. The main contribution of the paper is the use of survey data to model the unexpected interest rate variable, which is an alternative approach to the existing literature. We find evidence of significant negative interest rate sensitivity during the early 1980s, and evidence of declining significance in the late 1980s and early 1990s. This result is also obtained when using the forecast errors of ARIMA processes to model the unexpected movement in the interest rate.

1. Introduction

The interest rate sensitivity of US bank stock returns has been the research topic of many academic papers. Most papers start from the two-index model developed by Stone (1974). This asset pricing model expands the standard market model of asset returns by adding an interest rate index. The function of this interest rate factor is to account for the influence of unexpected interest rate changes on the stock returns of banks. Empirical research by, among others, Fama and Schwert (1977) and Fogler et al. (1981) has shown that the inclusion of an interest-rate factor adds substantial explanatory power to the single-factor market model.

A group of papers combining years from the 1970s and 1980s into one data set find that US bank stocks exhibit a statistically significant inverse relationship between unanticipated interest-rate changes and the returns on these stocks (Flannery and James, 1984; Brewer and Lee, 1985; Scott and Peterson, 1986; Kane and Unal, 1988; Saunders and Yourougou, 1990; Yourougou, 1990; Kwan, 1991; Akella and Greenbaum, 1992; Choi et al., 1992). This result is not qualitatively influenced by the choice of a short-term

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or long-term interest rate variable. Neither is it qualitatively influenced by the size of the banks: large money-centre banks, middle-sized super-regional banks, or smaller regional banks. There is also a group of papers containing data sets only covering the 1970s or allowing us to focus on subsets of data covering only the 1970s (Chance and Lane, 1980; Sweeney and Warga, 1986; Kane and Unal, 1988; Choi et al., 1992). These papers find an insignificant interest rate sensitivity during the 1970s. This result is not counter-intuitive given the fact that, on 6 October 1979, the Federal Reserve Board announced a switch from interest rates to unborrowed reserves as its short-term operating target, which led to an increase in the level and variability of interest rates. However, Saunders and Yourougou (1990) and Yourougou (1990) still find significant interest rate sensitivity for the period October 1977 to September 1979. In recent papers, Allen and Jagtiani (1997) and Choi et al. (1996) present evidence of declining significance of interest rate sensitivity in the late 1980s and early 1990s. Both sets of authors link this decline to the availability of interest rate derivatives contracts for hedging purposes. Another paper incorporating recent data is Robinson (1995). Robinson employed quarterly data in contrast to the weekly data in our analysis. His results are quite mixed in the sense that the sign of the interest rate sensitivity appears to depend on the choice of the interest rate variable in his time series models.

The contribution of this paper to the literature is twofold. First, employing weekly data for the period 1974–93 and using the forecast errors of autoregressive integrated moving average (ARIMA) processes to model the unexpected interest rate, we provide empirical evidence on the interest rate sensitivity of the stock returns of the twenty largest US bank holding companies. As in most previous studies, we do not find statistically significant interest rate sensitivity during the 1970s, strong evidence of negative interest rate sensitivity during the early 1980s, and evidence of declining significance in the late 1980s and early 1990s. This result is qualitatively independent of using the three-month Treasury bill rate or the rate on ten-year Treasury bonds as input for the ARIMA modelling of the unexpected interest rate variable.

The second and main contribution of this paper is to use survey data to model the unexpected interest rate variable.¹ This is an alternative approach compared to the existing literature. Flannery and James (1984) and Robinson (1995) use the forecast errors of an autoregressive (AR) model as a proxy for unexpected interest rate movements. Scott and Peterson (1986), Sweeney and Warga (1986) and Kane and Unal (1988) use changes in the yield on a given maturity of long-term government bonds to capture unanticipated changes in interest rates. Finally, Mishkin (1982) and Brewer and Lee (1985) proxy unanticipated changes in interest rates by the difference between the spot three-month Treasury bill rate at time \( t \) and the forward three-month Treasury

¹ We would like to thank Kees Koedijk for bringing this possibility to our attention.
bill rate embedded in the yield curve at time $t - 1$. In this paper, we use weekly survey data on the US federal funds rate for the period 29 April 1980 to 22 December 1993. The survey was conducted by Money Market Services (MMS) International (part of Standard & Poor’s) in Belmont, California. The weekly surveys generate a market expectation for the federal funds rate for a certain survey period which is then confronted with the realized value of the federal funds rate during the same survey period. This enables us to calculate an unexpected movement in the federal funds rate for the relevant survey period which is then used for estimating the interest-rate sensitivity in the two-index model.

Survey forecasts of interest rates have been studied in the literature. Some prominent references are the earlier work by Friedman (1979, 1980) and the somewhat more recent results of Froot (1989). Survey forecasts are an interesting alternative for the use of ARIMA model forecasts, among other things, because, unlike the ARIMA forecasts, they are intrinsically forward looking. Also, many studies indicate that standard time-invariant time series models simply cannot be viewed as adequate representations of relatively complex interest rate processes. Using an extensive dataset covering the period 1969–86, Froot (1989) finds little evidence that expected future short rates under-react to current short-rate changes. He could not reject the hypothesis that the market’s expectation of future short rates is rational. With regard to longer-term interest rates, Froot finds expectational biases in the survey data. The behaviour of the expectational errors suggests that expected future rates under-react to changes in the short rate. As in many other studies, Froot (1989) rejects the expectations theory of the interest rate. Time series and survey approaches each have their own advantages and drawbacks. This makes it interesting to explore both avenues in empirical work.

In our empirical analysis using survey data, we find a statistically significant negative interest rate sensitivity for the period 1980–84. Since then, the statistically significant relation between unexpected federal funds rate changes and bank stock returns has broken down. This result is consistent with our previous findings where we used the forecast errors of ARIMA processes related to the three-month Treasury bill rate and the ten-year Treasury bond rate as a proxy for unanticipated interest rate movements. Also, in the latter case, we found a breakdown of the interest rate sensitivities during the second half of the 1980s.

The paper is organized as follows. In section 2, we present our model and data selection. Section 3 contains our empirical analysis for the period 1974–93 using the forecast errors of ARIMA processes for the US three-month Treasury bill rate and ten-year Treasury bond rate as proxies for the unexpected interest rate variable. Section 4 contains our empirical findings using survey data for the expected US federal funds rate. In section 5, concluding this paper, we interpret the breakdown of the statistical significance of the interest rate sensitivity during the second half of the 1980s.
2. Model and Data Selection

We start the analysis from the two-index model developed by Stone (1974). This asset pricing model expands the standard market model of asset returns by adding an interest rate index. In this model \( R_p \), being the return on asset \( p \), is expressed as

\[
R_p = \beta_0 + \beta_m R_m + \beta_i R_i + e_{pt} \tag{1}
\]

\( \beta_m \) and \( \beta_i \) are measures of the asset’s systematic market and interest rate risk, while \( R_m \) and \( R_i \) represent a stock market return and a return on debt.\(^2\) Because of the observed moving-average pattern in the regression errors, the following empirical version of the model is estimated:

\[
R_p = \beta_0 + \beta_m R_m + \beta_i R_i + e_{pt} + \theta e_{pt-1}
\]

Here, \( \theta \) is a first-order moving average parameter.

In our sample, we have chosen for the return on the S&P500 composite index as a proxy for the stock market return \( R_m \). The variable \( R_p \) is the return on an equally weighted portfolio of the common stocks of the twenty largest US bank holding companies. The data were corrected for stock-splits. \( R_i \) serves as the variable indicating the unexpected interest rate movement on government debt.

In the following, we will elaborate on the choices of data and methodology in our empirical analysis for both the ARIMA and the survey data modelling of the unexpected interest rate variable.

2.1. Unexpected Interest Rate Generated as Forecast Error of an ARIMA Process

For a period of twenty years (1974–93), we calculate weekly returns for the S&P500 composite index, the individual bank stocks, and the equally weighted bank index consisting of the twenty individual bank stocks. The weekly data, retrieved from Datastream, cover the periods from the closing value at a Wednesday until the closing value on the next Wednesday.

For both the three-month Treasury bill rate data and the ten-year Treasury bond rate data, obtained from the H15 release of the Board of Governors of the Federal Reserve System, we estimate ARIMA processes. The calculations cover the same weekly periods as those used for the calculations of stock returns.

For each interest rate variable, we selected two processes, one based upon the Akaike lag-length selection criterion and the other based upon the Schwarz

\(^2\) Following Kane and Unal (1988), we employ the unorthogonalized two-index model. This means that no orthogonalization is used between \( R_m \) and \( R_i \).
lag-length criterion; see, for example Priestley (1981). The residuals generated by the estimation of the optimal ARIMA processes are considered as the best approximation of the unexpected interest rate movement. These residuals are then used as $R_i$ in our model.

2.2. Unexpected Interest Rate Generated as Forecast Error of Survey Data

For a period of about 13.5 years (29 April 1980 until 22 December 1993), we use weekly survey data on the US federal funds rate. The weekly survey were conducted by MMS International (part of S&P) in Belmont, California. The methodology of the survey was changed in November 1987 which prompted us to split the 1980–93 data set into two distinct survey periods.

From 29 April 1980 until 30 October 1987, the weekly surveys were conducted on a week/next week basis. This implies that individual market participants were asked to formulate their expectation for the federal funds rate for the next week, i.e. for the coming five trading days. Moreover, the survey did not ask for the expected value of the federal funds rate at the end of the coming five trading days, but required individual market participants to give their average expected value of the federal funds rate for the next five trading days. The average federal funds rate expectations of the individual market participants were then combined into one market expectation for the average value of the federal funds rate during the next five trading days by taking the median of the individual expected values.

In our sample, we confront the average value expected by the market for the next five trading days with the realized average value of the federal funds rate for the same five trading days. By subtracting the realized average value from the expected average value, we construct a variable indicating the unexpected average federal funds rate during the next five trading days. This variable then becomes the $R_i$ in our model. For reasons of consistency, we also compute average returns on the equally weighted bank index ($R_p$) and the S&P500 composite index ($R_m$). Moreover, these average returns are calculated in such a way that they exactly match the periods of five trading days on which the survey expectations are based.

Starting from 29 April 1980, the surveys were conducted on Tuesdays and were related to the next five trading days (Wednesday through Tuesday). However, on 17 February 1984, the survey day was changed to Friday so that the surveys covered Monday through Friday as the next five trading days. In our sample, we took this change into account when we calculated $R_p$, $R_m$ and $R_i$.

Sometimes, the survey was conducted one day later than usual, e.g. during 1980–84 not on the regular Tuesday but on the Wednesday just after this Tuesday. In these cases, the survey expectation is related to the next four (and not five) trading days. For these particular cases, we computed $R_p$, $R_m$ and $R_i$. 

as four-day averages for the relevant four-day periods. In some rare cases, the survey was conducted one, two or three days earlier than the regular survey day. In these cases, the survey expectations still cover a period of five days. However, the survey periods are not the next five trading days immediately following the earlier survey days, but still the next five trading days as if the surveys had been conducted on the regular days and not on the earlier days.

Starting 6 November 1987, the weekly surveys were no longer on a week/next week basis but were related to the two-week Federal Reserve Board’s reserve maintenance period beginning on a Thursday and ending on a Wednesday, two weeks later. The weekly surveys still took place on Fridays. However, market participants were no longer asked for the average expected value of the federal funds rate during the remaining trading days of the maintenance period, but they were asked to give the expected value of the federal funds rate on the Wednesday at the end of the two-week maintenance period.

Because the weekly surveys are now related to a Wednesday occurring once every two weeks, we are confronted with survey expectations covering different numbers of days. The surveys conducted on the first Friday of the two-week maintenance period require market participants to give their expectations for a period of twelve days (eight trading days) ahead, while the surveys on the second Friday of the same maintenance period cover an expectation period of five days (three trading days) ahead. To deal with this phenomenon in an adequate way, we split the November 1987–December 1993 sample into two subsamples. The first subsample uses the expectations for the federal funds rate eight trading days ahead. By subtracting the realized value of the federal funds rate at the end of the eight trading days (corresponding to the Wednesday ending the maintenance period) from the expected value based on the survey, we are able to compute the unexpected federal funds rate at the end of the next eight trading days. This variable then becomes the $R_i$ in our model. For reasons of consistency, we also compute the end-of-period returns on the equally weighted bank index ($R_p$) and the S&P500 composite index ($R_m$). Moreover, these end-of-period returns are calculated in such a way that they exactly match the periods of eight trading days on which the survey expectations are based. For the second subsample, which contains the expectations for the federal funds rate three trading days ahead, we follow exactly the same methodology. Naturally, all variables are constructed for the relevant three days. Like for the 1980–87 period, we corrected our data set for surveys not conducted on the regular Fridays, but on an earlier or later day.

3. The Period 1974–93 using ARIMA Processes

In this section, we present our results on the interest rate sensitivity of US bank stock returns using time series processes to generate unexpected interest rates. ARIMA models are estimated for both three-month Treasury bills and
ten-year Treasury bonds. Model selection is performed on the basis of the Akaike and Schwarz lag-length selection criteria. As the interest rate sensitivity results are quite similar for the two selection criteria, we only report results obtained using the Schwarz criterion. The estimation results for equation (1) are presented in Table 1. To address the serial correlation that is present in the residuals in a number of cases, we have allowed for a first-order moving average in the residuals, where appropriate. This moving average appears to capture the error term dynamics satisfactorily.

The empirical results in Table 1 are presented for the whole sample period as well as for three subperiods. Our choice of subperiods corresponds closely to the subperiods investigated by Flannery et al. (1997), who studied the subperiods 1973–78, 1979–84 and 1985–90. Note that we chose to start our second subperiod directly after the change in operating procedures by the Federal Reserve Board on 6 October 1979, and that our somewhat longer third subperiod extends through 1993. To be precise, subperiod 1 of our weekly data covers 2 January 1974–3 October 1979, subperiod 2 covers 10 October 1979–26 December 1984 and subperiod 3 covers 2 January 1985–29 December 1993.

From Table 1, we can infer that our results are quite robust to the choice of the interest rate variable. In both cases, i.e. for the short-term and long-term

| Table 1: Regression Results on the Interest Rate Sensitivity of Bank Stock Returns, 1974–93, using ARIMA models |
|-----------------|-----------------|-----------------|-----------------|-----------------|--------------|--------------|
| Subperiod       | 3-month T-bill  | 10-year T-bond  |                |
| Whole period: 2/1/74–29/12/93 | 0.053 (0.865) | 0.058 (0.954) | 0.551 1,044 |
| 3-month T-bill  | 0.976** (34.417) | 0.946** (32.315) | 0.976 (34.417) | 0.946** (32.315) |
| 10-year T-bond  | 0.120** (3.904) | 0.122** (3.972) | 0.120** (3.904) | 0.122** (3.972) |
| 3-month T-bill  | 0.976** (34.417) | 0.946** (32.315) | 0.976 (34.417) | 0.946** (32.315) |
| 10-year T-bond  | 0.120** (3.904) | 0.122** (3.972) | 0.120** (3.904) | 0.122** (3.972) |
| First subperiod: 2/1/74–3/10/79 |
| 3-month T-bill  | -0.011 (0.122) | 0.858** (21.403) | 0.233** (4.109) | 0.627 301 |
| 10-year T-bond  | -0.003 (0.037) | 0.850** (20.322) | 0.240** (4.230) | 0.628 301 |
| Second subperiod: 10/10/79–26/12/84 |
| 3-month T-bill  | 0.173 (1.701) | 0.774** (15.765) | 0.767** (4.021) | 0.568 273 |
| 10-year T-bond  | 0.200 (2.025) | 0.728** (15.004) | 0.744** (1.097) | 0.591 273 |
| Third subperiod: 2/1/85–29/12/93 |
| 3-month T-bill  | -0.008 (0.074) | 1.180** (23.624) | 0.605 (2.083) | 0.546 470 |
| 10-year T-bond  | -0.007 (0.066) | 1.158** (22.302) | 0.605 (2.083) | 0.546 470 |

Notes: t statistics are reported in parentheses; *(**) indicates statistical significance at the 5% (1%) level.
interest rate variable, the results are qualitatively similar, which contrasts with Robinson’s (1995) results. For the whole period, the standard result of negative interest rate sensitivity of bank stock returns obtains. Interestingly, analysis of the subperiod results reveals that negative interest rate sensitivity is entirely concentrated in the second subperiod (1979–84), in which the sensitivity is very significantly present. In the 1974–79 period no significant interest rate sensitivity is present and, in the 1985–93 period, the significant interest rate sensitivity disappears again. Returns on bank stocks appear to react differently to interest rate movements in different periods.

4. The Period 1980–93 using Survey Data

This section is devoted to the empirical results on the interest rate sensitivity of bank stock returns when survey data are used to determine unexpected interest rates. Because of variation in the survey methodology, as described above, we report results for two separate survey periods: 1980–87 and 1987–93.

Results for the first survey period are reported in the top half of Table 2. The results for the entire 1980–87 period indicate that no significant interest rate sensitivity is present. When the period is subdivided, again following Flannery et al. (1997), it becomes apparent that interest rate sensitivity is significantly present in the subperiod 1980–85, but not in the subperiod 1985–87. This corresponds with our findings based upon ARIMA models in section 3 above.

Our results for the second survey period, 1987–93, are reported in the lower half of Table 2. The results for the two subsamples based on eight-
trading-days-ahead expectations and three-trading-days-ahead expectations are reported separately. No significant interest rate sensitivity is present here.

5. Interpretation and Conclusion

Employing weekly data for the entire 1974–93 sample and using the forecast errors of ARIMA processes to model the unexpected interest rate, we provide empirical evidence on the interest rate sensitivity of the stock returns of the twenty largest US bank holding companies. As in most previous studies, we do not find statistically significant interest rate sensitivity during the 1970s, strong evidence of negative interest rate sensitivity during the early 1980s, and evidence of declining significance in the late 1980s and early 1990s. The latter result is also obtained when we use survey data to model the unexpected interest rate.

On 6 October 1979 the Federal Reserve Board announced a switch from interest rates to unborrowed reserves as its short-term operating target, which led to an increase in the level and variability of interest rates. In our empirical analysis, we use this event as the switching date for the significant change in the interest rate sensitivity of the stock returns of the twenty largest US bank holding companies. The latter is consistent with Aharony et al. (1986) who published a study on the October 1979 event in which they showed that after the monetary policy switch, banks started to experience significant interest rate sensitivity.

Our empirical results for the 1980s show a breakdown of the statistically significant interest rate sensitivity of US bank stock returns during the second half of the 1980s. This result is qualitatively independent of the methodology chosen for modelling the unexpected interest rate variable: both the ARIMA and survey approaches generate this result.

We believe, given our previous remarks, that the breakdown of interest rate sensitivity of US bank stock returns can be viewed as a process which developed gradually and became significantly visible during the second half of the 1980s. The increase of interest rates due to the October 1979 event caused many insolvencies of savings and loan (S&L) associations. These S&Ls found themselves locked into negative interest margins (low fixed rates on the assets side and high floating rates on the liabilities side). The S&L crisis led to an increase of interest rate risk awareness on the part of bankers and regulators. A gradual process of an increasing professionalization of interest rate risk management by banks started. Part of this process was a shift in the composi-

3 The estimation results for the three-trading-days-ahead expectations were generated by omitting one outlier. Hamilton (1996) notes that ‘spectacular outliers’ are quite common for federal funds rate data.

4 We would like to thank George Kaufman for suggesting this interpretation.
tion of bank loans, namely a shift towards more variable-interest-rate loans. Moreover, hedging of interest rate risk became easier and cheaper because of the explosive growth of derivatives markets trading interest rate futures and options. In particular for the largest banks, as in our study where we focus on the twenty largest US bank holding companies, access to these derivatives markets is easy and immediate. Smaller-sized banks are likely to experience more difficulty in using derivatives for hedging interest rate risk, resulting in different conclusions with respect to interest rate sensitivity (Elyasiani and Mansur, 1998). The largest banks started to limit the amount of interest rate risk they were willing to accept and to reduce their sensitivity to unexpected interest rate movements.

An interesting alternative interpretation (Flannery et al., 1997) is that lack of variation in the interest rate in the second half of the 1980s makes any hypothesis about interest rate sensitivity hard to reject. Besides that, the late 1980s and early 1990s were a period of ‘reregulation’ of the banking system: the Competitive Equality in Banking Act (CEBA) in 1987, the Financial Institutions Reform, Recovery and Enforcement Act (FIRREA) in 1989, and the Federal Deposit Insurance Corporation Improvement Act (FDICIA) in 1991. The reregulation implied a decrease in bank beta instability (Brooks et al., 1997), even if it had a low impact on the risk taking behaviour by banks (Galloway et al., 1997).
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Non-technical summary

In this paper, we provide empirical evidence on the interest rate sensitivity of the stock returns of the twenty largest US bank holding companies. The main contribution of the paper is the use of survey data to model the unexpected interest rate variable, which is an alternative approach to the existing literature. Most existing studies use ARIMA models to capture expected and unexpected components of interest rates. Specifically, we use weekly surveys conducted by Money Market Services (MMS) on the federal funds rate. The survey measure enables us to calculate an unexpected movement in the federal funds rate during the survey period, which is then used to estimate interest rate sensitivity in a two-index model. Survey forecasts are an
interesting alternative for the use of ARIMA model forecasts, because they are intrinsically forward looking. Also, many studies indicate that standard time-invariant time series models simply cannot be viewed as adequate representations of relatively complex interest rate processes. We find evidence of significant negative interest rate sensitivity during the early 1980s, and evidence of declining significance in the late 1980s and early 1990s. This result is also obtained when using the forecast errors of ARIMA processes to model the unexpected movement in the interest rate, which adds to the robustness of the results. We believe that the breakdown of interest sensitivity of US bank stock returns can be viewed as a process that developed gradually and became visible during the second half of the 1980s, reflecting an increasing professionalization of interest rate risk management. Also, hedging of interest rate risk became easier and cheaper because of the explosive growth of derivatives markets trading interest rate futures and options. An interesting alternative hypothesis is that lack of variation in the interest rate in the second half of the 1980s made any hypothesis about interest sensitivity hard to reject.