

Interest Rate Sensitivity of Financial Institutions by Liquidity Risk: Evidence from U.S. Property/Liability Insurers

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Abstract

Attempts to understand the impact of interest rate changes on common stock returns have resulted in numerous studies in finance literature, and significant interest rate sensitivity by stocks of financial institutions has been reported. This paper extends the extant literature by investigating US property-liability (P/L) insurer's stock returns with respect to changes in different termed interest rates and to liquidity risk of the stocks. First, returns on property-liability insurers stocks are influenced by changes in interest rates, but the direction shifts as the insurance market condition changes. This is true for every portfolio we studied, albeit at different magnitudes. Second, trading volume also plays a role in stock returns to interest rate changes.

Introduction

Attempts to understand the impact of interest rate changes on common stock returns have resulted in numerous studies in finance literature. After Stone (1974) postulates that return on a security should be endogenous to not only market returns, but also bond returns, numerous studies directly and indirectly show the validity of Stone's argument of interest rate sensitivity of stocks to interest rate changes. To further understand the impact of interest changes on stock returns, studies investigate the relationship between interest rate sensitivity and maturity composition of a firm's assets (Flannery & James 1984a), interest rate sensitivity of firms in different industry (Martin & Keown 1977; and Sweeney & Warga 1986), and interest rate sensitivity of firms by size (Elyasiani & Mansur 1998, 2004; and Park & Choi 2006), to name a few. In addition, a volatility of stock returns, especially using GARCH models, plays a significant role in a stock return study (Elyasiani & Mansur 1998, 2004). Although there is consensus that stock returns of financial instructions are sensitive to interest rate changes, consensus is yet to be reached on the direction and of the effect of short-term and long-term interest rates on stock returns. Park and Choi (2006) find that P/L insurer stocks exhibit different sensitivities to different interest rates at different time periods.

Another important issue in a stock return study includes whether or not the stock trading volume is a useful piece of information in understanding the impact of interest rate changes. The benefit of investigating the impact with respect to trading volume brings dynamic context into the analysis. It is well accepted that liquidity can affect the stock returns. The presence of many traders of a stock (actively traded stock) seems to present challenges and competitiveness to capture excess returns, if any, with useful information, while inadequate number of traders for a stock (inactively traded stock) may provide a better chance to capture excess returns, if any, with useful information. It is well documented that there is an inverse relation between stock returns and trading activity (Chordia et al. 2001 and Brennan et al. 1998).

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Following Stone (1974), this study investigates the impact of interest rate changes on property-liability insurers' stock returns given the liquidity level, proxied by trading volume. In addition, the study further scrutinizes whether or not the magnitude and direction of the impacts are dependent on the maturity of an interest rate. We find that property-liability insurers are influenced by changes in interest rates, but the direction shifts as the insurance market condition changes. This is true for every portfolio we studied, albeit at different magnitudes. The remainder of paper is organized as follow. Next, we review relevant literature, followed by the description of the empirical models and the data. We then discuss the empirical findings, and the final section concludes.

Literature Review

Numerous studies have focused on the impact of interest rate changes on stock returns among different industries, especially after Stone postulates the two-index model. Stone (1974) extended the single market-index model of the return-generating process into a two-index model so as to quantify the concept of systematic IRR. Studies have incorporated various debt market indexes to proxy IRR, such as the Solomon Brother Index (Lloyd & Shick 1977) and Treasury security rates (i.e., Bae 1990; Choi et al. 1992). In addition, Stone's two-index model is frequently augmented with additional explanatory factor such as foreign exchange rate risk (Choi et al. 1992) or two separate debt indexes for short-term and long-term debt (Lynge & Zumwalt 1980; Park & Choi 2006). Under other econometric specifications, stock returns exhibit sensitivity to interest rate changes. (i.e., GARCH-M model by Elyasiani & Mansur 1998). In addition, using Stone's model, Park and Choi (2006) find considerable, but time varying, interest rate sensitivity of property-liability insurer stock returns, and similar time varying interest rate sensitivity by banks is also documented by Akella and Chen (1990). Brewer III et al. (2007) find greater interest rate sensitivity of life insurer stocks than property-liability stocks.

The magnitude of the impact of interest rate changes and the direction of the impact are far from consensus. The magnitude of interest rate sensitivity of stock returns to long-term interest rate changes are reported to be different from that of short-term interest rate changes. For example, Akella and Chen (1990) find that bank stock returns are sensitive to long-term interest rate changes, but not to short-term interest rate changes, while Benink and Wolff (2000) reports a negative sensitivity of bank stock returns to both long- and short-term interest rate changes. Thus, this matter is more of an empirical issue to investigate how and what extent changes of long- and short-term interest rates have an impact on stock returns.

It's not spurring to find that not all stocks are impacted by changes in interest rates after controlling for the market effect. Besides, stock returns of financial institutions such as commercial banks (i.e., Martin & Keown 1977; Sweeney & Warga 1986), utility companies, life insurance companies (Brewer III et al. 2007), and property casualty insurance companies (Park & Choi 2006) are found to be more interest sensitive than firms in other industry.

According to the market efficiency theory, the expected values of factors, such as expected interest rate changes, should be already reflected in asset values; that is, asset returns should be affected by unanticipated changes in factors such as unanticipated interest rate changes. Among others, Akella and Chen (1990) and Choi et al. (1992), Flannery and James (1984a),

Benink and Wolff (2000) conduct the analyses using unanticipated interest rate changes to incorporate the market efficiency theory, but findings are mixed. Flannery and James (1984a & 1984b), and Bae (1990) document no significant difference in the impact of interest rate changes between actual and unanticipated interest rate changes.

Chordia and Swaminathan (2000) report that high volume stocks tend to react promptly to market-wide information and thus trading volume plays an important role in the dissemination of information to the market. The importance of trading activity-related variables in the cross-sectional analysis of expected stock returns is also documented (Chordia et al. 2001). In addition, Blume et al. (1994) demonstrate that both past returns and trading volume are informative in estimating stock returns. Testing an emerging market, Gebka (2005) provides evidence that the direction of trading volume changes contains information. Lee and Rui (2002) also document that, in a dynamic environment like a stock market, trading volume conveys information of price changes. Although many previous studies use change in trading volume as a factor affecting prices or returns, Lee and Rui (2002) find that trading volume does not Granger-cause stock market returns in three different stock markets studied, including US.

Empirical Model and Data

The sensitivity of P/L insurer stock returns to interest rate changes¹, following Stone's argument, specifies the following return generating process:

$$\text{Model 1: } R_{jt} = \alpha_j + \beta_{Mj} R_{Mt} + \beta_{Ij} R_{It} + \varepsilon_{jt},$$

where R_{jt} is the return on the j th portfolio at time t , and R_{Mt} is the market return at time t . R_{It} is the return on interest rate indexes, and ε_{jt} is the error term. The α_j , β_{Mj} , and β_{Ij} are constant characteristics of portfolio j and the parameters to be estimated. In Model 1, β_{Mj} and β_{Ij} represent systematic equity risk and systematic interest-rate risk, respectively. This study focuses specifically on the β_{Ij} , which presents the effect of nominal interest rate changes on the stock return.

Multicollinearity between R_{Mt} and R_{It} in Model 1 exists and an orthogonalizing procedure between them is suggested. However, a theoretical justification for "what causes what" is not clear. That is, if an orthogonalization scheme is to regress R_{Mt} on R_{It} , the estimate of β_{Mj} will be the same, but the estimate of β_{Ij} will be changed. For a reverse orthogonalization scheme, the estimate of β_{Ij} is the same, but the estimate of β_{Mj} will be changed. Although Giliberto (1985) and Akella and Chen (1990) note that an appropriate model depends on *a priori* specification of the true return generating process, Kane and Unal (1988) find that the parameter space spanned is the same regardless of whether or not the indices are orthogonalized. To eliminate the multicollinearity between interest rate indices and market returns, we adopt an orthogonalization scheme such that R_{Mt} is regressed on R_{It} as $R_{Mt} = a + bR_{It} + \delta_t$, where a and b are parameters to be

¹ The P/L insurance industry assets distributions for the year 2006 are U.S. government and municipal securities (39.0%), corporate and foreign bonds (20.4%), corporate equities (17.0%) and other miscellaneous assets (23.6%), according to Insurance Information Institute.

estimated and δ_t is a residual, which is serially uncorrelated to R_{jt} . The substitution of this scheme into Model 1, the following return generating model, Model 2, is specified:

$$\text{Model 2: } R_{jt} = \gamma_j + \beta_{Mj} \delta_{Mt} + \lambda_{lj} R_{lt} + \varepsilon_{jt},$$

where $\gamma_j = \alpha_j + a\beta_{Mj}$ and $\lambda_{lj} = b\beta_{Mj} + \beta_{lj}$.

To investigate the impact of unanticipated interest rate changes on P/L insurer stock returns, this study estimates unanticipated interest rate changes using ARIMA specifications.² The forecast errors of the ARIMA processes, UR_{lt} , are adopted as a proxy for the unanticipated interest rate changes. The return generating model with the unanticipated interest rate changes to be estimated is as follow:

$$\text{Model 3: } R_{jt} = \omega_j + \beta_{Mj} R_{Mt} + \beta_{lj} UR_{lt} + \eta_{jt},$$

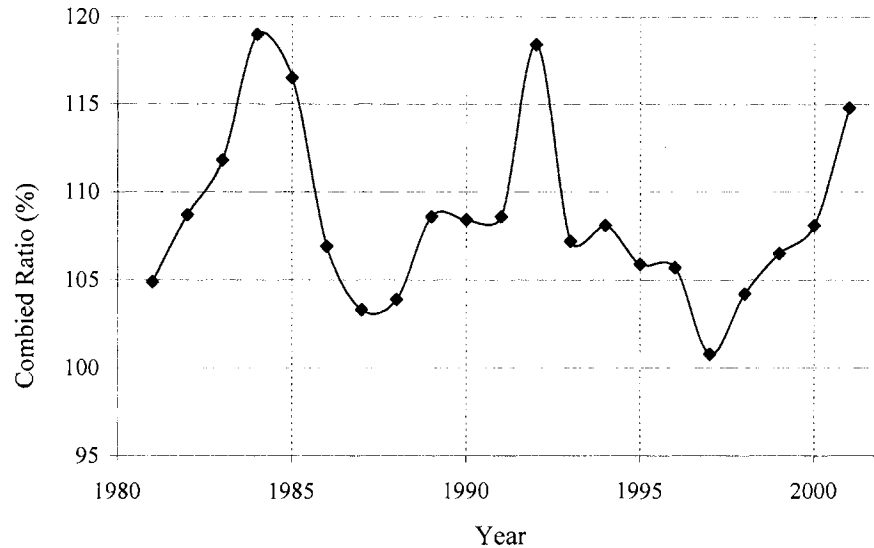
where η_{jt} is the error term.

Starting 94 property-liability insurers retrieved from the Center for Research in Security Prices (CRSP), this study ends up having a sample of 37 insurers for years between 1992 and 1996 period and a sample of 39 insurers for the years between 1997 and 2001. Two sets of sample insurers meet the following two selection criteria: (1) Insurers must belong to SIC 6331: Property and Casualty Insurance in the CRSP data file; and (2) Insurers must have continuous data over the either sample period.

The time period this study investigates, between 1992 and 2001, represents the insurance industry's full business cycle, so called underwriting cycle. The combined ratio is commonly used to indicate the profitability of the insurer's operations by combining the loss ratio with expense ratio. Thus, the higher the ratio, the lower the operating profitability is. As illustrated in Figure 1, between 1992 and 1996, the P/L industry has experienced increasing underwriting profit, followed by the period between 1997 and 2001 with decreasing underwriting profit.

Friday-ending weekly returns are calculated as $(P_t - P_{t-1}) / P_{t-1}$, where P_t is Friday-ending insurer's stock price at time t . Same methods are used to obtain market returns using S&P 500 index as a proxy for market and interest rate changes using Treasury indices. In order to focus on the effect of interest rate changes on the P/L insurers' stocks, the unit of analysis is a portfolio of stocks instead of an individual stock. The insurers are grouped into two portfolios depending on the trading volume. Unlike studies that have documented or tried to document roles of trading volume on correlating stock returns, this study focus on how stocks with different level of trading activity are associated with interest rate sensitivity. For the purpose of this study, creating a portfolio by trading activity can be simply done based on the number of trading shares. The percentage of outstanding shares traded can be used as well. The use of portfolios in lieu of individual stocks alleviates, if not completely removes, idiosyncratic behaviors of an individual

² See Appendix 1 of Park and Choi (2006) for ARIMA model specifications used to estimate the unanticipated interest rate changes.

Figure 1. Aggregated Stock Property-Liability Insurer's Combined Ratios for Years 1981 - 2001

stock. This study uses equally weighted average returns of portfolios, and the number of observations is 261 weeks for the first period and one less week for the second period due to the market closing after the terrorist attack on September 11, 2001.

The market returns and various Treasury rate indexes are obtained from the CRSP file and the *Federal Reserve Bulletin*, respectively. To investigate differences in the sensitivity with respect to different termed interest rates, this study tests six different maturities – 3-month, 1-year, 3-year, 7-year, 10-year, and 30-year Treasury security rates.

Discussion of Findings

The descriptive statistics of sample insurers in two different time periods are reported in Table 1, which shows that regardless of the industry's condition, the portfolio of inactive-traded insurers considerably outperforms its counterpart (0.21% vs. 0.32% in the first time period and 0.07% vs. 0.18% in the second time period), which is consistent with Chordia et al. (2001) and Brennan et al. (1998). Surprisingly, when the industry's operating profit deteriorates (Panel B), the return volatility of the portfolio of inactive-traded insurers is less than its counterpart (3.31% vs. 2.30%). There is a significant difference in trading activity between two sub-sample periods such that actively traded stocks become more active when the industry's operating profit deteriorates (from 130,791 shares to 507,231 shares) while inactive-traded stocks are rather stable (from 11,767 shares to 15,784 shares).

Table 1. Descriptive Statistics of Portfolios of Property-Liability Insurer Stocks

Portfolio	No. of Insurers	Weekly return (%)		Daily trading volume (shares)		Market value (in \$1,000,000)	
		Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
<u>Panel A. 1992 – 1996 Time Period</u>							
Actively-traded Insurers	19	0.2100	1.6740	130,791	127,665	4,110.4	8,227.9
Inactively-traded Insurers	18	0.3262	1.7180	11,767	9,318	2,133.9	6,352.6
Total Insurers	37	0.2665	1.4219	72,888	108,754	3,148.8	7,342.3
<u>Panel B. 1997 – 2001 Time Period</u>							
Actively-traded Insurers	20	0.0717	3.3132	507,231	726,491	13,161.8	34,334.2
Inactively-traded Insurers	19	0.1809	2.2971	15,784	11,643	4,805.6	18,663.3
Total Insurers	39	0.1249	2.5259	267,808	570,865	9,090.8	27,790.6

In each time period, the portfolio of Inactively-traded (Actively-traded) insurers is comprised of insurers of which daily trading volume is less (greater) than the median.

When it comes to interest rate sensitivities of the portfolios of insurers stocks, the finding suggests that P/L insurers' stocks are influenced in a different direction depending on the industry's operating profits. However, this study finds little difference in results from different econometric model specifications. Tables 2 through 4 present coefficient estimates of interest rate indices for three return generating models specified in the previous section. Regardless of portfolio specification by trading activity, interest rate indices used, or econometric model specifications, negative interest rate sensitivities are found during 1992 – 1996 time period, while the sign of coefficient estimates is opposite during 1997 – 2001 time period. This is consistent with Park & Choi (2006) in terms of directions of the sensitivities and also with Akella and Chen (1990) who reports the time varying interest rate sensitivity of bank stocks.

When multicollinearity between market returns and interest rate changes is removed (Model 2), the explanatory power of the model (R^2 is not reported) and the statistical significance of coefficient estimates of interest rate changes substantially improves (Table 3 vs. Tables 2 and 4). However, as are reported by Flannery and James (1984a) and Bae (1990), this study also finds that the observed changes in interest rates are as good a factor as the unanticipated changes in an interest rate (Table 2 vs. Table 4).

Since the reported coefficients in tables are very consistent in terms of the direction and the statistical significance, further discussion is limited to Table 3. It is noted from Table 3 that insurers' stocks are more negatively (positively) sensitive to changes in long-term (short-term) interest rates than short-term (long-term) when the industry's underwriting experience is improving (deteriorating). For example, the reported interest rate coefficient estimates of actively-traded portfolio decrease in absolute value from -0.477 for 30-year T-Bond to -0.156 for 3-month T-Bills. This is the same for the coefficient estimates of inactively-traded portfolio as

Table 2. Estimates of Interest Rate Sensitivity for Portfolios of Property-Liability Insurer Stocks
Model 1: $R_{jt} = \alpha_j + \beta_{Mj} R_{Mt} + \beta_{lj} R_{lt} + \varepsilon_{jt}$

Interest rate index	Portfolio Classification (1992 – 1996)			Portfolio Classification (1997 – 2001)		
	Inactive	Active	Total	Inactive	Active	Total
3 - month	-0.058 (0.053)	-0.118 *** (0.044)	-0.088 ** (0.039)	0.208*** (0.045)	0.150** (0.062)	0.179*** (0.046)
1 - year	-0.086 * (0.048)	-0.109 *** (0.040)	-0.098 *** (0.035)	0.173*** (0.050)	0.127* (0.067)	0.149*** (0.050)
3 - year	-0.075 (0.046)	-0.125 *** (0.038)	-0.101 *** (0.034)	0.149*** (0.052)	0.112 (0.070)	0.130** (0.052)
7 - year	-0.097 * (0.057)	-0.162 *** (0.047)	-0.131 *** (0.041)	0.103 (0.065)	0.070 (0.086)	0.086 (0.064)
10 - year	-0.117 * (0.063)	-0.198 *** (0.052)	-0.159 *** (0.046)	0.086 (0.068)	0.062 (0.090)	0.074 (0.068)
30 - year	-0.153 * (0.081)	-0.250 *** (0.067)	-0.203 *** (0.059)	0.019 (0.085)	0.013 (0.112)	0.016 (0.085)
Insurers in portfolio	18	19	37	19	20	39
Observations	261	261	261	260	260	260

***, **, and * indicates statistical significance at 1, 5, and 10 percent levels, respectively, and standard errors in parenthesis.

Table 3. Estimates of Interest Rate Sensitivity for Portfolios of Property-Liability Insurer Stocks
With Orthogonalized Market Returns, Model 2: $R_{jt} = \gamma_j + \beta_{Mj} \delta_{Mt} + \lambda_{lj} R_{lt} + \varepsilon_{jt}$

Interest rate index	Portfolio Classification (1992 – 1996)			Portfolio Classification (1997 – 2001)		
	Inactive	Active	Total	Inactive	Active	Total
3 - month	-0.078 (0.053)	-0.156 *** (0.044)	-0.118 *** (0.039)	0.287*** (0.044)	0.309*** (0.060)	0.298*** (0.044)
1 - year	-0.128 *** (0.047)	-0.188 *** (0.039)	-0.158 *** (0.035)	0.261*** (0.049)	0.300*** (0.065)	0.281*** (0.049)
3 - year	-0.119 *** (0.045)	-0.208 *** (0.037)	-0.165 *** (0.033)	0.236*** (0.051)	0.281*** (0.068)	0.259*** (0.051)
7 - year	-0.165 *** (0.055)	-0.291 *** (0.045)	-0.230 *** (0.040)	0.169*** (0.064)	0.192** (0.085)	0.181*** (0.064)
10 - year	-0.195 *** (0.061)	-0.344 *** (0.050)	-0.272 *** (0.044)	0.152** (0.068)	0.183** (0.089)	0.168** (0.067)
30 - year	-0.258 *** (0.078)	-0.447 *** (0.064)	-0.355 *** (0.057)	0.033 (0.085)	0.039 (0.112)	0.036 (0.085)
Insurers in portfolio	18	19	37	19	20	39
Observations	261	261	261	260	260	260

Table 4. Estimates of Interest Rate Sensitivity for Portfolios of Property-Liability Insurer Stocks With Unexpected Interest Rate Changes, Model 3: $R_{jt} = \alpha_j + \beta_{Mjt} R_{Mt} + \beta_{Ijt} UR_{It} + \eta_{jt}$

Interest rate index	Portfolio Classification (1992 – 1996)			Portfolio Classification (1997 – 2001)		
	Inactive	Active	Total	Inactive	Active	Total
3 - month	-0.046 (0.054)	-0.109 ** (0.045)	-0.079 ** (0.040)	0.212*** (0.042)	0.171*** (0.057)	0.191*** (0.042)
1 - year	-0.100 ** (0.051)	-0.111 *** (0.042)	-0.106 *** (0.037)	0.203*** (0.049)	0.180*** (0.066)	0.191*** (0.049)
3 – year	-0.083 * (0.048)	-0.121 *** (0.040)	-0.102 *** (0.035)	0.167*** (0.053)	0.144** (0.071)	0.155*** (0.053)
7 – year	-0.100 * (0.058)	-0.147 *** (0.048)	-0.124 *** (0.043)	0.108 (0.067)	0.075 (0.088)	0.091 (0.066)
10 - year	-0.124 * (0.065)	-0.181 *** (0.054)	-0.153 *** (0.048)	0.081 (0.071)	0.051 (0.093)	0.065 (0.070)
30 - year	-0.154 * (0.084)	-0.219 *** (0.069)	-0.188 *** (0.061)	-0.008 (0.088)	-0.040 (0.117)	-0.025 (0.088)
Insurers in portfolio	18	19	37	19	20	39
Observations	261	261	261	260	260	260

***, **, and * indicates statistical significance at 1, 5, and 10 percent levels, respectively, and standard errors in parenthesis.

well. However the magnitude changes during the second time period from insignificant 0.039 to 0.309 for same portfolio category. This finding suggest that insurers may changes their balance sheet and/or off-balance sheet components, including asset and liability portfolios to reflect their changes in operating profits, causing a change in a maturity gap between their assets and liabilities. It has been postulated that the maturity gap between interest rate sensitive assets and liabilities is the source of interest rate sensitivity (Flannery & James 1984b; Kwan 1991).

The systematic difference in interest rate sensitivity between portfolios by trading volume is also noted from the table. In either time period, changes in interest rates have a greater impact on the portfolio of actively-traded insurers than its counterpart. Interest rate sensitivities of the portfolio of actively-traded insurers (inactively-traded insurers) range between -0.447 (-0.258) to changes in 30-year T-Bonds rate in 1992 – 1996 time period and 0.309 (0.287) to changes in 3-month T-Bills rate in 1997 – 2001 time period.

Conclusions

Using sample of US property/liability insurers stock returns during the time period of 1992 to 2001, this study reports several significant findings. First, this study finds greater mean return for inactively-traded stocks than actively-traded stocks. Second, P/L insurers' stock returns are sensitive to changes in interest rates, but time varying. Considering the fact that there has not been a regulatory change during the time period studied, which may affect or explain the

apparent time varying sensitivity, we attribute the time varying interest rate sensitivity to the change in the industry's operating performance (see Figure 1), and we suspect that insurers adjust their asset-liability composition to react to the industry's (or individual insurer's) performance operating. Third, the capital market seems to regard the liquidity risk of insurers, in addition to the industry's business cycle. Stocks of actively traded insurers are affected greatly and widely by changes in interest rates. Finally, the sensitivity also differs drastically depending on the interest rate maturity.

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