Sensitivity of Stock Returns to Changes in the Term Structure of Interest Rates – Evidence from the German Market

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1 Introduction

For a long time, interest rates have been considered one of the macroeconomic factors determining stock returns. The role of interest rates in the return generating process of stocks has therefore been extensively investigated in general, but particularly so with regard to financial institutions, which are often deemed to be more sensitive to changes in interest rates than stocks from other industries. Generally, this specific sensitivity has been attributed to i.) the predominant role of financial (i.e. nominal) assets and liabilities on the balance sheets of financial intermediaries and ii.) the maturity transformation performed especially by depository institutions and the resulting maturity mismatch of assets and liabilities (see [14] for an extensive review).

Nevertheless, interest rates also influence the market value of non-financial corporations. First, this is due to the fact that these firms do hold financial assets and especially liabilities as well. Second, interest rates have a decisive impact on investment decisions and thus on future cash flows [1].

This study investigates the stock return sensitivities of both financial and non-financial German corporations to changes in the term structure of interest rates. Most recent contributions pursuing similar research objectives include [11] who investigate a sample of European financial and non-financial corporations, [5] who focus on UK financial institutions, and [6] and [8] for the case of US banks. Studies also investigating a data set similar to ours include the works of [1], [2], and [13] who investigate the sensitivity of German financial and non-financial corporations to changes in interest rates.

The approach most commonly used to estimate the sensitivity of stock returns to changes in interest rates is the two-factor model proposed by [15], which is basically a market model augmented by a second factor intended to capture changes in interest rates. However, [9] show that changes in the term structure are driven by changes in its level, slope, and curvature. Hence, a single interest rate factor will not necessarily capture the entire variability in stock returns caused by changes in the term structure (note the similarity to the duration approach in fixed-income management which has been criticized for the same reason). Therefore, we apply a multi-factor model which

uses changes in level, slope, and curvature of the German term structure of interest rates as factors explaining stock returns.

2 Methodology

[10] propose a parsimonious model of the term structure which describes the yield of a zero bond at time t, $Y_t(T)$, as a function of its time-to-maturity T and four parameters $\beta_{0,t}$, $\beta_{1,t}$, $\beta_{2,t}$, and τ_t.

$$\begin{aligned} Y_t(T) = \beta_{0,t} + \beta_{1,t} \left(\frac{1 - \exp(-T/\tau_t)}{T/\tau_t} \right) + \\ + \beta_{2,t} \left(\frac{1 - \exp(-T/\tau_t)}{T/\tau_t} - \exp(-T/\tau_t) \right) \end{aligned} \tag{1}$$

Since the (implicit) loading of $Y_t(T)$ on $\beta_{0,t}$ is one, any change in this factor affects all yields equally and thus causes a level shift. Taking limits of (1), we have $Y_t(\infty) = \beta_{0,t}$ and $Y_t(0) = \beta_{0,t} + \beta_{1,t}$. If we define the difference between the long rate and the short rate as the slope of the term structure, we see that the latter is modelled by $-\beta_{1,t}$. Note that the loading of $Y_t(T)$ on $\beta_{2,t}$ (the second expression in brackets in (1)) converges to zero for both shorter- and longer-term rates. This factor thus governs especially the behavior of medium-term rates and therefore affects the curvature of the term structure [4]. τ_t lacks such an interpretation; it determines the convergence of the exponential terms in (1).

In order to estimate the sensitivity of stock returns to changes in interest rates, we apply the extended factor model proposed by [3] using monthly data. In this model, changes in the parameters of (1) are employed as measures of changes in the shape of the term structure.

$$r_{i,t} = \alpha_i + \beta_{i,L} \Delta L_t + \beta_{i,S} \Delta S_t + \beta_{i,C} \Delta C_t + \beta_{i,M} r_{M,t} + \varepsilon_{i,t} \tag{2}$$

Equation (2) assumes that the returns of stock i in excess of the one-period risk-free interest rate, $r_{i,t}$, are generated by a linear four-factor model. α_i is a constant and $\varepsilon_{i,t}$ is a mean-zero residual. ΔL_t is the first difference of the level factor $\beta_{0,t}$, ΔS_t is the change in the slope factor $\beta_{1,t}$, and ΔC_t captures the change in the curvature factor $\beta_{2,t}$. $r_{M,t}$ is the excess return of a market index. Finally, the β_is are the estimated sensitivities of the i^{th} asset to the respective risk factors.

Correlations between the explanatory variables range from –.386 to +.073. Despite these relatively low correlations, we apply an orthogonalization procedure to the explanatory variables prior to estimating (2) (for details see [11]). Following [9], we consider the level factor to be the most important interest rate factor, the slope factor to be the second, and the curvature factor to be the least important interest rate factor. Hence we orthogonalize the factors in this order. Finally, to capture market-wide shocks not included in the parameters of the model by [10], we employ a residual market factor where correlations with the interest rate factors have been removed. As a consequence, since the explanatory variables in (2) are linearly independent by construction, we can decompose the stock return variance into the sum of factor variances (times the respective squared sensitivity) and the variance of the error term.