The Spanish Review of Financial Economics 12 (2014) 33–39

The Spanish Review of Financial Economics

www.elsevier.es/srfe

Article

The implied equity duration for the Spanish listed firms

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ARTICLE INFO

Article history:
Received 24 June 2013
Accepted 26 September 2013
Available online 26 November 2013

JEL classification:
G12
G14
M41

Keywords:
Asset pricing
Financial analysis
Risk factors
Stock duration

ABSTRACT

In this paper, we compute the implied equity duration (IED) for the non-financial companies listed in the Spanish stock market for the first time, to the best of our knowledge. This measure of risk adapts the traditional expression of the duration of a bond to the stock context. We also conduct a sector analysis and a size analysis using the Ibex indices composition. The results are then compared with those from the U.S. stock market and related to other proxies of equity risk. This analysis shows that there is a significant relation between the IED and the earnings to price ratio, the book to market ratio and the sales growth rate, but not to capitalisation, thus excluding the presence of a size effect. The results support the relation of the IED with the high minus low factor, thereby suggesting that the latter is subsumed in this measure.

1. Introduction

The interest rate risk analysis in the fixed income context is built on a rigorous methodological approach based on discounting the cash flows promised by the issuer. The central concept in this framework is the duration, a risk measure commonly accepted and used by both academia and practitioners. This concept, first presented by Macaulay (1938), is defined as the weighted average of the times at which bondholders receive the cash flows from a bond, where the weights are equal to the present values of the payments normalised with respect to the price of the bond. The Macaulay duration effectively measures the sensitivity of a bond to changes in the discount rate in the fixed cash flow model, i.e., the yield to maturity.

However, the interest rate risk analysis for equities does not have a unique framework. Thus, we find from analysis based on simple models of stock valuation (Leibowitz, 1986) to others based on an empirical linear relation between the variations in stock prices and the variations in market interest rates a compromise solution. Despite the efforts of researchers, reaching up prepend the need of results to the rigour of the analysis, none of these methodologies has provided the necessary results to become a reference methodology.

In this context, Dechow et al. (2004) bridge the gap between techniques used in the analyses of bonds and equities, thus developing a measure of implied equity duration (IED) based on the Macaulay duration for a bond. Their methodology also combines, in the equity context, the two aforementioned approaches as they used an analytical model of stock valuation based on the discounted cash flows that matches the market quote by adjusting the terminal cash flow scheme.

Thus, implementing the IED requires estimating in advance the expected cash flows by the equity, in which a two-step process is used. First, using a simple model based on historic financial data, cash flows are estimated for a finite prediction horizon. It is then assumed that the rest of the equity market price is distributed as a perpetual start on the finite prediction horizon. Accordingly, applying the Macaulay duration formula to these cash flows leads to the IED.

Dechow et al. (2004) compute the IED for each of the companies using the available data from the NYSE, AMEX and NASDAQ, between 1963 and 1998, and obtain an IED average of 15.13 years, with a standard deviation of 4.09. The results of their empirical tests show that the IED explains the risk characteristics for the stock returns, resulting in a positive and significant relationship with the volatility of the stock returns and their betas, and that the IED provides more prediction power of these variables than does its own lagged variables. Furthermore, the IED captures a strong common factor in the profitability of the shares that encompass the common factor related to the book-to-market ratio (BtM) whose empirical properties were revealed by Fama and French (1993).

In this context, the objective of this paper is to compute the IED for the listed firms in the Spanish stock market with the data available at the end of 2011, compare the results with those obtained

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http://dx.doi.org/10.1016/j.srfe.2013.09.003

in Dechow et al. (2004) for the U.S. market, perform sector and size analyses and search for the relationship of the IED with other commonly used variables as risk proxies to find evidence of the relationship between the IED and the company growth options as well as the size and effects of the IED as gathered by the Fama and French factors.

The latter analysis links this work within the empirical literature that relates the systematic risk of stock with the premium value by breaking down the betas for assets in cash flow betas and discount-rate betas. In this context, Campbell and Mei (1993) find that the discount-rate betas represent the large part of the total beta of the companies, and based on that, Cornell (1999) suggests that the high betas for growth stocks are a consequence of a greater weight of the cash flows removed in time, or equivalently, of growth stocks longer duration. Campbell et al. (2009) show that the value premium is a consequence of the differences in the timed schedule of the expected cash flows by the shareholder represented by the duration. At the same time, Da (2009) shows how cross-sectional differences in the duration of companies could explain an important part of the stock returns. In summary, as Santa-Clara (2004) has noted, the IED "is an interesting new approach to measuring stock risk".

This paper is organised as follows. In the next section, we derive the measure of interest rate risk of the equity, the IED. Section 3 describes the data selection process. Section 4 presents the results: (i) the results of computing the IED for each company and the main statistics for the entire sample; (ii) the results of the sectorial and size analyses carried out using the stock market activity classification and size indices; and (iii) the results related to the relationship of the IED with other variables used as risk proxies, which include the earnings-to-price ratio (EPR), the BtM, the sales-growth-rate (SGR) and the capitalisation (CAP). Finally, Section 5 summarises the results and states the main conclusions.

2. Implied equity duration

Macaulay (1938) first introduced the duration concept as the weighted average of the times until fixed bond cash flows are received. Hicks (1939) further showed that the duration is essentially a measure of the elasticity of bonds to interest rates. From the bond price formula, it is straightforward to note that bond prices are inversely related to their yield to maturity as a unique risk factor.[1]

However, in the equity valuation, there are many factors, including interest rate, that affect cash flows beyond the discount rate used to compute their present values. Lintner (1971), Boquist et al. (1975) and Livingston (1978) initially proposed the concept of stock duration, and then in the works of Leibowitz (1986) and Leibowitz et al. (1989), it was first computed for individual firms. More recent studies in this line are Cohen (2002), Hamelink et al. (2002) Lewin et al. (2007), Shaffer (2007) and Leibowitz et al. (2010).

In Boquist et al. (1975), the stock duration measure is built on the dividend discount model. However, Leibowitz (1986) used market quotes to develop an alternative measure. But, as Leibowitz and Kogelman (1993) noted, the values for both measures are significantly different, even when the compensation between price risk and reinvestment risk is taken into account as proposed by Johnson (1989). These differences determine the so-called duration paradox and give rise to works, such as Leibowitz and Kogelman (1993) and Hurley and Johnson (1995), that attempt, though unsuccessfully, to conciliate the two measures.

[1] In the fixed income field, the duration concept has been widely used and developed up to the concept of duration vector to unobservable factors, extracted by principal component analysis (Benito, 2006) and independent component analysis (González and Nave, 2010) from the term structure of interest rates.

In this paper, we use an alternative stock duration measure proposed by Dechow et al. (2004) that is based on the Macaulay's duration for a bond (one time period before the first future cash flow):

$$D=\frac{\sum_{t=1}^{T}(t\cdot CF_t)/(1+r)^t}{P} \tag{1}$$

where CF_t are the bond cash flows; r is the bond yield to maturity; and P is the actual price of the bond.

As previously mentioned, the bond duration is a weighted average of the maturities of T-cash flows, where the weights are the relative contribution of each cash flow to the actual bond price. The main role of the bond duration in the fixed income analysis is as a measure of the bond's price sensitivity to changes of bond yield to maturity.

Differentiating the bond price expression with respect to its yield to maturity, we obtain the relationship between changes in the price of a bond and changes in its yield to maturity as a function of the duration:

$$\frac{\partial P}{\partial r}=-P\frac{D}{1+r} \tag{2}$$

We can rewrite this relationship and express it in discrete form to obtain the following relation between the relative bond price changes and the discrete changes in its yield to maturity as a function of $[D/(1+r)]$, the so-called modified duration,

$$\frac{\Delta P}{P}\approx-\frac{D}{1+r}\Delta r \tag{3}$$

Extending the duration concept to equities introduces one drawback. That is, while the amount and timing of bond cash flows are usually fixed in advance so the bondholder has little uncertainty, the cash flows of equities are not specified in advance and may be subject to great uncertainty.

If we decompose the duration formula shown in Eq. (1) into two parts, one with a finite horizon up to T and another with an infinite horizon from T, we obtain Eq. (4), which expresses the equity duration as a sum of the weighted values of the duration of the cash flows for the finite horizon and the duration of terminal cash flows.

$$D=\frac{\sum_{t=1}^{T}(t\times CF_t)/(1+r)^t}{\sum_{t=1}^{T}CF_t/(1+r)^t}\cdot\frac{\sum_{t=1}^{T}CF_t/(1+r)^t}{P}+\frac{\sum_{t=T+1}^{\infty}(t\times CF_t)/(1+r)^t}{\sum_{t=T+1}^{\infty}CF_t/(1+r)^t}\cdot\frac{\sum_{t=T+1}^{\infty}CF_t/(1+r)^t}{P} \tag{4}$$

where P is the market firm capitalisation; CF_t are the predicted firm pay outs to the stockholders; and r represents the expected return on firm equity.

If we also assume that the terminal cash flows are a perpetual with an actual value equal to the difference between the market capitalisation and the present value of the predicted cash flows for the finite period, then:

$$\sum_{t=T+1}^{\infty}\frac{CF_t}{(1+r)^t}=P-\sum_{t=1}^{T}\frac{CF_t}{(1+r)^t} \tag{5}$$

As the duration of the perpetual that begins in T periods is $[T+(1+r)/r]$, substituting (5) into (4), we obtain the following expression for the IED:

$$D=\frac{\sum_{t=1}^{T}(t\cdot CF_t)/(1+r)^t}{P}+\left(T+\frac{1+r}{r}\right)\cdot\frac{P-\sum_{t=1}^{T}CF_t/(1+r)^t}{P} \tag{6}$$

To compute Eq. (6), we need predictions of firm cash flows for the finite period $(0, T]$. In this sense, Dechow et al. (2004) used a