



ARTICLE

Interest rate changes and stock returns in Spain: A wavelet analysis



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Abstract This paper investigates the relationship between changes in interest rates and the Spanish stock market at the industry level over the period from January 1993 to December 2012 using a wavelet-based approach. The empirical results indicate that Spanish industries exhibit, in general, a significant interest rate sensitivity, although the degree of interest rate exposure differs considerably across industries and depending on the time horizon under consideration. In particular, regulated industries such as Utilities, highly indebted industries such as Real Estate, Utilities or Technology and Telecommunications, and the Banking industry emerge as the most vulnerable to interest rates. Further, the link between movements in interest rates and industry equity returns is stronger at the coarsest scales. This finding is consistent with the idea that investors with long-term horizons are more likely to follow macroeconomic fundamentals, such as interest rates, in their investment decisions.

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Introduction

Understanding the linkage between interest rates and stock prices is a critical issue to many areas of finance, including asset allocation, portfolio management, risk management, asset pricing and monetary policy transmission, and it may

be, therefore, of special interest to investors, portfolio managers, corporate managers and policy makers. The link between changes in interest rates and stock returns is based on financial theory. Modern financial theory assumes that any firm generates a stream of future cash flows and the stock price of that firm is equal to the present value of all expected future cash flows discounted at the appropriate discount rate. Interest rates affect stock prices through two primary channels. First, movements in interest rates have a direct effect on the discount rate used in equity valuation. Second, interest rate changes affect firms' expectations about future cash flows by altering the cost of financing,

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mainly in the highly indebted companies. Consequently, it is expected that interest rates will be a significant determinant of stock prices. In this regard, according to survey evidence by [Graham and Harvey \(2001\)](#), interest rate risk is ranked by U.S. firm managers as the second most relevant financial risk factor, only behind credit risk.

The relationship between interest rate fluctuations and the market value of companies has received a great deal of attention in the literature, although much of this research has focused on financial institutions as a large proportion of income and expenses of these firms directly depend on interest rates. Nevertheless, interest rate variations may be also important for non-financial corporations, principally through their effect on the borrowing costs and the value of financial assets and liabilities held by these companies. The classical ordinary least squares (OLS) regression has been the most common approach used in the literature to assess the relation between changes in interest rates and stock returns. More recent studies have utilized, however, more sophisticated time series methods in the time domain, such as cointegration, Granger causality, vector autoregressive (VAR) or generalized autoregressive conditional heteroscedasticity (GARCH) models. A major limitation of the existing empirical research is that it is restricted to one or at most two time scales, i.e. the short run and the long run.

Despite remarkable advances in modeling techniques, little attention has been paid so far to the influence of a potentially relevant feature such as the investment horizon on the interest rate-stock market link. Financial security markets such as bond and stock markets are complex systems consisting of thousands of heterogeneous agents making decisions over different time horizons (from minutes to years), who collectively determine aggregate market behavior. For example, agents with short investment horizons, such as day traders, are typically linked to speculative activities and make decisions largely based on ephemeral phenomena such as sporadic events (i.e. announcements of earning surprises, mergers), market sentiment or psychological factors. In contrast, agents with long horizons, such as big institutional investors, are more involved in investment activities and follow more closely macroeconomic fundamentals such as the business cycle, inflation, monetary policy stance, etc.

In this way, it is not unreasonable to think that the extent of connection between interest rates and stock prices may vary across time scales associated with different investment horizons of market participants. In such a context, where the strength and direction of relationships between economic and financial variables may differ with the time scale, wavelet methods appear as a very appealing alternative. Wavelet analysis is a comparatively new, at least in finance, and powerful tool for signal processing that takes into account both time and frequency domains. The essential advantage of wavelets is their ability to decompose any signal into its time scale components.¹ This signal decompo-

sition property provides an opportunity to study economic relationships on a scale-by-scale basis. Thus, it is possible to separate those time horizons at which the connection is statistically significant from those horizons at which it is not and, therefore, to obtain a broader picture as compared to the time domain approach which in fact aggregates all time horizons together.

The purpose of this paper is to examine the linkage between changes in interest rates and the Spanish stock market at the industry level across different investment horizons by using a wavelet approach. More specifically, three complementary wavelet-based tools are employed, namely wavelet variance, correlation and cross-correlation. The central research question of this study is whether the relationship between interest rate fluctuations and industry equity returns varies across investment horizons and if so, how it does. A priori, we expect that this relationship will be stronger at long investment horizons because market participants with a very long view (years) are more likely to be interested in market fundamentals, such as interest rates, than agents with shorter horizons, who are mainly influenced by transitory factors.

This work contributes to the current literature in several aspects. First, to the best of our knowledge, this study is the first to investigate interrelationships between movements in interest rates and stock returns in the Spanish case at multiple investment horizons by using the wavelet methodology. In this respect, the Spanish equity market offers an ideal setting to assess the interest rate exposure given the great importance of financial, regulated and heavily indebted firms, all of them being particularly sensitive to interest rate fluctuations, in this market. Second, no previous research has examined the linkage between interest rates and stock returns at the industry level through wavelet techniques. The analysis on an industry basis is, however, appropriate because market aggregation may mask significant differences among industries in terms of interest rate sensitivity. Third, this study is also unique in the sense that a novel discrete wavelet technique is applied, which is called Haar à trous wavelet transform (hereafter referred to as HTW). The HTW was introduced by [Murtagh et al. \(2004\)](#) and overcomes the drawbacks of traditional wavelet functions. As is argued by [Jammazi \(2012b\)](#), the major reason behind the choice of this alternative wavelet transform is its ease in dealing with the boundary problem without the need to remove data. Therefore, the HTW transform ensures the conservation of the whole information included in the original signals, making it possible to better characterize the real interactions between interest rate changes and stock returns.

Our results indicate that the Spanish equity market exhibits a remarkable degree of interest rate sensitivity, although sizeable differences can be observed across industries and depending on the time horizon considered. Unsurprisingly, regulated industries such as Utilities, heavily indebted industries such as Real Estate, Utilities or Technology and Telecommunications, along with the Banking industry emerge as the most interest rate sensitive. On the contrary, there is a wide range of industries such as Chemicals and Paper, Financial Services, Construction, Health Care, and Industrials hardly influenced by interest rates. It is also found that the interest rate-stock market link becomes more pronounced at longer investment horizons (low fre-

¹ As noted by [Schleicher \(2002\)](#), the wavelet decomposition of a signal can be compared to the activity of a camera-lens. Zooming out the lens brings a broad landscape, while zooming in the lens allows to find details that are not observable in the landscape portrait.

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