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The profitability of low-volatility

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ABSTRACT

Low-risk stocks exhibit higher returns than predicted by established asset pricing models, but this anomaly seems to be explained by the new Fama-French five-factor model, which includes a profitability factor. We argue that this conclusion is premature given the lack of empirical evidence for a positive relation between risk and return. We find that exposure to market beta in the cross-section is not rewarded with a positive premium, regardless of whether we control for the new factors in the five-factor model. We also observe stronger mispricing for volatility than for beta, which suggests that the low-volatility anomaly is the dominant phenomenon. We conclude that the low-risk anomaly is not explained by the five-factor model.

1. Introduction

Vast empirical evidence shows that the unconditional Capital Asset Pricing Model fails to explain cross-sectional differences in average stock returns. The early tests of the model already indicated that the relation between beta and return is flatter than predicted; see, for instance, Black et al. (1972), Fama and MacBeth (1973), and Haugen and Heins (1975). Two decades later, Fama and French (1992) conclude that, if one controls for size effects, market beta is unpriced in the cross-section of stock returns, implying that firms with higher market sensitivity are not rewarded with higher average returns. Closely related to the low-beta anomaly is the low-volatility effect of Blitz and van Vliet (2007) and Blitz et al. (2013), who document that the relation between past stock volatilities and subsequent stock returns is not merely flat, but even negative in all major stock markets over recent decades. The low-volatility effect is also related to studies which report superior risk-adjusted returns for minimum-variance portfolios, such as Haugen and Baker (1991) and Clarke et al. (2010), and to the work of Ang et al. (2006, 2009), who find a similar anomaly for very short-term idiosyncratic volatility. More recent studies such as Baker et al. (2011), Baker and Haugen (2012), and Frazzini and Pedersen (2014) confirm the low-volatility and/or low-beta effects.

Various studies show that the three- and four-factor models fail to explain the low-risk anomaly. For instance, Blitz (2016) finds that the Fama and French (1993) three-factor model is unable to explain anomalously high returns of low-volatility stocks, and Frazzini and Pedersen (2014) report that the low-beta anomaly is not subsumed by the three- and four-factor models. However, Novy-Marx (2014) argues that the low-beta and low-volatility anomalies are explained by a three-factor model augmented with a profitability factor. Fama and French (2016) also find that their (2015) five-factor model, which adds profitability and investment factors to their original three-factor model, is able to explain returns on beta-sorted portfolios. Both papers use time-series regressions to come to these conclusions. This means that they first create beta- or volatility-sorted portfolios, and next regress the resulting time series of portfolio returns on the time series of the factors that comprise their proposed asset pricing models. The

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absence of economically large and statistically significant alphas in these regressions is interpreted as evidence that the low-beta and low-volatility anomalies are explained.

This paper does not question the empirical results of Fama and French (2016) and Novy-Marx (2014), but argues that direct evidence for a linear, positive relation between market beta and returns, which is assumed in their models, is still lacking. If the Fama and French (2015) and Novy-Marx (2014) asset pricing models were correct, it should be possible to construct portfolios which show that the positive, linear relation between beta and returns holds in practice, provided one controls appropriately for the other factors in their models. This can be tested by the use of Fama-MacBeth (1973) regressions, as the estimated coefficients in these regressions can be interpreted as returns on portfolios which have unit exposure (ex-ante) to factors, controlling for exposures (ex-ante) to all other factors included in the regression. Fama (2015) also argues for considering not just one, but multiple asset pricing tests, including Fama-MacBeth (1973) cross-section regressions. However, the rejections of the low-beta anomaly by Novy-Marx (2014) and Fama and French (2016) are solely supported by time-series spanning tests.

Using Fama-MacBeth regressions we test whether the factors in the five-factor model are rewarded with significant premia, and find that all factors are, except market beta. In other words, a unit exposure to market beta in the cross-section does not result in significantly higher returns, regardless of whether one controls for the additional factors proposed by Fama and French (2015). At the same time, the constant in the regressions, which ought to be zero according to this asset pricing model (if returns in excess of the risk-free return are used), is large and significant. Taken together, these results imply that the relation between market beta and return in the cross-section is flat instead of positive, which is consistent with the asset pricing models of Blitz (2014) and Clarke et al. (2014). Simply put, we are unable to construct high-beta portfolios with high returns and low-beta portfolios with low returns by controlling for factors such as profitability, while it should be possible to do so if the low-beta anomaly is fully explained by such factors.

We also find more pronounced mispricing for volatility than for beta. This suggests that the low-volatility anomaly is stronger than the low-beta anomaly, and, given that the two are closely related, that the low-volatility anomaly is the dominant phenomenon. These results are consistent with the earlier findings of Blitz and van Vliet (2007), who find higher alpha spreads for volatility-sorted portfolios than for beta-sorted portfolios. Lastly, we show that our results are robust to the choice of profitability measure, and also, using two distinct methodologies, to the well-known errors-in-variables problem.

2. Data

We consider all common stocks (share codes 10 and 11) in the CRSP database traded on NYSE, AMEX, and NASDAQ exchanges, except those with share price below 1 dollar. Following Frazzini and Pedersen (2014), we estimate stock and market return volatilities over the past year (minimum 120 days) and correlations with the market portfolio over the preceding five year period (minimum three years). For volatilities we use log returns (ln(1+r)), whereas for correlations we use the average of past three log returns to control for non-synchronous trading. If daily data are not available, we use past twelve monthly returns to calculate volatilities and sixty (minimum 36) for correlations. These estimates are used to calculate market betas, which we shrink towards one using the commonly employed shrinkage factor of 1/3, as proposed originally by Blume (1971, 1975).

For the calculation of size, value and momentum characteristics we follow the standard Fama-French methodology. The market capitalization (ME) of a stock is its price times the number of shares outstanding, and size is defined as the natural logarithm of market capitalization at the end of the previous month. The balance sheet and income statement information stems from Compustat North America annual files. Book value is the book value of shareholders' equity, plus balance sheet deferred taxes and investment tax credit, if available, minus the book value of preferred stock (calculated using the redemption, liquidation, or par value, in that order). If available, we use shareholders' equity from either Compustat or Moody's Industrial manuals, otherwise, we measure stockholders' equity as the book value of common equity plus the par value of preferred stock, or the book value of assets minus total liabilities. The valuation of a stock is defined as its book-to-market ratio, i.e. BE/ME, calculated as the book value of common equity at the previous calendar year's fiscal year-end divided by the market value of equity at the end of the previous calendar year, updated at the end of June each year. The momentum of a stock is defined as its total return over the preceding twelve months excluding the most recent month.

For profitability, Fama and French (2015, 2016) use an operating profitability ratio which is defined for all stocks, while Novy-Marx (2014) uses a gross profitability ratio which is undefined for financials. As their results suggest that for explaining the alpha of low-risk strategies it does not matter which definition is used, we use the Fama and French (2015, 2016) measure as our base-case definition of profitability. This means that we calculate operating profitability as annual revenues minus cost of goods sold, interest expense, and selling, general, and administrative expenses divided by book equity. In the penultimate section of the paper, we challenge the robustness of our results to the choice of profitability measure. Next to Novy-Marx (2014) gross profitability we also consider cash-based operating profitability, based on Ball et al. (2016), and return on equity based on Hou et al. (2015). Gross profitability is defined as annual revenues minus cost of goods sold divided by total assets. Cash-based operating profitability is defined as revenues minus costs of goods sold minus reported sales, general, and administrative expenses minus change in account receivables, inventory, and prepaid expenses, plus change in deferred revenue, trade account payable, and accrued expenses. All changes are calculated on the year-to-year bases.

Return on equity (ROE) is defined as income before extraordinary items divided by book equity, but we deviate slightly from the definition of Hou et al. (2015) by using annual instead of quarterly earnings data. In this way we ensure consistency with the frequency of the other accounting factors that we consider. Another advantage of annual ROE is that it is available for the full span of our sample, while the quarterly measure of Hou et al. (2015) is only available from 1972. Moreover, Novy-Marx (2015) analyzes the