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Conditional risk and performance evaluation: Volatility timing, overconditioning, and new estimates of momentum alphas ☆

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ABSTRACT

Unconditional alphas are biased when conditional beta covaries with the market risk premium (market timing) or volatility (volatility timing). We demonstrate an additional bias (overconditioning) that can occur any time an empiricist estimates risk using information, such as a realized beta, that is not available to investors ex ante. Calibrating to U.S. equity returns, volatility timing and overconditioning can plausibly impact alphas more than market timing, which has been the focus of prior literature. To correct market- and volatility-timing biases without overconditioning, we show that incorporating realized betas into instrumental variables estimators is effective. Empirically, instrumentation reduces momentum alphas by 20–40%. Overconditioned alphas overstate performance by up to 2.5 times. We explain the sources of both the volatility-timing and overconditioning biases in momentum portfolios.

1. Introduction

Under the conditional version of the capital asset pricing model (CAPM), risk equals the conditional exposure to market returns given the information available to investors. As is well known, time-variation in risk can impact unconditional estimates of investment strategy performance (Jensen, 1968; Dybvig and Ross, 1985) and asset pricing tests (Jagannathan and Wang, 1996). We call the conditioning problems studied in prior literature "underconditioning" because the empiricist is typically assumed to work with a subset of investor information, as in the canonical study of Hansen and Richard (1987). To empirically address underconditioning, Shanken (1990) and others allow estimated loadings to depend on lagged data observable to investors, such as the dividend yield.[1]

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[1] Other studies using lagged instruments for alpha estimation include Avramov and Chordia (2006), Bollerslev, Engle, and Wooldridge (1988),

Empiricists are not restricted, however, to using lagged data known to be in the investor information set. For example, an alternative approach directly estimates conditional factor loadings using "realized betas" estimated from short-window regressions simultaneous with or subsequent to the returns to be risk-adjusted (e.g., Chan, 1988; Grundy and Martin (2001, GM); Lewellen and Nagel (2006, LN)). Using a realized beta to risk adjust has a natural appeal and could appear to be fully justified by the theoretical linear relation between conditional risk and expected return.[2] With daily and higher-frequency data increasingly available, we anticipate growing use of realized betas for performance measurement and asset pricing tests.

In this paper, we identify a novel source of alpha bias that may occur any time an empiricist uses a conditional risk proxy not entirely contained in the investor information set. This potential empirical problem is the complement of underconditioning, and we call it "overconditioning." While the concept is general, we focus on the overconditioning bias generated by using contemporaneous realized beta as a proxy for conditional beta. All empirical realized betas contain some degree of estimation error, and thus cannot be fully anticipated by investors.[3] The estimation error can be substantial in short windows, and can impact alpha even under the optimistic assumption that it has mean zero. The overconditioning bias generated when using a realized beta is tied to nonlinearity in the relation between asset and factor returns. For example, if an asset return is concave in the market return, an estimated realized beta that uses contemporaneous market returns tends to be too high when the market returns are lower than expected, and too low when the market returns are higher than expected. This negative correlation between mismeasurement in beta and market return innovations biases alpha upward. For convex returns, the opposite holds and alphas based on contemporaneous realized betas are biased downward.

Theoretically, payoff nonlinearities can occur for many reasons. Any stock return can be decomposed into real and financial options (Brennan and Schwartz, 1985; McDonald and Siegel, 1985, 1986; Black and Scholes, 1973), which produce nonlinearities as discussed in the context of performance measurement by Jagannathan and Korajczyk (1986) and Chen, Ferson, and Peters (2010). Behavioral biases could also create nonlinearities, for example, if past returns or other characteristics cause a stock to respond differently to positive versus negative systematic news, due to a disposition effect or biased self-attribution (Grinblatt and Han, 2005; Daniel, Hirshleifer, and Subrahmanyam, 1998).

Empirically, abundant evidence of nonlinearities is provided by Harvey and Siddique (2000), Ang and Chen (2002), Ang, Chen, and Xing (2006), Hong, Tu, and Zhou (2007), and others. These studies show, for example, that many individual stocks and style portfolios covary differently with negative and positive market surprises, and they investigate whether assets that respond more to down- than up-markets earn higher returns. By contrast, we show the implications of nonlinearities for performance measurement under the conditional CAPM, where there is no risk premium for beta asymmetry or coskewness.

Many pricing models imply a linear relation between expected asset returns and factor betas, but the relation between realized asset and factor returns can still be nonlinear. For example, under quadratic preferences the CAPM holds for arbitrary return specifications. Similarly, the arbitrage pricing theory is compatible with nonlinearities for an arbitrary number of assets provided these average out in random large portfolios.[4] Our paper argues that, when combined with inappropriate conditioning, nonlinearities can be important for risk measurement and performance evaluation.

If contemporaneous realized betas produce biased alphas due to overconditioning, then how should an empiricist measure conditional risk? One possibility is to use a lagged beta estimate following Fama and MacBeth (1973), but previous authors point out a problem with this approach. Specifically, Chan (1988) shows that the market betas of winners fall on average from the formation to the holding period, while loser betas increase. Similarly, GM observe predictable changes in the size loadings of winners and losers after formation. Using a historical beta biases alpha if the holding-period beta differs predictably under investor information.

We propose a simple solution to this problem that to our knowledge has not previously been used in performance evaluation: using lagged loadings as instruments, rather than direct proxies, for the conditional loading.[5] The instrumental variables (IV) method solves the problems noted by Chan (1988) and GM because it adjusts the conditional beta estimate for predictable changes from the formation to the holding period. Our approach therefore combines the traditional method of using lagged

(*footnote continued*)
Campbell (1987), Cochrane (1996), Duffee (2005), Ferson and Harvey (1991, 1993, 1999), Ferson, Kandel, and Stambaugh (1987), Ferson and Schadt (1996), Gibbons and Ferson (1985), Harvey (1989), Lettau and Ludvigson (2001b), Petkova and Zhang (2005), Santos and Veronesi (2006), Wang (2003), and the textbook of Cochrane (2001).

[2] GM proxy for month τ momentum betas using loadings estimated in the holding period τ to $\tau+5$, and they explain that "the relevant risk to an investor…is the strategy's factor exposure during the investment window" (p. 43). LN state: "Our methodology…does not require any conditioning information. As long as betas are relatively stable within a month or quarter, simple CAPM regressions estimated over a short window — using no conditioning variables — provide direct estimates of assets' conditional alphas" (p. 291). Ang, Chen, and Xing (2006) similarly explain: "The CAPM predicts an increasing relationship between realized average returns and realized factor loadings…. More generally, a multi-factor model implies that we should observe patterns between average returns and sensitivities to different sources of risk over the same time period used to compute the average returns and the factor sensitivities" (p. 1201).

[3] In ideal settings more restrictive than needed for a conditional CAPM, local quadratic variations and covariations are observable (e.g., Foster and Nelson, 1996), but microstructure effects remain important empirically.

[4] See, e.g., Chamberlain and Rothschild (1983) generalizing Ross (1976), or Grinblatt and Titman (1985).

[5] Prior studies have used lagged betas as instruments for conditional beta, but not in performance evaluation. For example, Ghysels and Jacquier (2006) focus on estimating the persistence of conditional beta and use lagged betas as instruments in autoregressions.