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Do jumps contribute to the dynamics of the equity premium? ☆

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ABSTRACT

This paper investigates whether risks associated with time-varying arrival of jumps and their effect on the dynamics of higher moments of returns are priced in the conditional mean of daily market excess returns. We find that jumps and jump dynamics are significantly related to the market equity premium. The results from our time-series approach reinforce the importance of the skewness premium found in cross-sectional studies using lower-frequency data; and offer a potential resolution to sometimes conflicting results on the intertemporal risk-return relationship. We use a general utility specification, consistent with our pricing kernel, to evaluate the relative value of alternative risk premium models in an out-of-sample portfolio performance application.

1. Introduction

This paper evaluates whether jumps contribute to the dynamics of the equity premium for a broadly diversified portfolio of U.S. stocks. Motivated by a generalized utility specification (Kimball, 1990) and nonlinear pricing kernel (Harvey and Siddique, 2000; Dittmar, 2002, Chabi-Yo, Ghysels, and Renault, 2007; Guidolin and Timmermann, 2008), we test whether risks due to dynamics of the conditional variance, skewness, and kurtosis are priced in aggregate stock returns. Our focus is the effect of jumps on the dynamics of the conditional moments and consequently, if priced, on the dynamics of expected excess returns (the equity premium) associated with the market portfolio. We derive a mapping between our estimated prices of risk and the generalized preferences to evaluate

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the relative utility of alternative risk premium models in an out-of-sample portfolio performance application.

Our model filters daily market excess returns into large versus smaller changes, simultaneously with estimation of all of the parameters of the conditional distribution. In our parameterization, large changes in daily returns (jumps) contribute to the dynamics of conditional variance, the dynamics of conditional skewness and kurtosis, and consequently, the dynamics of expected return through pricing of the associated risks. This allows expected jumps to have an impact (whether or not they occur) on the shape *and* location of the distribution of market excess returns.

We model innovations of the return process using a Generalized Autoregressive Conditional Heteroskedastic (GARCH)-jump mixture model. The jump component of the innovation follows a compound Poisson–Normal distribution with an autoregressive jump intensity and a normal jump size distribution. The diffusive component of the innovation is directed by an asymmetric two-component GARCH process, and allows the persistence of jump effects on variance to be different than that of the diffusive component. These features are important for our pricing application since the second GARCH component helps control for noise associated with daily returns and, as such, improves the sorting into jumps versus diffusive components.

Flexible modeling of the conditional variance, skewness, and kurtosis dynamics will undoubtedly improve the explanatory power of the model for capturing the changing shape of the distribution. However, the focus of this paper is concerned with whether the dynamics of the (standardized) higher moments of returns are associated with time-varying expected returns. Are the risks associated with the arrival of jumps, and their effect on the higher moments of returns, priced in the mean?

Studies on jumps often assume that the compensation for jump risk is a linear function of the jump intensity, mostly to make risk-neutral pricing (of options) tractable. In contrast, using a pricing kernel associated with generalized preferences to derive our equity premium specification, prices of risk are not restricted by a single parameter of relative risk aversion and jump risk is priced *linearly* through the conditional dynamics of variance, and *nonlinearly* through conditional skewness and kurtosis. To the best of our knowledge, this is the first study to find significant pricing of both jump risk and diffusive risk, as well as realistic total equity premium estimates, using only a time-series of equity return data.

Our empirical results show that higher-order moments are significantly priced in the equity premium. First of all, we find a positive risk-return tradeoff associated with the traditional risk for the market measured by the conditional variance. The pricing of the conditional variance is robust across our proposed time-varying jump model specifications. When we restrict the model to have no jumps and only include one GARCH component, the variance dynamics are not significantly priced.

By fixing the GARCH component of volatility, we are able to analyze the marginal effect of jumps on the equity premium. We show that the latter is positive at all levels of the GARCH volatility. The equity premium is increasing in the conditional jump frequency and this increase is greatest for low jump-arrival rates and for low levels of the GARCH variance component. For our parameterization and sample, if the expected number of jumps increases by one per year, a representative investor will demand, on average, 0.1062% additional expected return for taking on the extra jump risk. This implies that the equity premium associated with jumps is about 3.61% per annum on average. All higher-order moments can be affected by jumps to returns. According to our parameter estimates, on average, jumps contribute 1.06% to the equity premium through the variance dynamics and also add 2.55% to the equity premium through their contribution to skewness.

We find robust pricing of both the conditional variance and the conditional skewness in the market equity premium. The equity premium associated with skewness is about 3.4% per annum. This is very close to the 3.6% per annum risk premium compensation for systematic skewness found by Harvey and Siddique (2000) who study the conditional skewness in a cross-section of monthly stock returns. When we impose the preference restriction of a nonnegative price associated with risk due to dynamics of kurtosis, our findings show that this price is close to zero; although, conditional kurtosis is significantly priced with a positive sign when the skewness factor is not included. At least at the market level, any contribution of kurtosis to the equity premium has already been largely captured by dynamics of the conditional skewness.

Our results offer an explanation for the conflicting results in the literature on market risk and market expected return. We find a significantly positive equity premium but the positive relationship between conditional *variance* and return only occurs when the GARCH variance component is at or above average levels. An increase in GARCH variance increases both the conditional variance and the conditional skewness (s_t has a smaller negative value), leading to offsetting effects on the equity premium. During calm times (low level of the GARCH variance component), the skewness effect dominates. In more volatile times, the variance premium effect dominates and we will be able to see a positive risk-variance tradeoff, whether we include conditional skewness in the equity premium specification or not.

Solving for the functional relationship between the parameters of our assumed general utility function and the prices of risk associated with the asset pricing model, we are able to calibrate the implied utility parameters to the empirical estimates for our equity premium specification. We then evaluate the out-of-sample realized utility and certainty-equivalent returns associated with a simple portfolio allocation application. Compared to several special case benchmarks, including one that does not include jumps, our maintained *prudence* model generates higher realized utility and certainty-equivalent returns.

Finally, we check the robustness of our results by extending the model to include a variance risk term as defined by Chabi-Yo (2012). The variance risk is not significantly priced in our maintained model which includes the premium of conditional skewness. When we exclude the contribution of conditional skewness to equity premium, the price of variance risk becomes significant.