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The long and the short of the risk-return trade-off☆

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ABSTRACT

The relationship between conditional volatility and expected stock market returns, the so-called risk-return trade-off, has been studied at high- and low-frequency. We propose an asset pricing model with generalized disappointment aversion preferences and short- and long-run volatility risks that captures several stylized facts associated with the risk-return trade-off at short and long horizons. Writing the model in Bonomo et al. (2011) at the daily frequency, we aim at reproducing the moments of the variance premium and realized volatility, the long-run predictability of cumulative returns by the past cumulative variance, the short-run predictability of returns by the variance premium, as well as the daily autocorrelation patterns at many lags of the *VIX* and of the variance premium, and the daily cross-correlations of these two measures with leads and lags of daily returns. By keeping the same calibration as in this previous paper, we ensure that the model is capturing the first and second moments of the equity premium and the risk-free rate, and the predictability of returns by the dividend yield. Overall adding generalized disappointment aversion to the Kreps–Porteus specification improves the fit for both the short-run and the long-run risk-return trade-offs.

1. Introduction

To study the relationship between conditional volatility and expected stock market returns researchers have mainly run linear regressions. The outcome after more than two decades of empirical studies is rather disappointing. Some find a positive relation, others a negative one. In many studies, there is no significant trade-off.[1] Several recent contributions have revived the debate. Bandi and Perron (2008) find that the dependence is statistically mild at short horizons, which explains the contradicting results in the literature, but increases with the horizon and is strong in the long run (between 6 and 10 years). A recent trend in the literature has also put forward the variance risk premium (VRP) as a strong predictor of stock returns in the short run (see in particular Bollerslev et al., 2009). Bollerslev et al. (2006) study the relationship between volatility and past and future returns in high-frequency equity market data. They find an asymmetric pattern in the cross-correlations between absolute high-frequency returns and current and past high-frequency returns. Correlations between absolute returns and past returns are significantly

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[1] In a survey about measuring and modeling variation in the risk-return trade-off, Lettau and Ludvigson (2010) attribute in large part the disagreement in the empirical literature on this relation to the limited amount of information generally used to model the conditional mean and conditional volatility of excess stock market returns. Rossi and Timmermann (2010) argue that there is no theoretical reason for assuming a linear relationship between the expected returns and the conditional volatility. They found support for nonlinear patterns in the risk-return trade-off.

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negative for several days, while the reverse cross-correlations between absolute returns and future returns are negligible.

We propose an equilibrium consumption-based asset pricing model with generalized disappointment aversion preferences and volatility risk to rationalize these recently put-forward stylized facts. We extend the model in Bonomo et al. (2011) in two ways. First, since we want to address short-run volatility-return relationship, we write the model at the daily frequency. Second, we add a short-run volatility risk to the long-run volatility risk in Bonomo et al. (2011). Our main contribution is to reproduce relations between returns and volatility at short and long horizons with an equilibrium model calibrated at a high-frequency daily level. We can then solve the model daily and construct realized quantities at lower frequencies. Thanks to Markov-switching fundamentals, a key advantage of the model proposed by Bonomo et al. (2011) is to find analytical formulas for moments of asset pricing quantities such as payoff ratios and returns, and for coefficients of predictability regressions at any horizon. In this framework we are able to produce analytical results at high frequency as in Bollerslev et al. (2006) together with the long-run regressions of Bandi and Perron (2008) in the same model. For generating empirical stylized facts, we keep the same calibration as in Bonomo et al. (2011) to make sure that the model produces first and second moments of price-dividend ratios and asset returns as well as return predictability patterns in line with the data.

At the high-frequency level, we assess the capacity of the model to reproduce the autocorrelation of daily returns, squared daily returns, and cross-correlations of daily returns and squared returns at various leads and lags. We also build measures of monthly realized variance (RV) by summing daily squared returns and compute moments of realized volatility. The variance premium is obtained by first taking the expectation under the risk-neutral measure of this realized volatility and subtracting the latter from the obtained risk-neutral volatility. The predictability of returns by the variance premium is then established for horizons of one to twelve months. At longer horizons, we reproduce the predictability regressions of Bandi and Perron (2008) by aggregating returns and volatilities over periods of one to ten years.

With generalized disappointment aversion preferences, the stochastic discount factor (SDF) has a kink at a disappointing threshold equal to a given fraction of the certainty equivalent of lifetime future utility. In regular disappointment aversion preferences, the threshold is equal to the certainty equivalent. In the model we propose, expected consumption growth is constant. Therefore, the only long-run risk is an economic uncertainty risk captured by the volatility of consumption. To capture a richer short-run dynamics in volatility and the predictability of returns by the variance premium we add a short-lived volatility component to the persistent component that was used in Bonomo et al. (2011). Shocks in the high- and low-persistence components of consumption growth volatility affect the volatility of the SDF. A persistent increase in consumption growth volatility increases the volatility of future utility. A more volatile future utility increases the probability of disappointing outcomes, making the SDF more volatile. In our model dividends share the consumption volatility process, so an increase in volatility will increase negative covariance between the SDF and the equity return, increasing both the equity premium and the stock return volatility. This will ensure that the long-horizon regressions of aggregated returns over aggregated volatilities will produce R^2 that increase with the horizon.

The variance risk premium is measured as the difference between the squared VIX index (VIX^2) and expected realized variance. In the short-run, the low-persistence component of consumption growth volatility will add volatility to the SDF. This additional volatility will impact relatively more the option-implied variance and the volatility of the variance premium will increase. So, we expect a stronger relationship between the variance premium and the future returns in the short-run than in the long-run. Indeed, for the short-run predictability of returns by the variance premium, we obtain with the model the pattern exhibited by the data (a peak around 2 to 3 months and a slow decline up to 12 months).

In terms of moments of the VIX^2, RV and VRP, we match the mean of the VIX^2 but tend to overestimate the mean of the realized volatility, therefore underestimating the mean of the variance premium. For the second moments, we overestimate the standard deviation of both VIX^2 and RV and underestimate the standard deviation of the variance premium. For the short-run risk-return trade-off stylized facts, we are able to reproduce the daily autocorrelation patterns in VIX^2 and VRP, up to 90 lags, that is the more persistent autocorrelation for the first measure and the faster decay for the variance premium. For the cross-correlations of VIX^2 and VRP with 22 leads and lags of daily returns, we observe a negative pattern in the lags and a close to zero pattern in the leads for both measures. Our model produces negative cross-correlations in the lags (interpreted in the literature as a leverage effect), albeit weaker than in the data, but overestimates the positive cross-correlations in the leads. Therefore, our model creates a stronger volatility feedback effect than observed. This short-run predictability of returns by the variance measures remains in the long-run since the model reproduces the increasing explanatory power at longer horizons found by Bandi and Perron (2008).

Given that all moments and regression coefficients are obtained analytically we are able to conduct a thorough comparison between our GDA specification and two important sub-cases. The first one (called DA0) will be the simplest specification among disappointment averse preferences. The threshold is set at the certainty equivalent and we do not allow any curvature in the stochastic discount factor except for the disappointment aversion kink. Therefore, without disappointment, the SDF will be constant and equal to the constant time discount parameter. The second one (denoted by KP) is of course the Kreps–Porteus preferences which are used most often in long-run risk models as in the original Bansal and Yaron (2004). For the three sets of preferences, we compute all asset pricing moments, predictability regression statistics, and high-frequency dynamics autocorrelations and cross-correlations. In addition, we report graphs that exhibit the sensitivity of all statistics to variations in the key persistence values of the two components of consumption growth volatility. This analysis of the interplay between the persistence of the two components produces very interesting patterns in some of the statistics, that in all likelihood will be hard to detect in an estimation exercise. The analytical solutions are very useful to measure the robustness of model implications. In several dimensions, both DA0 and KP come short of matching our benchmark specification in reproducing the moment and predictability statistics. For reproducing asset returns moments and predictability of returns by the dividend-price ratio, pure disappointment aversion as captured by DA0 plays the most important role, as shown in Bonomo et al. (2011). However, for the risk-return trade-off statistics, short-run risk aversion appears to be important. Therefore, GDA preferences, which incorporate both disappointment aversion and short-run risk aversion are better able to reproduce the complete set of stylized facts. For KP preferences, we already pointed out in Bonomo et al. (2011) its inability to capture the predictability of excess returns by the price-dividend ratio, as well as its counterfactual predictability of consumption growth. For risk-return trade-off statistics, KP preferences match poorly the realized variance, VIX^2 and variance premium moments, but reproduce somehow the patterns for the short-run predictability of excess returns by the variance premium, the long-run risk-return trade-off and the daily autocorrelations