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The business cycle and the equity risk premium in real time

Renatas Kizys [a], Christian Pierdzioch [b,*]

[a] Instituto Tecnologico y de Estudios Superiores de Monterrey (ITESM), Campus Monterrey, Departamento de Economia, Monterrey C.P. 64849, Nuevo Leon, Mexico
[b] Department of Economics, Saarland University, P.O. Box 15 11 50, 66041 Saarbruecken, Germany

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ABSTRACT

Building on the stochastic discount factor model, we estimated a multivariate exponential GARCH-in-mean model to analyze the link between the business cycle and the equity risk premium in the United States. In order to measure the business cycle, we used revised and real-time monthly data on industrial production for the period from 1965 to 2008. The main result of our empirical analysis is that estimates of the equity risk premium based on real-time macroeconomic data may significantly differ from estimates of the equity risk premium based on revised macroeconomic data.

1. Introduction

Macroeconomic variables represent key state variables in widely used asset-pricing models. Given the importance of macroeconomic variables for asset-pricing, an extensive literature has developed that centers around the question whether macroeconomic variables that are measures of the business cycle help to explain equity returns, the volatility of equity returns, and the equity risk premium. While various macroeconomic variables may help to measure the stance of the business cycle, the link between output growth and equity market developments has received a lot of attention in a large and growing literature. For example, Chen, Roll, and Ross (1986) document that output and other macroeconomic variables (including interest rates) have a significant effect on equity market developments. Balvers, Cosimano, and McDonald (1990) analyze the implications of using output for the predictability of U.S. stock returns in a production-based general equilibrium model. An application of their model to U.K. data can be found in recent work by Lovatt and Parikh (2000), who also analyze the predictive power of expected macroeconomic variables (including expected output growth). Boldrin, Lawrence, and Fisher (2001) analyze the equity risk premium in a real business cycle. Lee (1996) emphasizes the predictive power of long-term U.S. output growth for stock returns. Schwert (1989) analyzes the predictive power of output growth and other macroeconomic variables for the volatility of equity returns. Erb, Harvey, and Viskanta (1994) analyze the cross-country correlation of equity returns, and find that this correlation tends to be asymmetric in the sense that it strengthens during business-cycle recessions. In a similar vein, Smith, Sorensen, and Wickens (2009) analyze potential asymmetric effects of the U.S. business cycle on the equity risk premium. Their findings suggest that negative supply shocks increase the equity risk premium in recessions, and that supply shocks are more important than demand shocks. Smith, Sorensen, and Wickens (2007) report further results on potential asymmetries in the effect of the U.S. business cycle on the equity risk premium.

* Corresponding author. Tel.: +49 681 302 58195; fax: +49 681 302 58193.
E-mail addresses: renatas.kizys@itesm.mx (R. Kizys), c.pierdzioch@mx.uni-saarland.de (C. Pierdzioch).

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When studying the link between the equity risk premium and the business cycle, the question arises whether it is important to account for the fact that revised macroeconomic data available to a researcher differ from the macroeconomic data available to equity market investors in real time. Lettau and Ludvigson (2009) argue that revised macroeconomic data should be used when the question of interest is whether historical macroeconomic data match equilibrium relations implied by asset-pricing models. Real-time macroeconomic data, in contrast, are useful for equity market investors who seek to assess the risk of equity market investments in real time. The argument is that researchers have access to macroeconomic data that have been retroactively revised many times. In contrast, equity market investors who must reach decisions in real time only have access to preliminary first-releases of macroeconomic data. Equity market investors can make inferences regarding the link between the business cycle and the equity risk premium only by using the then latest release of publicly available macroeconomic data. Empirical evidence that may help equity market investors to answer the question whether and, if so, how the equity risk premium is linked to the business cycle in real time is rather limited. Only a few studies are available that report evidence of the implications of using real-time macroeconomic data for asset-pricing and research in empirical finance (Christoffersen, Ghysels, & Swanson, 2002; Evans & Speight, 2006; Guo, 2003). By contrast, the analysis of the implications of using real-time macroeconomic data has a long tradition in research in macroeconomics and in business-cycle analysis (Croushore & Stark, 2003; Diebold & Rudebusch, 1991; Orphanides & van Norden, 2002).

In order to study how the choice between real-time and revised macroeconomic data affects estimates of the equity risk premium, we used the stochastic discount factor model (SDF). The SDF model, which has been recently surveyed by Campbell (2000) and Smith and Wickens (2002), is a general model for the pricing of assets in arbitrage-free markets. The SDF model stipulates that the equity risk premium should be proportional to the covariance of equity returns with the business cycle. In order to empirically implement the SDF model, we estimated a multivariate exponential GARCH-in-mean (MEGARCH-M) model to analyze the link between the business cycle and the equity risk premium. Variants of multivariate GARCH-M models have been used in recent literature to study the macroeconomic determinants of the equity risk premium (Scruggs, 1998; Smith, Sorensen, & Wickens, 2009). However, a common feature of these studies is that they have not studied the implications for the equity risk premium of using real-time macroeconomic data. We used monthly real-time and monthly revised data on industrial production and data on the term spread for the period from 1963 to 2008 to measure the U.S. business cycle.

The aim of our empirical analysis is not to give new insights into the theoretical modeling of the equity risk premium, or to survey the large and significant literature on the equity premium puzzle (for a survey, see Kocherlakota, 1996). The aim of our empirical analysis is to analyze the implications for the equity risk premium of measuring the business cycle using real-time macroeconomic data rather than revised macroeconomic data. The main result of our empirical analysis is that estimates of the equity risk premium based on real-time macroeconomic data can significantly differ from estimates of the equity risk premium based on revised macroeconomic data. This main result is robust to various extensions of our MEGARCH-M model. We started our empirical analysis of the equity risk premium with a relatively simple bivariate MEGARCH-M model that only features excess equity returns and real-time or revised macroeconomic data. This model shows that the choice of real-time versus revised macroeconomic data has a significant effect on the equity risk premium. We then extended the bivariate MEGARCH-M model to incorporate a constant term in the conditional mean equation for the excess returns on equity. The constant term turns out to be irrelevant. The irrelevance of the constant term is an important result insofar as the constant term should capture the effect of a potential misspecification of the SDF model on the equity risk premium. The robustness of our main result is further corroborated by a trivariate EGARCH-M model in which the difference between the equity risk premium measured based on real-time macroeconomic data and the equity risk premium measured based on revised macroeconomic data is tested upon controlling for the dynamics of the term spread. Further, we found that our main result does not change when we split our sample period into periods of a bullish and a bearish equity market, or into periods of business-cycle expansions and business-cycle recessions. Only in periods when the equity market is in a bearish period, or in periods when the economy is contracting, is the mean of the equity risk premium measured based on real-time macroeconomic data not significantly different from the mean of the equity risk premium measured based on revised macroeconomic data. But even in these periods, the variance of the equity risk premium as estimated on real-time macroeconomic data significantly differs from the variance of the equity risk premium estimated on revised macroeconomic data.

Our main result has important implications for investors' investment decisions and for empirical research in finance. For example, Lettau and Ludvigson (2003) argue that Tobin's Q theory of investment implies that movements in the equity risk premium should have implications for investments today, but also for investments over longer horizons. This implies that, if managers and equity market investors use information on the equity risk premium to assess the optimality of investments in physical capital, using preliminary real-time macroeconomic data rather than revised macroeconomic data may lead to different estimates of the equity risk premium and, as a result, different investment in a company's capital stock.

We organize the remainder of this paper as follows. In Section 2, we lay out the SDF model and the MEGARCH-M model. In Section 3, we describe our data. In Section 4, we report our results. In Section 5, we offer some concluding remarks.

2. The model

The stochastic discount factor (SDF) model provides a general framework for pricing assets in arbitrage-free markets. The SDF model is built on the notion that, at the beginning of period t, the price of an asset, P_t, is given by its expected discounted payoff, X_{t+1}, at the beginning of period $t+1$:

$$P_t = E_t(M_{t+1}X_{t+1}), \tag{1}$$