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Do the production-based factors capture the time-varying patterns in stock returns?☆

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ABSTRACT

As a summarization of previously suggested production-based approaches, Chen et al. (2010) propose two production-based factors. We examine whether the proposed factors explain the time-varying patterns in stock returns, captured by the common conditioning variables. With a variety of test portfolios, we find that the fitted conditional expected return (*fit*) is always statistically significant in the presence of the production-based factors. Moreover, when the *fit* is included in the analysis, the magnitude of the production-based factors becomes consistently smaller and the *fit* drives out the significance of the production-based factors. Our empirical results cast some doubt on the validity of the production-based model as a conditional benchmark for risk adjustment.

1. Introduction

Understanding the risk and return in stock markets is one of the most fundamental questions in financial economics. In the empirical asset-pricing literature, the Fama–French three-factor model (1993) has served as a benchmark for risk adjustment. However, the empirical performance of the Fama–French model has weakened over the last two decades. For example, it does not capture the momentum effect, and financial distress anomaly.[1]

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[1] The fact that stocks with high (low) returns over the preceding several months tend to have high (low) future returns is referred as momentum effect (Jegadeesh and Titman, 1993). Financial distress anomaly means negative relation between average stock returns and financial distress measured by bankruptcy risk (Campbell et al., 2008).

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Given the failure of the Fama–French three-factor model, researchers have proposed many alternative models. One prominent area of research is the production-based model. From the producer's first order conditions, the production-based model implies that investment should be high when expected returns are low. Since the pioneer work of Cochrane (1991), there is extensive literature investigating the impact of production-based models on expected stock returns (Cochrane, 1996; Lamont, 2000; Kogan, 2004; Lyandres et al., 2008; Xing, 2008; Liu et al., 2009, Liu and Zhang, 2011). In addition, there have been numerous works on the relation between stock returns and profitability. Prominent examples include Ball (1978), Basu (1983), Zhang (2005), Fama and French (2006), and Novy-Marx (in press). These studies are also linked to the production-based approaches because profitability measures such as earning-to-price ratio, and return on equity can be interpreted as firm characteristics from the production side of economy.

Based on the empirical success of the production-based models, Chen et al. (2010, hereafter CNZ) propose a new three-factor model by summarizing these two strands of previous studies on the production-based approaches. The three factors are (1) market excess return (MKT), (2) investment factor (INV), the difference between the returns on low and high investment-to-asset portfolios, and (3) return-on-assets factor (ROA), the difference between the returns on high and low return-on-asset portfolios. The INV and ROA are production-based factors since they are motivated from production side of economy, while the MKT is from the consumption side of economy.

In the empirical asset-pricing literature, the CNZ model is very important with at least three reasons. First, the CNZ model explains many cross-sectional patterns of average stock returns that the famous Fama–French three-factor model fails to account for, including the momentum effect and the financial distress anomaly. Given the dominance of the Fama–French model in empirical studies, an appearance of a new model which is comparable to the Fama–French model draws much attention. Second, as an analogy to the Fama–French three-factor model, it is a factor pricing model which means that the proposed model is practical due to the availability of high-quality monthly returns data. In other words, the new model can be used for risk adjustment such as calculating costs of equity, and evaluating mutual fund performance. Finally, the CNZ model well summarizes previously suggested successful works on the production-based asset pricing approaches. Therefore, investigating the CNZ model is crucial given the importance of the production-based models as one promising area of research.

The development of a new asset pricing model always triggers further investigation of the proposed model. For example, there is still an ongoing debate surrounding the validity of the widely used Fama–French three-factor model.[2] Similarly, given the striking empirical performance of the alternative three-factor model, we believe that it is equally interesting to study whether the model indeed performs well.[3] In addition, our investigation has one big implication: although we investigate mainly the CNZ model, our work reviews the extensive literature on the production-based models since the factors in the CNZ model well summarizes previous studies in this line of approaches.

There are many empirical methodologies to test the performance of the proposed model. One concrete study is conducted by Ferson and Harvey (1999), who investigate the empirical performance of the Fama–French three-factor model. In this paper, we revisit Ferson and Harvey (1999)'s experiment with the production-based factors. One reason that we choose the Ferson and Harvey's approach is that CNZ (2010) advertise that their model is an alternative of the Fama–French model, and Ferson and Harvey (1999)'s work is one of the most elegant studies which carefully tests the performance of the Fama–French three-factor model. Therefore, the adoption of the Ferson and Harvey's approach fits into our purpose.

Moreover, the Ferson and Harvey's experiment has at least two advantages. First, it enables us to test whether the CNZ model is a good candidate for a conditional model.[4] Specifically, by adding the fitted conditional expected return (*fit*) predicted by common conditioning variables in the cross-sectional

[2] Barry et al. (2002) find that the value premium exists in 35 emerging markets. Using the data on North African countries, Hearn (2011) finds that while firm size is a priced factor in Morocco, the empirical results for other North African countries are mixed. Lischewski and Voronkova (2012) document that size and value factors are priced in Polish markets.

[3] For example, Walkshäusl and Lobe (in press) investigate the performance of the CNZ model using 40 non-US stock markets. They document that the CNZ model underperforms the Fama–French three-factor model.

[4] Recent papers in the literature propose empirical methodologies in evaluating conditional asset pricing models. For example, a recent paper by Nagel and Singleton (2011) suggests a methodology when the stochastic discount factor is a conditionally affine function of a set of priced factors. Ang and Kristensen (2012) develop a way to estimate time-varying alphas and betas using nonparametric techniques.