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Loss aversion, habit formation and the term structures of equity and interest rates

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ABSTRACT

I propose a consumption-based asset pricing model that jointly explains the high equity premium, the counter-cyclical behaviour of stock returns, the upward-sloping term structure of interest rates and the downward-sloping term structure of equity. The driving forces behind these results are loss aversion and time-varying habits. The high premium is the reward for holding assets that deliver low returns when consumption descends below habits. The term structure of interests rates is upward-sloping because long-term bonds are more sensitive to fluctuations of discount rates. The term structure of equity is downward-sloping because long-horizon equity gives higher chances to beat consumption habits than short-horizon equity.

1. Introduction

The empirical asset pricing literature has documented that the term structure of interest rates is upward-sloping. Recently, van Binsbergen et al. (2012) have noted that the term structure of equity is downward-sloping. Explaining the joint behaviour of the two term structures represents a challenge for general equilibrium asset pricing models. Indeed, as shown by Lettau and Wachter (2011), the key economic mechanism that generates the upward-sloping term structure of interest rates, namely the fact the investors require higher compensation for holding long-horizon assets, also tends to generate an upward sloping term structure of equity.[1] As a motivating example, consider the habit formation model of Campbell and Cochrane (1999). Buraschi and Jiltsov (2007) and Wachter (2006) show that habit formation explains the term structure of interest rates well. However, van Binsbergen et al. (2012) show that habit formation makes the term structure of equity upward-sloping.

In this paper, I propose a pure exchange economy that jointly explains the slope of the two term structures and generates realistic properties of stock returns. These findings are based on two main components. The first is habit formation in

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[1] The argument in Lettau and Wachter (2011) is more general than this: they study the cross-section of stock returns and build an equilibrium models that explains the returns of value and growth stocks. However the mechanism that generates the upward-sloping term structure of equity is the same as the one I describe here.

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consumption in the spirit of Campbell and Cochrane (1999). Habit persistence causes time variation in the aggregate risk aversion which, in turn, makes the price of risk counter-cyclical and helps explain the dynamics of stock returns. However, the habit formation literature is based on the assumption that consumption does not fall below habits (the so-called addictive property of habits) which is probably counter-factual, especially during economic downturns. The second component is thus a utility function that allows the optimal consumption to decrease below the reference level when economic conditions deteriorate. This result is achieved by assuming that agents are equipped with the gain-loss utility of Kahneman and Tversky (1979, 1991, 1992) and evaluate consumption relative to a time-varying reference level. Finally, there is a continuum of agents who differ in the reference level of consumption.

Habit formation has already proved successful in explaining the observed properties of the term structure of interest rates. Introducing loss aversion allows the term structures of equity and interest rates to be simultaneously explained. First, due to habit formation, bond prices are positively correlated with consumption in excess of habits, which implies an upward-sloping yield curve. Second, long-horizon assets have larger expected pay-offs than short-horizon assets and thus represent better investment opportunities against the risk that consumption falls below the reference level. As a result, loss averse agents are willing to pay more to hold long-horizon assets, generating the downward-sloping term structure of equity.

Recently, Hung and Wang (2010) have developed a representative agent model with loss aversion in consumption that explains the main quantitative properties of the term structure of interest rates. My work differs from theirs in two ways. First, I consider a heterogeneous economy, while Hung and Wang (2010) work in the representative agent framework. Second, in addition to the implications for the term structure of interest rates, I also analyse the implications of loss aversion for the term structure of equity.

Loss aversion also explains the equity premium and the excess volatility of stock returns. According to Yogo (2008), when agents care about fluctuations of consumption around a certain reference point, stocks are risky because they deliver low returns in recessions, when consumption approaches or falls below the reference level. Thus, the equity premium is the required compensation to hold assets that are positively correlated with consumption losses. The same result is obtained in my model. In addition, I extend the model of Yogo (2008) by introducing heterogeneity in the reference level of consumption. Investor heterogeneity generates cross-sectional implications for the consumption/wealth distribution that can be used to empirically evaluate the driving forces behind the fluctuations of asset prices.

This paper also offers a technical contribution. I show that with an s-shaped utility of consumption, the continuum of agents is essential for the existence of the equilibrium which is not obtained in a representative agent model or with a discrete number of agents. A similar result is provided by De Giorgi et al. (2010) who assume that agents have (cumulative) prospect theory preferences over final wealth and evaluate outcomes according to subjective decision weights rather than the true probabilities.

The rest of this paper is organized as follows. Section 2 introduces the model and the primitives of the economy. Section 3 characterizes the competitive equilibrium. Section 4 presents the results of the quantitative analysis, and Section 5 concludes. Technical details and proofs can be found in Appendix A.

2. The model

Consider an infinite-horizon, pure-exchange economy where a single consumption good serves as numeraire and investors trade continuously on a complete financial market to share risk. The uncertainty is represented by a filtered probability space $(\Omega, \mathcal{F}, (\mathcal{F}_t), \mathbb{P})$ on which I define a two-dimensional Brownian motion $B_t = [B_{1,t}, B_{2,t}]$ with instantaneous correlation $\langle dB_{1,t}, B_{2,t}\rangle = \rho_{1,2}\, dt$.

The economy features two non-standard elements. First, agents are equipped with the gain-loss utility of Kahneman and Tversky (1979, 1991, 1992). More precisely, agents (i) care about fluctuations of consumption around a time-varying reference level, which is interpreted as the standard of living, (ii) are more sensitive to losses than gains and (iii) are risk-seeking in the domain of losses. Second, the economy is populated with a continuum of investors who differ from each other with respect to their sensitivity to the standard of living.

Preferences: All agents in this economy maximize the expected utility of consumption

$$\mathbb{E}\left[\int_0^{+\infty} e^{-\rho t} U(c_t, Z_t, b)\, dt\right] \tag{1}$$

where

$$U(c_t, Z_t, b) = \begin{cases} -B\dfrac{(n(b)Z_t - c_t))^{1-\gamma}}{1-\gamma} & \text{if } c_t < n(b)Z_t, \\ \dfrac{(c_t - n(b)Z_t)^{1-\gamma}}{1-\gamma} & \text{if } c_t \geq n(b)Z_t, \end{cases} \tag{2}$$

$\gamma < 1$, c_t is the consumption rate at time t and Z_t is the standard of living. $n(b)$ is a density function that represents the agent-specific sensitivity to the standard of living. In addition, the optimal consumption cannot decrease below the agent-specific subsistence level $n(b)\underline{Z}_t \geq 0$, with $\underline{Z}_t < Z_t$. Formally, I impose $c_t \geq n(b)\underline{Z}_t \quad \forall t, b$.