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From boom 'til bust: How loss aversion affects asset prices ☆

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ABSTRACT

This article studies the impact of heterogeneous loss averse investors on asset prices. In very good states loss averse investors become gradually less risk averse as wealth rises above their reference point, pushing up equity prices. When wealth drops below the reference point the investors become risk seeking and demand for stocks increases drastically, eventually leading to a forced sell-off and stock market bust in bad states. Heterogeneity in reference points and initial wealth of the loss averse investors does not change the salient features of the equilibrium price process, such as a relatively high equity premium, high volatility and counter-cyclical changes in the equity premium.

1. Introduction

The aim of this paper is to analyze the impact of loss averse investors on asset prices in a continuous-time version of the Lucas (1978) pure-exchange economy with heterogeneous agents. We link the equilibrium outcomes to the optimal dynamic investment strategy of the investors, to understand how myopic loss averse agents influence stock prices and volatility. We first consider an economy populated by a group of regular risk averse agents and a group of myopic loss averse agents. Both groups of agents have a power utility function over intertemporal consumption. The first group of agents also evaluate their wealth at the end of the first evaluation period with a power utility function, measuring total expected utility from future consumption during their remaining lifetime. The myopic loss averse agents, on the other hand, evaluate changes in their wealth at the end of the evaluation period with the value function of prospect theory, while ignoring all events beyond that first period. For loss averse investors it matters a lot whether wealth is above or below the reference point. We therefore also study a second economy with heterogeneous loss averse agents that have different levels of initial wealth and reference points. We are particularly interested to see whether this type of heterogeneity smooths the demand for stocks, potentially reducing the equity premium and volatility compared to a representative agent economy with one loss averse agent.

This paper contributes to the growing literature on loss aversion and asset pricing, including amongst others Benartzi and Thaler (1995), Barberis et al. (2001), and McQueen and Vorkink (2004). Benartzi and Thaler (1995) introduce the concept of myopic loss aversion and argue that it can explain the equity premium puzzle. Barberis et al. (2001) fit the historical equity premium in an infinite-horizon consumption-based equilibrium model with one aggregate loss averse investor, while McQueen and Vorkink (2004) show that a similar model can replicate the asymmetric GARCH properties of monthly US stock market data. The basic features of our Lucas exchange economy are similar to Barberis et al. (2001), except that our setup has a finite horizon, which improves the tractability of the model. The setup allows us to analyze the impact of investor heterogeneity in an economy populated by loss averse agents with different levels of initial wealth and different reference points. In our opinion this type of investor heterogeneity is an important issue, as the investment strategy of loss averse agents changes drastically depending on the level of wealth relative to the reference point.

Other relevant related papers are Berkelaar et al. (2004) and Gomes (2005). Berkelaar et al. (2004) derive the optimal dynamic

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investment strategy of loss averse investors in a continuous-time complete market setting, providing the foundation for the equilibrium results in this paper. Gomes (2005) analyzes portfolio choice of loss averse investors in a discrete-time model with finite horizon and asset prices in a heterogeneous agent economy with both regular agents and loss averse agents. While Gomes (2005) focuses more on the implications for trading volume, in this paper we study asset prices and volatility, using an approach that gives more closed-form expressions, including results for economies with heterogeneous loss averse investors.

The outline of the paper is as follows. In Section 2 we introduce the continuous-time economy and we derive the main result, an expression for the equilibrium stock price in an economy with loss averse investors, both homogeneous and heterogeneous. In Section 3 we calibrate the model with US consumption data and present the main properties of the equilibrium stock price, the equity premium and volatility. We compare our results to the literature. Section 4 concludes the paper.

2. Asset prices in an economy with myopic loss averse agents

In this section we formulate the Lucas (1978) pure-exchange economy in a continuous-time framework, following Basak (1995). We consider an economy with a finite horizon $[0, T']$, where T' represents the lifetime of the agents in the economy. There is a single consumption good and other quantities, e.g. prices and dividends, are measured in units of this good. We assume that the agents trade one risk less bond and one risky stock continuously in a market without transaction costs. The bond is in zero net supply, while the stock is in constant net supply of 1 and pays out dividends at the rate $\delta(t)$, for $t \in [0, T']$. We assume that the dividend rate follows a Geometric Brownian motion:

$$d\delta(t) = \mu_\delta \delta(t)dt + \sigma_\delta \delta(t)dB(t), \tag{1}$$

with $\mu_\delta > 0$ and $\sigma_\delta > 0$ constants, and B a Brownian motion that models the uncertainty regarding future dividends in the economy.[1]

The equilibrium processes of the risk less money market account $S_0(t)$ and the stock price $S_1(t)$ are the following diffusions, as will be shown in Section 2.3:

$$dS_0(t) = r(t)S_0(t)dt, \tag{2}$$

$$dS_1(t) + \delta(t) = \mu(t)S_1(t)dt + \sigma(t)S_1(t)dB(t), \tag{3}$$

where the interest rate $r(t)$, the drift rate $\mu(t)$ and the volatility $\sigma(t)$ are adapted processes, possibly path-dependent.

As the market is complete, these asset price processes imply the existence of a unique state price density $\xi(t)$, also referred to as pricing kernel, given by

$$d\xi(t) = -r(t)\xi(t)dt - \kappa(t)\xi(t)dB(t), \quad \xi(0) = 1, \tag{4}$$

where $\kappa(t) = (\mu(t) - r(t))/\sigma(t)$ denotes the market price of risk.

2.1. Preferences, consumption and endowments

In the asset pricing literature the preferences of agents are often assumed to have the property of constant relative risk aversion (CRRA), which can be modeled with a power utility function:

$$U_{CRRA}(x) = \frac{1}{\gamma}x^\gamma, \quad \text{for } \gamma < 1; \; x > 0, \tag{5}$$

where x typically represents either consumption or wealth.

Over the past 30 years psychologists have reported evidence that people treat gains and losses differently, and in particular that losses loom larger than gains. Kahneman and Tversky (1979) presented a number of choice problems to students and university faculty and found serious violations of expected utility theory. The main conclusions from these experiments are that people care about changes in wealth rather than the absolute value of wealth. Moreover, people care about small risks and they are risk seeking in the domain of losses. These findings are formalized in prospect theory: economic agents maximize an S-shaped value function that is concave for gains, convex for losses and steeper for losses than for gains:

$$V_{LA}(x) = \begin{cases} -A(\theta - x)^{\gamma_L} & \text{for } x \leqslant \theta, \\ +B(x - \theta)^{\gamma_G} & \text{for } x > \theta, \end{cases} \tag{6}$$

with $A > B > 0$, $0 < \gamma_L \leqslant 1$ and $0 < \gamma_G \leqslant 1$. The parameter $\theta > 0$ is the investor's reference point distinguishing gains and losses. The reference point could represent the status quo of the investor (e.g. his current wealth) or an aspiration level. Fig. 1 shows the value function of prospect theory, using the parameter estimates of Tversky and Kahneman (1992), i.e. $\gamma_L = \gamma_G = 0.88$, $A = 2.25$ and $B = 1.0$.

Benartzi and Thaler (1995) argue that investors focus on a relatively short evaluation period while making investment decisions, e.g. 1 year, instead of rationally considering their lifetime financial planning problem. The explanation for this myopic behavior is that information about portfolio returns and financial markets tends to be based on a relatively short reporting period, e.g. yearly or quarterly, which biases the decision making process of investors toward a shorter planning horizon (framing). The combination of loss aversion and myopia is referred to as myopic loss aversion. Thaler et al. (1997) and Gneezy and Potters (1997) provide empirical support for myopic loss aversion in financial decision making.[2] To model myopic investor behavior we assume that the evaluation period of loss averse agents, denoted by T, is shorter than their lifetime T'. Even though the lifetime T' of a loss averse agent can be 60 years or more, we will assume that the evaluation period is limited to $T = 1$ year due to framing effects. Note that the myopic loss averse agents will continue to consume and to participate in the market after the first evaluation period, but they fail to take this into account properly while determining their investment strategy.

We assume that a proportion λ of the agents in the economy has CRRA preferences and that the remaining proportion $(1 - \lambda)$ is myopic and loss averse. Each CRRA agent is endowed at time zero with initial wealth $W_1(0)$, while each loss averse agent is endowed with $W_2(0)$. For both groups of agents we define a non-negative wealth process $W_i(t)$, a consumption process $c_i(t)$ and a process for the amount invested in stocks $\pi_i(t)$ for $i = 1, 2$.

The CRRA agents maximize expected utility $U_{CRRA}(c_1(t))$ from intertemporal consumption over their entire lifetime $[0, T']$ and do not evaluate intertemporal changes in wealth. It follows from the dynamic programming principle that the CRRA agents' optimal utility from consumption in the period $[T, T']$ can be summarized by a value function $H(W_1(T))$, depending on wealth $W_1(T)$ at time T. As shown by Merton (1969), the value function is a power utility function, i.e. $H(W_1(T)) = \rho_1 U_{CRRA}(W_1(T))$, where $\rho_1 > 0$ is a constant. Note that if r and κ are both constant, $\rho_1 = \left[\frac{1}{\eta}(e^{\eta(T'-T)} - 1)\right]^{1-\gamma}$, with $\eta = \frac{\gamma}{(1-\gamma)}r + 1/2\frac{\gamma}{(1-\gamma)^2}\kappa^2$.

The individual planning problem for each CRRA agent can now be formulated as follows:

[1] All stated processes are assumed to be well defined and satisfy the appropriate regularity conditions. For technical details the reader is referred to Karatzas and Shreve (1998).

[2] Although evidence for myopic decision making among individuals is widespread, recent work by Normandin and St-Amour (2008) suggests that aggregate US household portfolio allocations are non-myopic.