



Revisiting asset pricing under habit formation in an overlapping-generations economy

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ABSTRACT

By incorporating habit formation into an overlapping-generations economy, we show that the middle-aged consumers' savings decision has a substantial impact on the equity premium. The higher incentive for savings for the middle-aged, resulting from the habit formation preference, causes an even higher demand for bonds and a lower demand for equity, which eventually generates a lower risk-free rate and a higher required return for holding equity than does the framework of non-habit forming models. Calibration results verify that the habit formation setting, together with an OLG framework is capable of yielding lower bond returns and higher equity returns than the standard CRRA utility models, and the borrowing constraint imposed on the young-aged consumers amplifies the positive effect of habit formation on the equity premium. The findings imply that habit formation preferences within the overlapping-generations framework under the borrowing-constrained economy can provide a more improved explanation of the equity premium puzzle.

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1. Introduction

In their seminal work, Mehra and Prescott (1985) identify the phenomenon that the historical real returns of stock over government bonds are anomalously high. They show that the historical equity premium, which is defined as equity returns less government bond returns, exhibits an abnormally high level not only in the United States but also in many other industrialized countries, over long time periods.¹

Since the equity premium is supposed to reflect the relative risk of stocks compared to risk-free government bonds, the unexpectedly large percentage of the risk premium for equity implies an implausibly high level of risk aversion among consumers.² The

problem, known as the equity premium puzzle, is that the magnitude of the equity premium is too large to reflect a reasonable level of compensation justified under the standard neoclassical equilibrium asset pricing model.

Due to the importance of its economic implications, the equity premium puzzle has spawned extensive research efforts to resolve the puzzle in the macroeconomics and finance literature.³ In general, most of the papers explaining the puzzle take the approach of either finding factors requiring adjustment to the empirical side of the puzzle, or exploring alternative theoretical frameworks. The studies focusing on the empirical side of the puzzle include the question of sample time periods and mean reversion or aversion by Siegel (1992a,b).

On the other hand, the studies attempting to modify the theoretical features of the Mehra and Prescott (1985) model propose alternative assumptions about preference (Constantinides, 1990; Abel, 1990; Epstein and Zin, 1991; Meyer and Meyer, 2005; Giordani and Söderlind, 2006), disaster states and survivorship bias (Reitz, 1988; Brown et al., 1995; Barro, 2006), incomplete markets

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¹ They demonstrate that it is difficult to reconcile the empirical fact of a suspiciously high level of equity premium and the process of consumption growth with a reasonable assumption about the relative rate of risk aversion and the pure rate of time preference, in a conventional infinite-horizon model with an additively separable, constant relative rate of risk aversion (CRRA) utility function.

² By looking at the disparity from a different perspective, Weil (1989) raises an issue, known as the *risk-free rate puzzle*, on why bond returns are lower than equity returns. Ebrahim and Mathur (2001) suggest an equilibrium model reflecting investor heterogeneity, market segmentation and leverage to resolve the two puzzles.

³ The excessive magnitude of the equity premium has many important economic implications, such as those for resource allocation, social welfare, and economic policy, other than financial market implications. See Grant and Quiggin (2006) for more details.

(Constantinides and Duffie, 1996; Heaton and Lucas, 1996; Storesletten et al., 1999), and market imperfection (Bansal and Coleman, 1996; Alvarez and Jermann, 2000; Constantinides et al., 2002).

Also, more recent studies of the puzzle attempt to provide different rationales for explaining the equity premium, such as investor prospects (Benartzi and Thaler, 1995; Durand et al., 2004; Fielding and Stracca, 2007), macroeconomic influences (Campbell and Cochrane, 1999), and changes in tax rates (McGrattan and Prescott, 2001, 2005).⁴ Despite a great deal of literature suggesting a wide range of useful theoretical and empirical tools, the puzzle has not been completely resolved.

In this paper, we extend the framework of Constantinides et al. (2002). Incorporating habit formation into an overlapping-generations (hereafter OLG) economy with the borrowing constraint imposed on the young generation, we verify that there is a positive impact of habit formation on the savings levels of middle-aged consumers. The higher incentive for savings for the middle-aged, resulting from the habit formation preference, causes an even higher demand for bonds and a lower demand for equity, which eventually generates lower risk-free rates and higher required returns for holding equity than does the framework of non-habit forming models. Calibrating our model, we confirm that our model yields a lower risk-free rate and a higher equity return than do other general non-habit forming models. We thus argue that habit formation preferences within the overlapping-generations framework under the borrowing-constrained economy can provide a more improved explanation of the equity premium puzzle.

The rest of the paper is organized as follows: In Section 2, we discuss the related works on habit formation in the equity premium puzzle. In Section 3, we derive the optimum savings of the habit-forming middle-aged consumers under a borrowing-constrained economy, and confirm a positive effect of the habit formation preference on the middle-aged consumers' savings. In Section 4, we discuss the calibration of our model and its results. Section 5 concludes the paper.

2. Related works

Habit formation has been widely used in recent studies of financial economics as an important assumption in explaining the dynamic equilibrium path of consumption. For example, Constantinides (1990) and Abel (1990) show that habit-forming consumption, with its flexibility in modeling risk aversion and consumption paths, can partially resolve the equity premium puzzle posed by Mehra and Prescott (1985).⁵ This finding has indeed motivated a line of habit formation approaches in dynamic modeling of optimal consumption, savings and portfolio decisions (Sundaresan, 1989; Jermann, 1998; Campbell and Cochrane, 1999; Lettau and Uhlig, 2000; Guvenen, 2009).⁶

On the other hand, Constantinides et al. (2002) (hereafter CDM) propose an overlapping-generations (hereafter OLG) model that

explicitly captures the saving and dissaving behavior of consumers subject to a borrowing constraint. CDM show that with a simple time separable utility function and a borrowing constraint, consumers in a three-period overlapping-generations economy have an incentive to hold a diversified portfolio for different stages, over their life cycle. That is, a borrowing constraint prevents the young-aged generation from holding equity, and that equity prices are assumed to be exclusively determined by the middle-aged consumers. Knowing that their future retirement income is either zero or deterministic, and that their future consumption is highly correlated with equity income, the middle-aged consumers will save more by holding more bonds and less equity. Therefore, the middle-aged consumers' savings decision has a dominant impact on the level of the equity and the bond return.

In this paper, we extend CDM's work by incorporating habit formation into the OLG economy, such that the habit-forming consumers' optimal savings decision is derived from an overlapping-generations framework. Under the habit formation utility and the OLG economy, the impact of the middle-aged consumers' savings decision on the demand for equity and bonds is affected not only by the presence of a borrowing constraint, but also by the habit formation process. A habit-forming middle-aged consumer will have a much higher incentive to smooth consumption over time, and he/she will have a lower incentive to bear risk in order to guarantee a stable consumption for the next period, by demanding more bonds and less equity than a non-habit-forming consumer. Thus, the habit formation utility causes an even higher demand for bonds (yielding a lower risk-free rate) and a lower demand for equity (yielding a higher required return for holding equity), and thereby yielding a higher equity premium, than does a non-habit formation utility such as the CRRA utility suggested by CDM (2002). Also, we show that the effect of habit formation on the demand for equity and bonds is more profound under the borrowing-constrained economy than under the borrowing-unconstrained economy. In sum, the combination of the habit formation utility, and an OLG economy with a borrowing constraint, yields better results which can be used in explaining the equity premium.

3. Habit formation and optimum savings under borrowing constraint

In this section, we present a habit formation exchange economy in the OLG framework and derive the optimum savings of the middle-aged generation with the borrowing constraint imposed on the young generation. Under the borrowing-unconstrained economy, the young will borrow to purchase equity, thereby raising bond returns. The increase in bond returns induces the middle-aged investors to shift their portfolio holdings from equity to bonds, thereby reducing equity return. The increase in the demand for equity by the young will be outweighed by the decrease in equity demand by the middle-aged, such that the net effect is an increase in equity returns. The increase in equity returns and the increase in bond returns together shrink the equity premium. Under a borrowing-constrained economy, however, the young are prevented from borrowing for equity investments, so that both the equity and bond returns are exclusively determined by the habit-forming middle-aged investors. Due to the inability of the young to hold equity, resulting from the borrowing constraint together with high fluctuations in equity income, the demand for equity is reduced, and consequently, the net demand for bonds by middle-aged consumers is raised. Thus, the middle-aged consumers' savings decision has a substantial impact on the high equity premium (i.e., a high risk premium and a lower risk-free rate) under the borrowing-constrained economy.

⁴ McGrattan and Prescott (2001) suggest that the changes in tax rates can explain the equity premium puzzle. They show that the large reduction in individual income tax rates and the increased income from tax shelter opportunities have led to a dramatic increase in equity prices between income in 1960 and 2000. In turn, these increased equity prices generate much higher *ex post* returns on equity than on debt, such that they argue that at least for the post-WWII period, the equity premium is not puzzling.

⁵ See Cochrane and Hansen (1992) and Kocherlakota (1996) for surveys on the equity premium puzzle.

⁶ Guvenen (2009) proposes an asset pricing model focusing on the limited stock market participation and heterogeneity in the elasticity of intertemporal substitution in consumption. His model is partially successful in calibrating major features of asset pricing such as high equity premiums, smooth interest rates, procyclical stock prices, and countercyclical variations in the equity premium.

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