Journal of Economic Dynamics & Control 69 (2016) 152–178

Contents lists available at ScienceDirect

Journal of Economic Dynamics & Control

journal homepage: www.elsevier.com/locate/jedc

Asset prices with non-permanent shocks to consumption

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A R T I C L E I N F O

Article history:
Received 19 January 2015
Received in revised form
19 April 2016
Accepted 13 May 2016
Available online 25 May 2016

JEL classification:
G11
G12

Keywords:
Asset prices
Equity premium
Unit root
Non-permanent shocks

A B S T R A C T

Most standard asset-pricing models assume that all shocks to consumption are permanent. We relax this assumption and allow also for non-permanent shocks. In our specification, the long-run mean of consumption growth is constant; consumption levels are subject to short-run deviations from their long-run trend. The implications of our model are dramatically different from those obtained in the prior literature. A canonical and parsimonious asset pricing model with CRRA preferences and non-permanent shocks can reproduce the equity premium, high return volatility and return predictability with a coefficient of relative risk aversion below ten. This finding suggests that non-permanent shocks can play an important role in explaining asset pricing puzzles.

1. Introduction

It is a well-understood fact in the asset-pricing literature that if shocks to consumption are permanent—so consumption is a random walk—then the behavior of U.S. stock prices are difficult to reconcile with a parsimonious model of agents with constant relative risk aversion (CRRA). Expected returns are too high, stock prices are too volatile, and future returns are too predictable to be generated by such a model given the low volatility of consumption growth in the data. Thus, the general thrust of asset-pricing models has been towards more complex elements such as models with external habit or long-run risk, or towards disaster risk; see, among other papers, Campbell and Cochrane (1999), Wachter (2006), and Santos and Veronesi (2010); Bansal and Yaron (2004), Hansen et al. (2008), and Bansal and Shaliastovich (2013); Barro (2006), Rodriguez (2006), and Nakamura et al. (2013).

But what if there are non-permanent shocks to consumption, shocks whose impact diminishes over time? Then, as we show in this paper, the aforementioned conclusions neatly reverse themselves. Even for moderate levels of risk aversion in a canonical and parsimonious model, stock prices are volatile, expected returns are high, and future stock returns are partially predictable.

The question of whether or not shocks to the economy are permanent has led to a long and controversial discussion. Different studies (Nelson and Plosser, 1982; DeJong et al., 1992) have come down on both sides of the issue. Distinguishing between permanent and temporary-yet-persistent consumption shocks is very difficult given the data we have. Fortunately, our results are not driven by the *absence* of a permanent shock, but by the *presence* of non-permanent shocks. A model with a mixture of permanent and non-permanent shocks exhibits similar behavior to one with non-permanent shocks alone.

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http://dx.doi.org/10.1016/j.jedc.2016.05.010
0165-1889/

We amass several pieces of evidence towards the importance of non-permanent shocks for asset pricing. We consider a representative-agent model with CRRA utility, with a single process for aggregate consumption. We use a general specification for aggregate consumption that experiences both permanent and non-permanent shocks. One special case of this model – with temporary shocks that only last for one period – permits an exact analytical solution. We exploit this case to show how including a non-permanent shock can produce both a high equity premium and volatile returns with moderate levels of risk aversion.

We then calibrate a parsimonious model with a single shock to U.S. consumption and return data. The shock is persistent, but not permanent. This makes the model trend-stationary—that is, in the absence of additional shocks the economy returns to a constant long-run growth trend. We choose three different empirical targets for our calibration exercise. In our base case, we use consumption data from 1889 to the present. Explaining the equity premium in post-war data is particularly challenging, so we also consider post-war data as a second target. Finally, an emerging literature (Savov, 2011; Da and Yun, 2011; Qiao, 2013) argues that mismeasurement in consumption has led to an artificially smooth consumption series, so we consider Savov's proxy consumption series as a third empirical target. In all three cases, we are able to produce a high equity premium and volatile returns with much lower levels of risk aversion than would be required if the shock were permanent. The post-war NIPA consumption data does indeed require a somewhat higher level of risk aversion than the long sample, but the long sample and Savov's proxy consumption series lead to very similar results. We also show that adding an additional permanent shock in these calibrations does not materially change the results. This is consistent with our analytical results in that it is the presence of a non-permanent shock that drives the asset pricing results, and not the absence of a permanent shock.

Models with non-permanent consumption shocks are also able to generate many other time-series properties of asset prices with low levels of risk aversion. For example, in such a model most variation in the price-dividend ratio is driven by changes in expected returns rather than changes in expected dividends, consistent with Campbell and Shiller (1988a). Non-permanent shocks are also sufficient to generate return predictability and meet the Hansen–Jagannathan bounds.

Several authors have previously considered the asset pricing implications of trend-stationary consumption. Tallarini (2000) considers mean reversion in consumption for Epstein–Zin utility with the special case where the intertemporal elasticity of consumption (IES) is one, where the model is exactly solvable. That paper finds that for high levels of risk aversion mean reversion in consumption actually lowers the equity premium. DeJong and Ripoll (2007) estimate a model with trend-stationary dividends and consumption, but use a log–linear approximation that leads to a much smaller estimate of the equity premium. Rodriguez (2006) finds that trend-stationary consumption helps explain the volatilities of returns, but needs large possible permanent shocks (disaster states) to match the empirical equity premium. In particular in his calibrated model the probability of a drop in consumption of more than 25% exceeds 17% and the possibility of rare but large shocks to consumption explains a large fraction of the equity premium. Nakamura et al. (2013) incorporate large permanent and non-permanent rare disasters to consumption. When they occur, the non-permanent disasters cause an average drop of 11% in consumption per year and occur for six subsequent years (that is, an 11% drop each year, not a 11% drop over 6 years). The standard deviation of the disaster shocks is also quite large, which generates the risk of even larger losses in consumption. Our model contains no disaster shocks; instead the permanent and non-permanent shocks are calibrated to match the U.S. experience. Bansal et al. (2010) also find a large equity premium, but in a model that contains both short-term and long-term risks, as well as stochastic volatility. Alvarez and Jermann (2005) find, in interesting contrast to the equity market, that long-term bonds data suggests that shocks to consumption are permanent.

The remainder of this paper is organized as follows. In Section 2 we present the basic model and provide analytical solutions for the special case of one-period temporary shocks. Section 3 provides a description of the data sets and the consumption specifications for the baseline version of the model. In Section 4 we report results on the asset-pricing implications of the model and demonstrate their robustness. Finally, Section 5 concludes. In the Appendix, we derive the analytical results, describe the numerical solution method, and report additional results.

2. A consumption-based asset-pricing model

We briefly describe the particular version of the standard Lucas (1978) asset-pricing model that we employ in this paper with both permanent and non-permanent shocks. We then consider a special case that permits closed-form solutions for asset prices. We use this case to illustrate the impact of non-permanent shocks on asset prices.

2.1. Consumption and asset prices

We consider a standard Lucas (1978) infinite-horizon representative-agent asset-pricing model in discrete time, $t = 0, 1, \ldots$. There is a single perishable consumption good in each period. The agent's consumption in period t is denoted by C_t. The agent has expected utility

$$E_0\left[\sum_{t=0}^{\infty} \beta^t u(C_t)\right],$$