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The permanent income hypothesis, transitional dynamics, and excess sensitivity of consumption☆

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ABSTRACT

This paper studies the transitional dynamics of the linear-quadratic consumption model and reexamines existing analyses of the permanent income hypothesis (PIH). The model accounts for the life-cycle consumption behavior, with the short-run and long-run consumption functions. We show that the random walk model of consumption violates the relevant stability condition and delivers predictions that are inconsistent with the PIH. We find that while excess sensitivity may be due to liquidity constraints, it can also arise in accordance with the PIH in perfect capital markets – contrary to the prevailing view. Simulation experiments prove useful to explain the observed consumption behavior.

1. Introduction

The permanent income hypothesis (PIH) reformulated by Hall (1978) posits that consumption follows a martingale or random walk. This implies that anticipated changes in consumption are unrelated to anticipated or predictable changes in income and other variables that are in the consumer's information set. Many empirical studies, however, have found that consumption growth rates are robustly related to anticipated changes in income (see Jappelli and Pistaferri, 2010, for a survey of evidence). This phenomenon, referred to as excess sensitivity of consumption, is viewed as providing strong evidence against the PIH (Hall, 1978; Flavin, 1981). Capital market imperfections or liquidity constraints are usually believed to be the source of excess sensitivity (see Hall, 1978; Jappelli and Pagano, 1989), but other explanations such as precautionary saving, nonseparabilities between consumption and leisure, habit persistence, durability of goods, household production, aggregation bias, and demographics have also been suggested in past studies (Jappelli and Pistaferri, 2010; Ni and Seol, 2014).[1] Yet, excess sensitivity remains an unsettled issue of great concern in the analysis of consumption and saving.

This study investigates the transitional dynamics of the linear-quadratic consumption model and reexamines existing analyses of the PIH, with a new explanation for the observed excess sensitivity of consumption that is compatible with the PIH in perfect capital markets. The linear-quadratic consumption model has the convenient certainty-equivalence property, which allows us to analyze consumer behavior as if there were no uncertainty.[2] When the interest rate is equal to the rate of time preference, it gives rise to the celebrated random walk model of consumption (Hall, 1978), which is postulated to characterize the PIH describing a *proportional* relation between consumption and lifetime wealth or permanent income (Deaton, 1992; Obstfeld and Rogoff, Chapter 2, 1997; Ljungqvist and Sargent, Chapters 1 and 2, 2012). Hall's

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[1] There are alternative explanations for excess sensitivity of consumption based on hypotheses that depart from the consumer's complete optimization behavior (see Romer, 2006, pp. 378–379, for some references).

[2] Hansen and Sargent (2004) provide a good discussion of many uses of the certainty equivalence principle in dynamic analysis including linear-quadratic consumption model.

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analysis and numerous subsequent studies on the PIH (see, e.g., Flavin, 1981, 1993; Campbell, 1987; Deaton, 1992) take the random walk model as a valid proposition and examine the testable implications of the PIH. Undoubtedly, these studies have greatly enhanced our understanding of consumption behavior. However, the random walk model, by its nature, fails to take into account the steady state (long-run dynamics) and transitional paths of consumption and wealth (short-run dynamics) that are essential in dynamic analysis of consumption. In fact, these dynamic properties are not well understood in the literature on consumption and saving (see Deaton, 1992; and Attanasio and Weber, 2010, for a survey of the literature),[3] but are vital to account for the life-cycle behavior of consumption and wealth accumulation. And they are of crucial importance to derive short-run and long-run implications of the PIH, which allow us reexamine the validity of the random walk model to characterize the PIH, with an altogether different interpretation for the excess sensitivity puzzle.

The key mechanism that drives transitional dynamics – the process of evolution toward a steady state – in consumption is the wealth accumulation process which, in effect, governs the intertemporal or life-cycle behavior of consumption. A salient feature of the model is the existence of a *bliss* steady state, a situation where the consumer plans to reach, at around the retirement age, with a stationary bliss level of consumption – a level of consumption that he has achieved and endeavors to maintain after retirement. There is a bliss or target level of wealth that supports this stationary bliss consumption level at a given interest rate. The dynamic behavior of wealth and consumption is captured by the long-run and short-run consumption functions. The long-run consumption function depicts a steady state relationship between consumption and wealth. The short-run consumption function describes the joint behavior of wealth and consumption during a transition to the bliss state. While consumption varies directly with wealth in the short run, there is a *proportional* relation between them in *the long run*. In the steady state or long run, consumption is identically equal to permanent income, which is the annuity value of wealth.

We show that the PIH derives much of its predictions from the underlying dynamic properties of the linear-quadratic consumption model rather than from the random walk model of consumption. The random walk model of consumption violates the stability condition implied by the intertemporal consumption problem for a growing economy, contradicting the pattern observed for most developing and developed countries with growing consumption and wealth over time. Moreover, a *stable* proportional relation between consumption and wealth or permanent income prescribed by the PIH holds in *the long run*. The random walk model, however, generates a proportional relation between consumption and wealth that holds *contemporaneously*. These results indicate that the random walk model of consumption yields predictions that are strongly at odds with the PIH and cannot adequately account for the consumer's consumption behavior.

Previous studies on excess sensitivity of consumption are, for the most part, based on the random walk model (see Hall, 1978; Flavin, 1981; Jappelli and Pagano, 1989) and fail to allow for the dynamic adjustment path of consumption and wealth. From the consumer's dynamic adjustment behavior, we find that anticipated changes in income may or may not bring about anticipated changes in consumption in perfect capital markets. While excess sensitivity of consumption may stem from the presence of liquidity constraints, it can also be induced by the consumer's optimal adjustment to anticipated changes in income with the ability to borrow in perfect capital markets. Thus excess sensitivity can arise in perfect accordance with the prediction of the PIH without liquidity constraints, which is in direct conflict with the prevailing view. This suggests that excess sensitivity does not tell us conclusively about the presence of liquidity constraints in consumption and hence does not provide sufficient evidence against the PIH – contrary to the accepted view.

Since Hall's (1978) seminal work, the Euler equation, which generates the random walk model of consumption with quadratic utility, has been a principal tool in modern analysis of consumption and saving."(add highlighted in red, change the highlighted red). The use of the Euler equation allows us to estimate preference parameters and test the empirical relevance of a model without explicitly solving the dynamic optimization problem, which is often not feasible. The Euler equation, however, does not deliver a consumption function. Without a consumption function, it is difficult to analyze the effects of policy changes on consumption and saving. With the linear-quadratic model, we are able to derive the short-run and long-run consumption functions relating consumption to wealth. These consumption functions are designed to capture the life-cycle behavior of consumption and wealth accumulation and should provide useful information in many analyses. To illustrate the model, we undertake a quantitative investigation of its transitional dynamics with dynamic simulations, which proves to be useful to explain the observed consumption behavior.

2. The intertemporal consumption problem

We consider a representative consumer with lifetime utility U of the well-defined form:

$$U = \sum_{t=s}^{\infty} (1+\rho)^{-(t-s)} u(c_t), \tag{1}$$

where c_t is real consumption at period t ($t = s, s+1, \ldots, s+\infty$) and ρ is the constant rate of time preference with $0 < \rho < 1$. The within-period or instantaneous utility function $u(c_t)(t = s, s+1, \ldots, s+\infty)$ is twice continuously differentiable, strictly increasing, and strictly concave in consumption. We take labor supply or leisure as fixed and treat labor income as exogenous to the consumer. There are perfect capital markets so that the consumer can freely borrow and lend against future earnings at a given interest rate to finance consumption or accumulate assets. The consumer's net assets evolve over time according to

$$a_{t+1} = (1+r)a_t + y_t - c_t, \forall t \geq s, \tag{2}$$

where a_t is the value of net real assets at the beginning of period t with a given initial asset level a_s^0,y_t is real labor income at period t, and r is the real interest rate assumed to be constant over time.

With the transversality condition imposed[4]:

$$\lim_{T\to\infty} (1+r)^{-T} a_{s+T+1} = 0, \tag{3}$$

Eq. (2) can be expressed in the present value form as

$$\sum_{t=s}^{\infty} (1+r)^{-(t-s)} c_t \leq \omega_s \equiv (1+r)a_s + \sum_{t=s}^{\infty} (1+r)^{-(t-s)} y_t, \tag{4}$$

where ω_s is total lifetime net worth or wealth at period s, defined as the sum of the initial asset value with interest income (financial or nonhuman wealth) and the present value of current and future labor income (human wealth). Given this definition, the evolution of wealth over time is governed by

$$\omega_{t+1} = (1+r)(\omega_t - c_t), \forall t \geq s, \tag{5}$$

[3] This is in stark contrast to the literature on economic growth where transitional dynamics is the main focus of analysis (see Barro and Sala-i-Martin, 2004; see King and Rebelo, 1993, for an empirical analysis).

[4] This implies that Ponzi game outcomes in which the stock of debt grows faster than the rate of the interest rate never occur.