Review of Economic Dynamics 18 (2015) 484–504

Contents lists available at ScienceDirect

Review of Economic Dynamics

www.elsevier.com/locate/red

Innovation, product cycle, and asset prices

Ryo Jinnai [1]

Texas A&M University, 4228 TAMU, College Station, TX 77843, USA

ARTICLE INFO

Article history:
Received 25 June 2013
Received in revised form 25 September 2014
Available online 18 October 2014

JEL classification:
E30
G12
O30
O41

Keywords:
Innovation
Research and development
Product cycle
Imitation
Recursive preference
Long-run risk

ABSTRACT

This paper constructs a simple endogenous growth model featuring the product cycle, i.e., the transition from monopoly to perfect competition, and studies its implications for both asset market and business cycle statistics. I find that the product cycle is a powerful amplification mechanism; the model incorporating the product cycle is able to generate nearly twice as large an equity premium as the model without the product cycle and, as a result, matches the equity premium data. The current paper thereby contributes to advancing a promising theory on the economic sources of long-run risks, postulating that innovation and R&D cause long-run uncertainties in economic growth.

1. Introduction

The literature studying the link between asset market statistics and business cycle variables in versions of the canonical real business cycle models, exemplified by Boldrin et al. (2001), Jermann (1998), and Tallarini (2000), has experienced significant development in recent years. A line of research that has shown great promise incorporates disaster risk (Barro, 2006; Gabaix, 2012; Rietz, 1998) into the production economy (Gourio, 2012). Another research front of interest incorporates long-run risk (Bansal and Yaron, 2004) into the production economy. Prominent examples along this line of research include Kaltenbrunner and Lochstoer (2010), who study the long-run consumption risk arising from the household's intertemporal resource allocation, and Ai et al. (2013), Croce (2014), Favilukis and Lin (unpublished results), and Rudebusch and Swanson (2012), who study the implications of long-run productivity risk. An even more ambitious study is Kung and Schmid (in press), who link the long-run productivity risk to innovations and thereby identify (instead of assuming) economic sources of long-run risks in the data. They make a significant contribution toward solving the equity premium puzzle (Mehra and Prescott, 1985) by showing that approximately half of the actual size of the equity premium is justified by a highly stylized endogenous growth model augmented with a recursive utility (Epstein and Zin, 1989).[2] This result is remarkable, but the

E-mail address: rjinnai@econmail.tamu.edu.
[1] Fax: +1 979 847 8757.

[2] Aghion and Howitt (1997), Grossman and Helpman (1991), and Romer (1990) are prominent contributions to the founding of endogenous growth theory. See Acemoglu (2008) for a review of the literature.

http://dx.doi.org/10.1016/j.red.2014.10.002
1094-2025/

remaining unexplained half of the equity premium suggests that further elaboration on the basic endogenous growth model might provide a better understanding of the interesting links between asset market statistics and innovative activities.

This paper proposes such an elaboration, motivated by a simple observation: patents offer only partial protection to inventors and discoverers. Anecdotal evidence supporting this view is abundant (see Boldrin and Levine, 2008, 2013; Moser, 2013), but a story documented in the graduate-level industrial organization textbook written by Scherer and Ross (1990) is highly compelling: DuPont, for example, took out hundreds of patents on variants of its nylon synthetic fiber technology. However, even in the directly applicable polyamide molecule family, it left a gap into which Germany's IG Farben moved with Perlon L, and other companies invented competitive fibers using polyester and polyolefin molecules. This historical account is powerful testimony to the fact that the protection provided by the patent system is often weak because there can be many viable solutions to a technical problem. A survey encompassing 650 executives (Levin et al., 1987) confirms this view; among eight reasons why the effectiveness of patents was limited, they reported that the ability of competitors to legally invent around patented inventions was by far the greatest factor. Informal protections that do not rely on patents are also imperfect, and, in fact, the aforementioned survey suggests that imitating an unpatented product is less costly than imitating a patented one.[3] In sum, imitative research is pervasive. The logical consequence is heterogeneity in the degree of competition among local markets, which is the feature the current paper adds to the canonical endogenous growth model to investigate its implications.

I formalize this idea in a highly stylized way so that the deviation from Kung and Schmid (in press) is minimal. Specifically, I adopt the simple product cycle of Futagami and Iwaisako (2007). These authors assume that a product is initially monopolistically produced and later competitively produced. I assume the same market structure in the current manuscript. Futagami and Iwaisako also assume that the transition from monopoly to perfect competition is time-dependent, with the presumption that the duration of monopoly is the same as the duration of a patent.[4] I do not follow them in this regard because I believe that protection from imitation is far from perfect regardless of the method that inventors and discoverers rely on. Instead, I assume that the transition is stochastic. The stochastic transition is both arguably realistic and, with the additional assumption that it is i.i.d. among products and across time, convenient in terms of the analysis in that it reduces the number of state variables.

I show that the product cycle is a powerful amplification mechanism having great potential for improving the model's ability to match asset market statistics. Specifically, I show that with this mechanism, an otherwise standard endogenous growth model generates nearly twice as large an equity premium as the canonical endogenous growth model without the product cycle. In other words, given that Kung and Schmid (in press) demonstrate that the canonical model is able to justify approximately half of the actual size of the equity premium, augmenting the product cycle allows the model to nearly perfectly match the equity premium.

Two factors are important for this result. The first is the effect of the product cycle on economic fluctuations. Specifically, because product entries are not constant across time and imitation is a slow process, the ratio of monopolistic products to competitive products is endogenous. In particular, it is procyclical at high frequencies because innovative activities are procyclical and new products are more likely to be monopolistically produced. In contrast, the ratio of monopolistic products to competitive products is counter-cyclical at medium frequencies because productivity gains from competition become a more prominent mechanism for a longer time span. Both of these effects raise the equity premium, as the former makes the profit share procyclical and the equity more risky and the latter increases the persistence of economic fluctuations.

The second factor that contributes to a high equity premium in the model incorporating the product cycle is its effect on the steady-state asset sizes. Specifically, the size of intangible capital is smaller in the model with the product cycle than in the model without the product cycle due to the shorter duration of the monopoly. Because the aggregate stock market return is a value-weighted return of tangible and intangible capital, this change in weight makes the tangible capital return the more important determinant of equity premium, and because tangible capital return is higher than intangible capital return in the simulation, it contributes to a high equity premium.

A number of recent papers examine the link between technological progress and asset prices. Prominent examples are Garleanu et al. (unpublished results) and Garleanu et al. (2012), and Pastor and Veronesi (2009). These papers introduce differences in the relative importance of intermediate goods in final goods production, among the productivities of investment options, and in productivities between new and old technologies respectively. The current paper, in contrast, does not introduce any built-in cross-sectional heterogeneity in the physical attributes of products, instead introducing heterogeneity in the modes of competition in the local markets. Iraola and Santos (unpublished results) and Comin et al. (unpublished results) study the effects of technical advancements on asset markets. They introduce a slow adoption process after invention, which strongly amplifies the stock market volatility, but do not consider the imitation of adopted products. They focus on medium-term business cycles, the measurement of aggregate productivity, and the timings of responses of macroeconomic variables but put less emphasis on long-run risks.

The remainder of this paper is organized as follows. Section 2 presents the model economy. Except for the possibility that monopolists may lose market exclusivities, it is identical to the Kung and Schmid model. Section 3 inspects the product cycle in a controlled environment. Specifically, I compare the two models, with and without the product cycle, keeping the

[3] A consistent result is found in Mansfield et al. (1981).

[4] With this assumption, the authors analyze the welfare-maximizing patent policy in an endogenous growth model.