Human capital risk in life-cycle economies

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A R T I C L E   I N F O

A B S T R A C T

The aggregate effects of market incompleteness are studied in a model where agents face idiosyncratic, uninsurable human capital investment risk. Using a life-cycle model with a version of a Ben-Porath (1967) human capital accumulation technology, stationary equilibria of calibrated cases are analyzed in which risk arises from specialization risk and career risk. With career risk only, stationary equilibria resemble those studied by Aiyagari (1994), and the impact of uninsurable idiosyncratic risk is relatively small. With a significant amount of specialization risk, however, stationary equilibria are severely distorted, with human capital about 57 percent as large as its complete markets counterpart.

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1. Introduction

Dispersion of labor earnings increases over the life-cycle, a well documented feature of the U.S. data. According to Deaton and Paxson (1994), within-cohort labor income inequality increases with age. In related work, Huggett et al. (2009) investigate the reasons behind this rise in earnings dispersion and find that about one-third of the variation in lifetime earnings is due to idiosyncratic human capital shocks. Other cross sectional studies also indicate that agents face a great deal of uncertainty when making their schooling decisions.[1] Taken together, it appears that investment in human capital is risky and part of the labor income uncertainty that agents face over their life-cycle is a manifestation of this idiosyncratic human capital risk. In addition, it is widely understood that human capital investment is uninsurable. One main consequence of this type of labor income uncertainty is that it could deter investment in human capital. If a mechanism like this is at work in actual economies, the impact of market incompleteness on the aggregate economy could be large,[2] possibly calling for policy intervention to mitigate the effect of this risk on household decisions to invest in training.

This paper studies the macroeconomic implications of labor income uncertainty arising from the risky nature of human capital investment. It uses a specification that allows a direct analysis of the impact of risk on the accumulation of human capital, helps isolate and quantify the effect of risk on individual decisions, and allows commentary on the divergent views in the literature on the role of market incompleteness in the aggregate economy.

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[1] Carneiro et al. (2003) find that the substantial heterogeneity in the returns to schooling is unpredictable at the time when schooling decisions are made. In related work, Cunha et al. (2005) conclude that 40 percent of the variability in the returns to schooling is unforecastable at the time students decide to go to college.

[2] Even more so if one takes the view that human capital is an engine of growth. With the exception of few, Eaton and Rosen (1980), Krebs (2003), Benabou (2002), for example, this strand of the literature typically abstracts from the risky nature of human capital investment.

1.1. Main ideas and findings

A version of a Ben-Porath (1967) production function for human capital that allows for risky human capital is used here to understand how uninsurable risk impacts an individual's decision to train in a general equilibrium life-cycle model. Two types of uninsurable idiosyncratic risks, namely, specialization risk and career risk are considered in this paper. The specialization risk is such that the endogenous decision to train increases both the expected returns from training and its variance, while in the case of career risk the training decision only affects the mean return from training. The career risk is additive in the human capital accumulation technology and is the most common formulation in the literature which studies the impact of uninsurable idiosyncratic risk on the aggregate economy. Risks that look like the multiplicative specialization risk of this paper were first studied by Angeletos and Calvet (2006), but not in a human capital setting.

Following Calvet (2001) and Angeletos and Calvet (2006), constant absolute risk aversion (CARA) utility function and normally distributed shocks is used in this paper. In addition, an individual's risk-taking decision is independent of wealth. These features ensure that the endogenous decisions have closed form solutions and are independent of wealth.

In this paper, calibrated versions of the model are studied to clearly assess how each of these risks, the specialization and the career risk, influence the aggregate economy by altering individual decisions. Stationary equilibrium with only career risk has properties similar to Aiyagari (1994). In particular, the precautionary savings induced by this risk has only a small quantitative impact on the macroeconomy.[3] In the baseline calibration where both shocks play a role, the effects of the specialization risk dominate and there is a very large impact on macroeconomic variables in the stationary equilibrium. In particular, there is a 43 percent underaccumulation of human capital relative to the complete markets case. Accordingly, since labor quality is dramatically lower, output, physical capital, consumption and other variables are also drastically impacted. This suggests that specialization risk has a large impact on macroeconomic equilibrium, but that career risk does not.

1.2. Recent related literature

Using an incomplete markets framework and abstracting from aggregate uncertainty, several papers since Bewley (1977) have investigated the core implications of uninsurable idiosyncratic labor income risk on the aggregate economy. While Aiyagari (1994) finds that the quantitative implications of the labor income risk are not significant, a relatively recent view associated with Angeletos and Calvet (2006), Pijoan-Mas (2006) and Marcet et al. (2007), suggests that these effects could be large.[4]

A related paper, Krebs (2003), studies the impact of labor income risk in a model with risky human capital, but where the risky human capital is also the engine of growth. He finds that risk lowers investment in human capital which in turn lowers growth and welfare. Based on Krebs (2003) it is not clear whether the quantitatively significant macroeconomic implications of risky human capital are due to market incompleteness or because human capital is the engine of growth. To isolate the role of uninsurable risky human capital, this paper abstracts from growth in the stationary equilibrium. Even though this paper asks a question similar to Krebs (2003), the framework used here is quite different and is more consistent with the traditional analyses of human capital investment.

A feature of this paper is that it can also produce some of the life-cycle features seen in the data in a general equilibrium framework. There is growing empirical-theoretic, primarily partial equilibrium literature studying the life-cycle features in the data. Deaton and Paxson (1994) and Huggett et al. (2009) among others study these issues.

The paper is organized as follows. Section 2 introduces the model and Section 3 presents the quantitative results. The final section concludes.

2. Model

The economy has an infinite sequence of overlapping generations of agents who live for T periods. Time is discrete and is indexed by $t = 0,1,2,\dots$. In each period, a continuum of *ex ante* identical young agents with unit mass is born. Each agent is endowed with two units of time in each period until they retire. There is no population growth, physical capital is risk-free and there are no credit market imperfections.[5,6] In terms of notation, subscripts indicate when the agent is born and the

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[3] This is despite the fact that unlike Aiyagari (1994), the present model with human capital accumulation has no borrowing constraints or wealth effects. Aiyagari (1994) studied the macroeconomic impact of uninsurable idiosyncratic labor income risk arising due to shocks to labor endowments in a model where households live forever and where there is no human capital.

[4] None of these authors explicitly discussed human capital. Aiyagari (1994), Pijoan-Mas (2006), and Marcet et al. (2007) studied labor income risk whereas Angeletos and Calvet (2006) analyzed capital income risk. This paper is closer to Aiyagari (1994) and Marcet et al. (2007) but provides a different mechanism to explain variability in labor income. It also nests both the views in the literature and argues that the nature of risk, specialization versus career risk, determines which view prevails in the quantitative analysis.

[5] Underlying the assumption that physical capital is risk-free is the notion that for an individual human capital investment is more risky than investment in physical capital. Typically investment in human capital cannot be easily diversified or directly traded in the market since it is non-separable from the owner.

[6] Other papers on incomplete markets, for example Krebs (2003) and Angeletos and Calvet (2006) also assume that credit markets are perfect.