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The business cycle human capital accumulation nexus and its effect on hours worked volatility ☆

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ABSTRACT

This paper studies hours worked volatility and the cyclicality of human capital investments by embedding a Ben-Porath life-cycle model of human capital accumulation into an RBC setting. Agents differ across two dimensions: age and productivity in learning. Our results show that individuals invest more in human capital during economic downturns. However, human capital accumulation is more counter-cyclical for young and low-productivity individuals because they face a lower opportunity cost of education and a higher marginal product of human capital. These results are confirmed empirically using US data from the Current Population Survey and the American Time Use Survey. In addition, the paper contributes to the RBC literature by showing that the model's business cycle properties, in particular hours worked volatility, are sensitive to assumptions of heterogeneity. Introducing heterogeneity in productivity increases the volatility of aggregate hours worked and changes the life-cycle profile for hours volatility to better match the data.

1. Introduction

Among US high-school students age 16–24 who graduated in 2009, 70.1% enrolled in college in October 2009. This is the historical high for college enrollment rate since 1959. At the same time, the unemployment rate reached a level of 10% in October 2009 which is also the maximum level for unemployment in the recent financial crisis.[1] This fact seems to be consistent with several studies in the literature regarding the cyclicality of post-secondary education (PSE). On one hand, during a recession high unemployment decreases the opportunity cost of education and people substitute work with schooling (Heylen and Pozzi, 2007). On the other hand, family income is lower and students may not be able to afford the cost of education (Christian, 2007). If liquidity constraints are not too tight, economic theory suggests that PSE enrollment should be counter-cyclical.

Canton (2002) confirmed that uncertainty leads agents to accumulate more human capital to compensate for future income losses. DeJong and Ingram (2001) showed that, in the presence of a positive TFP shock, human capital is more

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[1] Source: US Bureau of Labor Statistics.

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expensive than physical capital. Thus agents decrease study hours and accumulate less human capital. Empirically, the results are more controversial. Mattila (1982), Polzin (1984), Kane (1994) and Edwards (1976) found no impact of business cycles on college enrollment in US. Instead, more recent papers (Betts and McFarland, 1995; Dellas and Sakellaris, 2003; Dellas and Koubi, 2003; Méndez and Sepúlveda, 2012) found evidence in favor of counter-cyclicality.

The cyclicality of schooling decisions has received particular attention in the literature because of its interesting implications. Economic downturns are bad for the economy. However, if enrollment rates are counter-cyclical, then economic crises are also the most efficient time to accumulate human capital and produce more skilled workers. This paper further investigates the topic both theoretically and empirically by focusing on heterogeneity among agents. The main result is that business cycles impact different types of agents in different ways. Young and low-productivity individuals are more likely to enroll in PSE during an economic downturn because they face a lower opportunity cost of education. In contrast, high-productivity agents and older people with work experience earn higher wages and are less likely to leave the labor market. As a result, their labor supply is less volatile compared to the rest of the population. This fact is consistent with US data and our model is able to replicate this empirical regularity for the first time.

To the best of our knowledge, this is the first theoretical and empirical study that analyzes the heterogeneous impact of business cycles on schooling decisions. In the existing literature, the only paper that looked at heterogeneity among agents in this context is Christian (2007), who distinguished between low and high income individuals. Using data from the October Supplement of the Current Population Survey (CPS), he found that enrollment decisions are more pro-cyclical for low income individuals compared to high income individuals.

The current paper also contributes to the RBC literature by studying the impact of heterogeneity and the cyclicality of education on the volatility puzzle. One of the main shortcomings of RBC models is their inability to correctly predict hours worked volatility. Specifically, these models predict a volatility that is lower compared to empirical estimates. Several solutions have been proposed in the literature, including the introduction of indivisible labor (Hansen, 1985) or alternatives to market production (e.g. home production and education (See Benhabib et al., 1991; Perli, 1998; DeJong and Ingram, 2001; Einarsson and Marquis, 1998.). These solutions assume that the RBC model systematically underestimates the volatility by excluding important factors that influence labor supply. However, the model may underestimate the volatility only for certain groups of individuals. In the data, labor supply is more volatile for young compared to middle-age individuals. This fact cannot be captured within a representative-agent framework. Therefore, introducing heterogeneity in the model may help to explain the volatility puzzle. Recent papers (e.g. Hansen, 2009; Gomme et al., 2004; Maliar and Maliar, 2001) have looked at the volatility puzzle from this perspective.

We further investigate the topic by looking at human capital accumulation and heterogeneity among agents. With respect to the existing literature we consider a new type of heterogeneity. Specifically, we embed a Ben-Porath (1967) model of human capital accumulation into a life-cycle RBC setting. Our analysis most closely resembles the work of Hansen (2009), but we build on their work by incorporating an additional type of heterogeneity. While they consider heterogeneity across ages only, we model heterogeneity in productivity both within and between ages. Moreover, in contrast to their paper, our focus is on formal education rather than learning-by-doing or on-the-job training. Our results show that introducing heterogeneity within ages increases the volatility of aggregate hours worked and changes the profile for hours volatility to better match the data. The presence of low-productivity agents is particularly important to improve the model's predictions with respect to hours worked volatility.

The rest of the paper is organized as follows. The model is presented in Section 2. The theoretical results and the implications about hours worked volatility are presented in Section 3. Section 4 discusses various sensitivity analyses. The model's predictions regarding the cyclicality of human capital investments are tested empirically using US data in Section 5. Finally, Section 6 concludes by summarizing the main results.

2. The model

Every year a new generation of equal size is born. Agents face an uncertain life span and may live for a maximum of S_{max} periods. In each period, they are endowed with one unit of time they can allocate among leisure, work and education. Individuals can work and study at the same time during their working life. Conditional on survival, they must retire at age S_r. During retirement, labor supply and education are absent and the time endowment is completely allocated to leisure. In any period, there are two types of capital: physical and human capital. Physical capital is accumulated during life through investment, while the human capital stock increases by allocating time to education. Agents start their life with no physical capital and leave no bequests at the end of their life. Instead, the initial human capital stock is positive. This is due to the fact that period 1 in the model represents the 18-year-old cohort in the data. Since our focus is on post-secondary education, a birth age of 18 seems the appropriate choice. Therefore, the positive initial human capital stock captures the amount of human capital accumulated during mandatory education.

At the beginning of their life, agents maximize their expected discounted lifetime utility:

$$E_t \sum_{s=1}^{S_{max}} \left(\prod_{j=0}^{s-1} \varphi_j \right) \beta^{s-1} \left[\frac{\left(c_{t+s-1,s} m_{t+s-1,s}^{\gamma} \right)^{1-\eta}}{1-\eta} \right], \tag{1}$$