論文の内容の要旨

論文題目　Three Essays in Financial Economics

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Human Capital as Age-Dependent Asset Mix and Optimal Life-Cycle Portfolio Policy

The largest component of household wealth consists of nontraded human capital. For a nation as a whole, returns to human capital (i.e., labor's share) are about 60% in national income. Although this is only a rough benchmark of the share of human capital in total wealth, labor income should play a central role in structuring household financial decisions. Human capital should be viewed as the core wealth, and households' financial wealth should be structured as a supplementary portfolio to make up the most desirable form of the total wealth portfolio. Investments in financial assets should act as a powerful tool for hedging the risk associated with nontraded human capital.

A key in understanding life-cycle pattern of household finance is the age-dependence of human capital. Although this observation is not new, past researches in this area paid relatively small attention on the risk characteristics of human capital.

Economic inquiries into agents' consumption and portfolio decisions originate in Samuelson (1969) and Merton (1969). Based on three basic assumptions, Samuelson and Merton showed that optimal portfolio weights are constant over the life cycle; in other words, optimal portfolio weights are neutral to investment time horizon.

Including labor income in the portfolio choice problem, several authors have shown that the Samuelson-Merton neutrality theorem is converted to a prediction that the share of bonds tend to rise with age up until retirement. Merton (1971) was the first in this line of argument. He showed that the optimal portfolio rule is still a constant-mix of the overall wealth if lifetime flow of labor income is capitalized at the risk-free rate and added to the financial wealth. Since the human capital thus defined is risk-free and very large for young workers, they tend to have less bonds and more stocks in their financial wealth. While the goal of this activity is to ensure that the share of risky assets in the overall portfolio remains constant, the share of stocks in the portfolio of financial assets tend to decline toward retirement.

This view has laid a theoretical foundation for the typical financial advice that as workers age their portfolio's allocation should shift from primarily stocks, to a balanced portfolio, and then to a primarily bond portfolio. The fast grown financial product of the mutual fund industry, life cycle funds (also called target date funds), is based on this exact premise. Indeed, one often-quoted strategy suggested by financial advisors is that investors should place (100 - age)% of their wealth in a well-diversified equity portfolio.

Cointegration "school" offers a different perspective. They propose a model in which labor income and stock market returns are cointegrated. For young workers cointegration has numerous opportunities to act over business cycles until retirement, and so young worker's human capital effectively becomes stock-like. In contrast, for older workers with shorter times to retirement, cointegration does not have sufficient time to act, and thus their human capital becomes more bond-like. Two conclusions follow from this observation. First, it supports the empirical finding that the growth rates of labor income and stock returns are very highly correlated over longer horizons, even though their correlation is low in short horizon. Since human capital is the capitalization of future income streams, this is almost equivalent to saying that the correlation of stock returns and the returns to human capital can be high even if it is low in a short horizon. Second, cointegration brings strong implications to agent's portfolio behavior.

We question whether the human capital is bond-like and therefore a proper account of human capital calls for more investment in stocks. We propose an alternative model of stochastic labor income with the following basic insight. Unlike liquid asset prices, movements of labor income are sluggish and are more or less foreseeable in the short run. Large uncertainty of a worker's labor income in a longer horizon is a result of accumulation of short-run fluctuations of economic conditions. A young worker has many years to go and his future labor income picks up the impacts of temporal economic

shocks and accumulates them over a long horizon. Then, the fluctuations of labor income over a horizon is very similar to the fluctuations of balance of a money market account over time, except that the temporal fluctuations of labor income are driven by equity-related shocks while the temporal fluctuations of money market balance are driven by shocks in short-term interest rate.

Majority of authors analyze the problem of optimal life-cycle portfolio decisions in discrete-time models and rely on numerical optimization algorithms to obtain qualitative predictions and conclusions. Such an approach restricts the depth of understanding the nature of the optimal decisions as well as insights into results of comparative analysis. We attempt to offer the simplest model which permits analytical tractability and yet maintains the key economic ingredients. We use the martingale method developed by Karatzas et al. (1987) and Cox and Huang (1989) to represent the optimality condition. We then derive a closed-form formula for the optimal consumption and portfolio policy with the help of Malliavin calculus following a procedure developed by Ocone and Karatzas (1991) and Detemple et al. (2003, 2005). The Malliavin derivative is particularly useful to analyze the exposure of human capital to various risk factors and to investigate how the exposure changes over the life cycle. The age-dependence of the risk exposure combined with the age profile of the magnitude of the value of human capital generates the optimal life-cycle portfolio policy.

Our main focus is to investigate the factors which determine portfolio rules over the life cycle, whether the optimal stock holdings should decline as workers age as more traditional models predict, or they exhibit hump-shaped life-cycle stock holdings as the cointegration literature predict. We assume a constant investment opportunity set in the sense that stock prices evolve according to geometric Brownian motions. We also assume that the short-term rate of interest is constant. Another key assumption is that households have time-additive constant relative risk aversion (CRRA) utility functions. We will see that the CRRA assumption generates the simple but perspicacious property that the optimal portfolio policy is to maintain constant portfolio weights on risky and riskless asset on overall wealth which includes human capital, and that this property does not depend on the market completeness. We will carry out the investigation both in complete and incomplete market settings.

We find that both of the two regimes, the declining stock holdings and the hump-shaped stock holdings, can emerge when labor income risk has a component which cannot be hedged by any set of stock portfolios. When the unhedgeable component is a relatively small fraction of the overall labor income risk, the optimal fraction of stock holdings depicts a hump shape over the life cycle. In contrast, when the

unhedgeable component dominates the overall labor income risk, the optimal fraction of stock holdings becomes a decreasing function of age. Our finding suggests that which life-cycle portfolio policy contributes to the maximum household welfare rests on the extent of market completeness, or the breadth of opportunities that the financial market offers to hedge the labor income risk.

Investment Frictions versus Financing Frictions

Frictions are the primary theme of the theory of the firm and corporate finance. In the past four decades, there has been a flood of theoretical as well as empirical studies on how investment frictions influence the dynamics of corporate investments. In contrast, how financing frictions influence corporate dynamics is a recent topic of research and has been studied mostly via numerical approach which provides realistic but intractable analysis.

Jorgenson's formulation of a dynamic investment problem (Jorgenson (1963)) is where our construction starts. In his classical model the firm can adjust her capital stock without any frictions, and this absence of frictions makes firm's optimal investment policy to be a purely static one in which the marginal product of capital equals the user cost of capital.

The firm's decision becomes a truly dynamic problem, in which anticipations about the future economic environment affect current decisions when frictions prevent instantaneous and costless adjustment of the capital stock. Bertola and Caballero (1994) introduced "irreversibility" of investment in the sense that the firm cannot sell its capital stock. This is equivalent to assuming that the selling price of capital is zero. Abel and Eberly (1996) generalized this model to the case of "costly reversibility"; namely the firm can sell its capital stock but at a price less than the purchase price. They were successful in showing that frictions are the source of nonlinear and intermittent investment dynamics

In this paper, we pursue the other direction of introducing financing frictions to Jorgenson's model. "Irreversibility" in our model means that the firm may return cash to stockholders by paying dividends or buying back shares but cannot obtain additional cash from stockholders by issuing new shares. "Costly reversibility" means that the firm can finance externally but at some cost. Readers will see that our development goes very much in parallel with the irreversible investment literature. Yet, by introducing financial frictions our formulation naturally includes financing decisions as well as investment decisions, which is in contrast to the optimal investment literature. In this

regard, the benchmark Jorgenson's model may as well be called the Modigliani-Miller model in our context.

We construct a model of an equity-only firm who must pay a linear financing cost for issuing new shares. We show that the firm's optimal investment-financing is a two-trigger policy in which the firm finances its investment by issuing new shares (supplementing internal funds) when the shadow price of capital hits the upper trigger value. When the shadow price hits the lower trigger value, she sells a portion of her capital stock and buys back shares (or pays dividends). Values of the shadow price of capital between the two trigger values define a range of "inaction", in which the firm does neither issue nor buy back shares and invests all of her internal funds for expansion. Analytically we work on the Hamilton-Jacobi-Bellman equation to characterize the optimal investment and financing policy. We will show that financial frictions force the shadow price of capital to satisfy a second-order ordinary linear differential equation, which is dual to the one generated by investment frictions.

A Dynamic Theory of Pecking Order Financing

Intertemporal considerations have important consequences in studying the connection between corporate finance and investment. In this paper, we extend the dynamic model of "Investment Frictions versus Financing Frictions" to include transactions with banks so that funds for investment can be taken from (i) internally generated cash flows, (ii) newly borrowing from banks or (iii) raising additional equity. We assume that the firm may incur a linear financing cost whenever she finances by issuing new shares. Our model also gives the firm a choice of how much to pay out versus how much to retain. Thus the firm can choose reserving any residual cash flow in her bank account or paying out it as dividends to the equityholders.

By solving the optimization problem, we obtain three main findings. First, the firm's optimal financing forms dynamic "pecking-order": the firm pays to finance as possible through internal funds and then to finance the excess of investment over internal funds with debt. Equity financing takes place only at the upper trigger, as part of appropriation of net income. And thus, contrary to the target adjustment school, the optimal leverage is path dependent. We show that the business condition relative to the current size of the firm will help to pin down the firm's optimal leverage. Second, there is another strict ordering in regard to the firm's residual cash flow: the firm prefers to preserve it in her bank account, and distribution

occurs only at the lower trigger. Third, we find that when firms can have transactions with banks they have more chance to realize the Jorgenson's optimal level of capital.