Portfolio Choice in the Presence of Personal Illiquid Projects

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Abstract

Personal projects, such as a private business or the purchase of a home, influence portfolio choice in two ways. First, financial assets can be used to provide diversification against bad outcomes of personal projects. Second, financial assets can be used to provide liquidity to personal projects when these projects are illiquid and individuals have a limited debt capacity. The latter interaction is the focus of our paper. Due to this liquidity consideration, individuals are more risk averse if there is a large penalty for discontinuing or under-investing in the final stages of a project. A large penalty arises when there is strong complementarity between investments at different stages, or in projects that require lumpy investments. We provide a theoretical analysis and an empirical investigation of these effects. Using data from the 1995 Survey of Consumer Finances, we show that, consistent with our hypotheses, households which are saving to invest in their own businesses or in their own homes have significantly safer financial portfolios. The impact of the first category is particularly strong. Our findings also help explain why households, in particular younger ones, have larger than expected holdings of safe financial assets.

A large portion of private assets are invested in personal illiquid projects. These are projects that must be partly self-financed and are costly to sell. According to the 1995 Survey of Consumer Finances (SCF),[1] residential housing and capital invested in unincorporated businesses account for 41.2% and 19.1%, respectively, of household wealth.[2] In this paper, we study the impact of these personal illiquid projects on individuals' portfolios of financial assets. Personal projects influence portfolio choice in two ways. First, financial assets can be used to provide diversification against bad outcomes of personal projects. This interaction is well-recognized in the literature as it emanates from standard portfolio theory. Second, financial assets can be used to provide liquidity to personal projects when the timing of investment in these projects is important. This latter interaction is the focus of our paper. We show that it helps explain why individuals, particularly young investors and entrepreneurs, have larger than expected holdings of safe financial assets.

In the financial planning literature, young investors are advised to hold a larger share of risky assets in their financial portfolios in order to capture the superior expected return of these assets. As investors grow older, they are advised to gradually reduce their holdings of risky assets. Jagannathan and Kocherlakota (1996) show that this advice is economically sound as long as the investor's human wealth is relatively uncorrelated with stock returns. The reason is wealth diversification: as investors age, their human wealth declines, and so they become more exposed to the risk of their financial portfolios.[3] The resulted higher correlation between consumption and financial wealth makes investors behave in a more risk averse fashion.[4] Hence, according to this argument, we expect to see the share of safe assets in financial portfolios increase with age. However, in reality, we observe that young individuals have a larger share of safe assets than individuals close to retirement.

In Table 1, we show the mean percentage of cash in financial portfolios across age.[5] The data we employ are from the 1995 SCF. The term "cash" refers to relatively safe and liquid assets. They include checking and savings accounts, call accounts at brokerages, and money market accounts either in deposits or in mutual funds. The financial portfolio includes, in addition to cash (as defined above), stock and bond mutual funds, stocks and bonds directly held, IRAs and thrift-type accounts, cash value of whole life insurance, other managed assets (trusts, annuities and managed investment accounts) and other financial assets (loan, future proceeds, royalties, futures, non-public stock- deferred compensation, money-in-hand).

[Table 1]

[1]A description of the SCF can be found in Section III.A.

[2]In addition, there is human capital, which is not explicitly measured in the SCF. Kendrick (1976) estimates that human capital is roughly as large as non-human wealth.

[3]Constantinides, Donaldson, and Mehra (1998) use this wealth diversification argument together with borrowing constraints of young investors to explain the equity premium puzzle. The problem with their explanation, which we attempt to address in this paper, is that young investors actually have safer portfolios than individuals close to retirement.

[4]Bodie, Merton and Samuelson (1992) make a similar point, arguing that since young investors have greater labour supply flexibility, they can tolerate more risk in their financial portfolios.

[5]Age refers to the age of the head of household in the Survey of Consumer Finances.

Two observations are apparent from Table 1. First, cash constitutes a large percentage of the financial portfolio. Second, young individuals have more conservative portfolios than middle-aged individuals. This pattern is robust even after controlling for wealth and income (we show this in Section III.B). To help explain these observations, we introduce a model in which the presence of multi-period personal illiquid projects, such as a private business and the purchase of a home, leads to larger holdings of cash in financial portfolios. As younger households are more likely to invest in this type of projects (we give evidence to this effect in Section III.B), our model helps to explain not only why the demand for cash is so large despite the much higher expected return of stocks, but also why younger households have larger cash holdings than middle-aged households.

In a recent paper, Heaton and Lucas (1999) show that entrepreneurs have significantly safer portfolios of financial assets than other investors with similar age and wealth. As argued by these authors, entrepreneurs hold a safe portfolio of financial assets to diversify the risk of their businesses. However, this is not the only possible reason. We argue in this paper that entrepreneurs may choose a safe financial portfolio to ensure a smooth continuation of their business projects.

Individuals are more risk averse in their portfolio choice when financial assets are used to fund projects in which there is a substantial penalty for discontinuing or under-investing in their final stages. These penalties may be the result of strong complementarity between investments at different stages of the project, or the lumpiness of the investment process. Once an individual has committed an initial investment in a project, she faces a penalty if the project is discontinued, or continued on an inappropriate scale, due to the lack of liquidity.

Consider an entrepreneur who has invested heavily in renovating the first floor of a building to open a restaurant. This entrepreneur would probably be unwise to put in stocks all the funds she has for buying food and for paying employees in the first few weeks of business. A downturn in the stock market would compromise not only the funds invested in stocks, but also - if she has exhausted her debt capacity - the continuation of her business. Furthermore, due to transaction costs, the entrepreneur would lose some of the capital already invested in the renovations, or at least the return on this capital for the period it takes to sell the business. Hence, the illiquidity of the business project makes advisable a relatively safe financial portfolio.

Another example is the purchase of a home, which can be viewed as part of a wider project of settling in a particular area. An individual who has committed to a job in an area and plans to remain there faces a minimum investment (i.e., the down payment) for the purchase of a home. Once the individual is close to achieving this minimum and is looking for a suitable residence, again, she would probably be unwise to put in stocks all of her funds. A downturn in the stock market may delay or frustrate a good purchasing opportunity. In this case, the initial investment in the project may be relatively small. However, the lumpiness induced by the minimum investment makes advisable a relatively safe portfolio, with two caveats. First, if housing prices in a particular area are correlated with the stock market, buying stocks may actually be the safer alternative. On average, though, the correlation between housing prices and the stock market is low[6]. Second, if the chances of accumulating the minimum investment with a safe portfolio are not good, the individual may find it optimal to bet her future in the stock market, or in a casino. Once the

[6] Using monthly returns, the contemporaneous correlation between real stock returns and the rate of change in real housing prices is 0.11 from 1968(2) to 1994(8). When real stock returns are lagged one month, the cross-correlation increases to 0.17, but remains fairly low. These correlations were calculated using the following series from Citibase: HEMP (Median Sales Price of Existing Single-Family Homes), FSPCOM (S&P Common Stock Price Index), FSDXP (S&P Common Stock Dividend Yield), and PZUNEW (Consumer Price Index).

individual owns the house, expenses such as mortgage payments, property taxes and maintenance are complementary to the initial investment in the house. Hence, the individual may again be unwise to put at risk financial assets that are planned for these expenses.

Although we do not formally test the theoretical model for lack of appropriate data, we look at the 1995 SCF for supporting evidence. We find that even after controlling for all of the variables typically used in econometric studies of portfolio composition (age, wealth, income ...etc.), households who are saving either to purchase their own homes or to invest in their own businesses, have significantly safer portfolios. In contrast, households who are saving for retirement have significantly riskier portfolios.

Our modelling of the interaction between liquidity and portfolio choice relates to the analysis of optimal hedging by corporations in Froot, Scharfstein, and Stein (1993), and the liquidity-based asset pricing model in Holmström and Tirole (1998). As in these papers, liquidity is required for investment purposes, and risk aversion emanates from the desire to meet physical investment needs. The main difference in our paper is that we analyze multi-period projects with complementarities between investments made at different stages of the project, or with lumpy investments that are required to continue the project. This focus allows us to find numerical examples with a strong interaction between the portfolio choice of financial assets and physical investments in a personal project. Also, we analyze the model from the point of view of a consumer-entrepreneur, and we can compare some of the model's implications using data from the SCF.

A much larger literature, which is too broad to survey here, has studied the effect of labor income risk and borrowing constraints on portfolio composition. (See, for example, Heaton and Lucas (1997), Cocco, Gomes, and Maenhout (1998), and Koo (1998)). In this literature, it is assumed that in the event of a temporary rise in spending needs or a temporary drop in labor income, investors may face liquidity constraints. Thus, when these episodes occur, investors are more vulnerable to the risk of their financial portfolios. As a result, they should avoid risky assets.[7] Despite the intuitive appeal of this argument, its effects are only economically significant for poor investors who collectively hold a small portion of a country's wealth. In contrast, the liquidity constraints that we study in this paper are relevant even for well-off entrepreneurs who are probably more important when it comes to the allocation of a country's wealth.

Our model is also related to asset pricing models with a mixture of liquid and illiquid assets. Aiyagari and Gertler (1991) and Heaton and Lucas (1996) assume non-trivial transaction costs for capital and for a subset of financial assets. Cocco (1999) studies a model with owner-occupied housing and a set of liquid financial assets in a life-cycle context. Grossman and Laroque (1990) examine a model with an illiquid consumer durable good and a set of liquid financial assets. Our model differs from these papers in many respects. Again, the most important difference is the multi-period structure of the personal projects in our model, in which illiquid physical assets are invested.

Our main findings can be summarized as follows. An important determinant of risk tolerance in portfolio choice is the possibility that the portfolio may be used to finance personal illiquid projects. If this is the case, the more productive the personal projects and the larger the penalties for

[7]Similar effects can be generated with idiosyncratic shocks to labour income, without the assumption of liquidity constraints (see Weil 1992). What is important for risk aversion is that the consumption policy function is steeply increasing with liquid funds to induce a strong negative correlation between the marginal utility of consumption and the return to the portfolio of liquid assets.

discontinuing or under-investing in the final stages of these projects, the more risk averse investors will be in their financial portfolio choice. Using data from the 1995 SCF, we find that households which are saving to invest in their own homes or in their own businesses have significantly safer portfolios. The data also suggest that it is the younger households that tend to invest in these personal projects. Hence, our result helps explain why young investors and entrepreneurs have larger than expected holdings of safe financial assets.

The rest of the paper is organized as follows. In Section I, we present a simple version of the model and analyze its implications qualitatively. In Section II, we generalize the model and evaluate the results numerically. In Section III, we analyze the 1995 SCF for empirical evidence supporting the conclusions of the model. A summary in Section IV concludes the paper.

I. The Theoretical Model

In our model, there are two types of financial assets: stocks which are risky and have a high expected return, and cash which is safe and have a low return. Both assets are traded in frictionless capital markets. In addition, individuals can invest in highly productive personal projects which are costly to sell before completion. For simplicity, we assume that the personal technology is non-transferable. Due to a combination of legal constraints and informational problems, projects using the personal technology cannot be financed by equity and have limited access to borrowing. Hence, these projects must be partly self-financed. Further, individuals can engage in at most one personal project at a time. Each project takes time to mature, so in some periods, it may yield no output. During these periods, the owner has to rely on her holdings of financial assets and limited access to credit for consumption and investment. Hence, financial assets provide a liquidity service to individuals engaged in these personal illiquid projects.

In this section, we analyze a simple version of the model with three periods and linear utility. In the next section, we generalize the model to an infinite horizon and concave utility. In both cases, we distinguish between convex investment and lumpy investment.

A. Convex Investment

An individual lives for three periods, and is endowed with an initial amount of liquid wealth, a_1, and the ownership of a personal project which is non-transferable. The personal project requires complementary investments, k_1 and k_2, in the first two periods and yields an output, y_3, in the third period:

$$y_3 = F(k_1, k_2), \tag{1}$$

where F is the gross production function describing the personal technology. For ease of notation, F includes any undepreciated capital. The function F is assumed to be continuous, positive, weakly increasing in both arguments, concave, and homogeneous of degree one.

In each of the first two periods, $t = 1, 2$, liquid wealth is allocated to consumption, c_t, capital for the personal project, k_t, stocks, s_t, and cash, b_t. The flow of funds constraint is:

$$a_t = c_t + k_t + s_t + b_t. \tag{2}$$

In the third period, all liquid wealth is consumed.

Consumption, capital, and stocks in each period must be nonnegative. The lower bound on cash is (minus) the debt capacity of the individual, d. The gross rate of return on stocks, R_t^s, is an i.i.d. positive stochastic variable. The gross rate of return on cash, R^b, is a constant positive real number. We assume that $ER^s > R^b$, where E is the expectation operator.

The initial liquid wealth, $a_{1,}$ is given. Liquid wealth in period 2, a_2, is equal to the sum of the gross returns to the financial assets purchased in period 1:

$$a_2 = s_1 R_1^s + b_1 R^b \tag{3}$$

where R_1^s is the realized return on stocks at the end of period 1. Liquid wealth in period 3 is equal to the sum of the gross returns to the financial securities purchased in period 2, and the output of the personal project. Since the entire liquid wealth is consumed in period 3 (the last period), we have:

$$c_3 = y_3 + s_2 R_2^s + b_2 R^b. \tag{4}$$

The utility function of the individual is:

$$U = c_1 + \beta c_2 + \beta^2 c_3. \tag{5}$$

where β is the discount factor.

For the analysis to be interesting, we assume that personal projects are sufficiently productive to entice their owners to save and to invest in them. The following assumption - though stronger than necessary - will suffice for this purpose.

Assumption 1: There is a real number, θ, in the interval [0,1] such that:

$$F[\theta, (1-\theta)R^b] > (ER^s)^2 > \beta^{-2}. \tag{6}$$

The first inequality assumes that there is at least one investment strategy for which the return on the personal project exceeds the expected return on stocks. This inequality ensures that if the individual saves, she would invest in the personal project. The second inequality assumes that the expected rate of return on stocks exceeds the subjective discount rate, so that liquid wealth is saved and accumulated until period 3. With risk neutrality, as in this section, adding a stochastic term to F to capture the riskiness of the personal project would make no difference. With risk aversion, this stochastic term would induce a diversification motive for holding financial assets. Methodologically, our assumption that personal projects are risk-free ensures that the interaction between the personal project and the financial portfolio is purely driven by liquidity considerations.

The optimal investment plan for the individual can be solved recursively. In period 2, the individual minimizes the holdings of cash because there are no further liquidity needs and stocks yield a higher expected return. Hence, $b_2 = -d$. The available funds, $a_2 + d$, are allocated entirely to capital, k_2, as long as the marginal product of k_2 exceeds the expected return on stocks. Once the marginal product of k_2 equals the expected return on stocks, any extra funds are invested in stocks, s_2. Hence, the optimal plan is:

$$k_2(k_1, a_2 + d) = \min(k_2^*, a_2 + d), \text{ where } k_2^* \text{ is defined by } \partial_2 F(k_1, k_2^*) = ER^s, \text{ and} \tag{7}$$

$$s_2(k_1, a_2 + d) = a_2 + d - k_2(k_1, a_2 + d). \tag{8}$$

The interesting portfolio choice occurs in period 1. Due to the second inequality in Assumption 1, k_1, s_1 and b_1 are chosen to maximize the expected consumption in period 3. This consumption, c_3, is a function of k_1 and $a_2 + d$:[8]

$$c_3 = v(k_1, a_2 + d) \equiv F[k_1, k_2(k_1, a_2 + d)] - dR^b + s_2(k_1, a_2 + d)ER^s. \tag{9}$$

where dR^b represents the interest on debt.

The function, v, is concave because the opportunity set of the individual's problem is convex and the objective is linear. For a given k_1, $v(k_1, \cdot)$ has two regions: one that is strictly concave corresponding to $a_2 + d$ small, and one that is linear corresponding to $a_2 + d$ large. This indirect utility function is illustrated in Figure 1.

[8] Recall from equation (3) that a_2 is a function of s_1 and b_1.

[Figure 1]

For $a_2 + d$ small, all of the available funds are invested in k_2. Hence,

$$v(k_1, a_2 + d) \equiv F(k_1, a_2 + d) - dR^b, \qquad \text{for } a_2 + d < k_2^*. \tag{10}$$

Since $a_2 + d < k_2^*$, the individual is liquidity constrained. In this case, she underinvests in the personal project.

For $a_2 + d$ large, the investment in k_2 is not liquidity constrained. Hence, $k_2 = k_2^*$ and the rest of the liquid funds are invested in stocks:

$$v(k_1, a_2 + d) \equiv F(k_1, k_2^*) - dR^b + (a_2 + d - k_2^*)ER^s, \qquad \text{for } a_2 + d \geq k_2^*. \tag{11}$$

For a given k_1, the individual solves a standard portfolio choice problem where the financial assets, s_1 and b_1, are chosen to maximize a concave function of next period's portfolio value, a_2. The degree of risk aversion in this problem depends on the probability that k_2 will be liquidity constrained, and on the curvature of $F(k_1, \cdot)$, as measured by the absolute value of the elasticity of the marginal product of k_2. If the initial portfolio size, $a_1 - k_1$, or the debt capacity, d, are sufficiently large (such that $(a_1 - k_1)R^s + d \geq k_2^*$ for all realizations of R^s), then with probability one, k_2 will not be liquidity constrained and the individual is risk neutral. Otherwise, the individual is risk averse. An interior solution for the portfolio choice is obtained when the degree of risk aversion is sufficiently high. In this case, the marginal utility of investing in stocks, $\frac{\partial v}{\partial s_1}$, equals the marginal utility of investing in cash, $\frac{\partial v}{\partial b_1}$:

$$E[\partial_2 v(k_1, a_2 + d)R^s] = E[\partial_2 v(k_1, a_2 + d)]R^b. \tag{12}$$

Note that s_1 and b_1 affect the amount of liquid funds available at the beginning of period 2, $a_2 + d$, through a_2. In turn, $a_2 + d$ determines whether or not the individual will be liquidity constrained, i.e. whether or not the individual will have to face the penalty of underinvesting in the personal project.

When k_1 is chosen optimally, the individual is indifferent between investing an extra unit of wealth in k_1 and in financial assets. Moreover, the utility of having an extra unit of k_1 in period 3 is just its marginal productivity:

$$E[\partial_2 v(k_1, a_2 + d)R^s] = E\partial_1 v(k_1, a_2 + d) = E\partial_1 F[k_1, k_2(k_1, a_2 + d)] \tag{13}$$

Because personal projects are more productive than financial assets (Assumption 1), the individual always chooses a k_1 that is sufficiently large so that k_2 is liquidity constrained with a nonzero probability. Further, the higher the productivity of F, the larger the choice of k_1, and the more likely it is that k_2 will be liquidity constrained. Hence, as long as the absolute value of the elasticity of the marginal product of k_2 is nonincreasing with k_2, the proportion of cash in the financial portfolio is unambiguously nondecreasing with the productivity of F.

B. Lumpy Investment

Many investment projects are nonconvex. Once started, they must be continued at a given size or be abandoned. To capture this scenario, we analyze the case in which the production function takes on the following form:[9]

[9]Some of the discussion of lumpy investment in this section is related to the idea of targetting in the financial planning literature (see for eample, Jagannathan and Kocherlakota, 1996).

$$F(k_1, k_2) = \left\{ \begin{array}{ll} (R^k)^2 k_1 + R^k k_2 & \text{if } k_2 \geq \gamma k_1 \\ (R_0)^2 k_1 & \text{if } k_2 < \gamma k_1 \end{array} \right\}; \tag{14}$$

where γ is the required proportion between k_1 and k_2 to continue the project, R^k is the gross internal rate of return on a completed project, and R_0 is the gross rate of return on k_1 if the project is discontinued. We assume that $R^k > ER^s$ and $R^k > R_0$.

Again, the portfolio problem can be solved recursively. In period 2, the project is always continued if $a_2 + d \geq \gamma k_1$, because $R^k > ER^s$. The individual borrows up to the limit, $b_2 = -d$, to take advantage of the fact that $ER^s > R^b$. Hence, $s_2 = a_2 + d - k_2$. This implies that the indirect utility function v is discontinuous. This function is depicted in Figure 2.

As in the case of convex investment, the interesting portfolio choice problem takes place in period 1. The discontinuity in F represents the penalty of failing to continue the project. If this penalty is large, avoiding this penalty is a major concern in the individual's portfolio choice. For a given k_1, this effect is nonmonotonic because the chance of continuing the project may increase or fall depending on the size and the riskiness of the financial portfolio in period 1. To see this, divide the indirect utility function in Figure 2 into four regions. The first region is where the individual has such a small financial portfolio ($s_1 + b_1$) that there is no chance the project will be continued in the next period. In this case, the individual is risk neutral, as there is nothing she can do to avoid the penalty. The second region is where the individual has a relatively larger financial portfolio, but it is still insufficient to continue the project unless she invests all of it in stocks and hopes for abnormally high returns. In this case, the individual is risk loving. This region corresponds to the range of liquid funds just before the discontinuity at k^* in Figure 2. The third region is where the individual has a sufficiently large financial portfolio and the continuation of the project can be assured by investing mostly in cash. In this case, the individual is risk averse because the downside risk of stocks may jeopardize the chance of continuing the project. This is the region just after the discontinuity at k^* in Figure 2. The fourth region is where the individual has such a large financial portfolio that the continuation of the project is assured for any asset allocation. In this case, the individual is risk neutral. Therefore, the individual's risk preference depends on the size and the riskiness of her financial portfolio in period 1. Note that the Friedman-Savage puzzle of why individuals may sometimes be risk loving and sometimes be highly risk averse does not apply here.

[Figure 2]

The above argument can be formalized when the distribution function of R^s is differentiable. In this case, the expected value of v is a differentiable function of the choices made in period 1. The following first-order condition is necessary for an interior solution:[10]

$$(ER^s - R^b)ER^s = k_1 \left[(R^k)^2 - (R_0)^2 + \gamma(R^k - ER^s) \right] (\partial_b P - \partial_s P), \text{ and} \tag{15}$$

where $\partial_s P$ and $\partial_b P$ are the changes in the probability of completing the project when s_1 and b_1 are increased by one unit, respectively.[11] For an interior solution, the additional return that stocks yield over cash must offset the benefit of completing the project times the extra probability of being

[10] This condition is not sufficient.

[11] This changes in probabilities can be expressed using the density function of the distribution of R^s.

able to do so from shifting a dollar from stocks to cash. This extra probability might be negative for the individual with a small financial portfolio, i.e., the risk lover.

When k_1 is chosen optimally, the size of the financial portfolio is endogenous. If personal projects are highly productive, k_1 is never chosen to be a value so small that the continuation of the project is guaranteed for all allocations of the financial portfolio. At the same time, if the penalty of failing to complete the project is large, k_1 is never chosen to be a value so large that the continuation of the project becomes unlikely. Consequently, the optimal choice of k_1 makes the risk averse region the most relevant one. In the next section, we show that in this region, the degree of risk aversion may easily be very high.

II. Numerical Evaluation

In this section, we assume that the individual has concave preferences and an infinite horizon. As before, she can engage in at most one personal project at a time, and each project takes two periods to mature. Thus, the individual undergoes a two-period cycle. In odd periods, she completes a personal project and starts a new one. In even periods, she continues the project started in the previous period. The project is illiquid and does not yield output until the next odd period. For simplicity, we assume that the individual's debt capacity, d, is zero.[12] In this environment, the amount of liquid funds available in odd periods is equal to the output of the personal project plus the realized value of the financial portfolio. In even periods, the amount of liquid funds available is simply equal to the realized value of the financial portfolio:

$$a_t = y_t + s_{t-1}R^s_{t-1} + b_{t-1}R^b_{t-1}, \text{ when } t \text{ is odd, and} \tag{16}$$

$$a_t = s_{t-1}R^s_{t-1} + b_{t-1}R^b_{t-1}, \text{ when } t \text{ is even.} \tag{17}$$

As in the previous section, the output of the personal project is a function of the capital invested in the two previous periods:

$$y_t = F(k_{t-2}, k_{t-1}). \tag{18}$$

In every period, the individual allocates liquid funds to consumption, capital for the personal projects, stocks, and cash, so the budget constraint (2) applies to all periods. In recursive form, preferences are represented by the following utility function:

$$U_t = \frac{c_t^{1-\sigma}}{1-\sigma} + \beta E_t U_{t+1}. \tag{19}$$

where U_t is utility in period t, σ is the coefficient of relative risk aversion ($\sigma > 0$), β is the discount factor ($1 > \beta > 0$), and E_t is the conditional expectation based on the information available in period t.

With convex investment, F is concave and differentiable. Hence, the optimal plans must satisfy the standard Euler conditions. For assets that mature in one period, i.e., stocks, cash, and capital invested in even periods, the Euler condition is:

$$c_t^{-\sigma} \geq \beta E_t(c_{t+1}^{-\sigma} R^i_{t+1}), \text{ with equality if the holding of asset } i \text{ in period } t \text{ is positive.} \tag{20}$$

[12] Obviously, if d is sufficiently large, the portfolio choice problem is trivial and most of the effects would disappear.

To simplify notation in (20), we use $R_{t+1}^{k_t}$ to denote the marginal product $F_2(k_{t-1}, k_t)$. The intuition of (20) is that a unit of output must yield at least the same utility if it is consumed today as the utility it generates if it is invested in asset i for consumption tomorrow. Moreover, the short-selling constraint on asset i is binding if consuming an extra unit of output today is preferred to investing it for consumption tomorrow. For capital invested in odd periods, condition (20) has to be modified by replacing the subscript $t+1$ with the subscript $t+2$, since this capital takes two periods to mature.

With lumpy investment, the function F is not differentiable with respect to its second argument. Hence, the Euler condition (20) is not well-defined for the capital invested in even periods. Numerically, the optimal plans can be calculated using recursive dynamic programming techniques by drawing a direct comparison of the utility attained from continuing the project and not continuing it. Intuitively, if the amount of liquid funds in even periods are very low, the optimal choice is to discontinue the project either because there is a liquidity shortfall or because continuing the project would imply a minute present consumption. At a certain level of liquid funds, the individual is indifferent between continuing the project and not continuing it. When the amount of liquid funds exceeds this level, the optimal choice is to continue the project.

The consumption policy functions with convex and lumpy investments are depicted in Figure 3. Regions with a positive slope are the risk averse regions as they imply that the marginal utility of consumption is negatively correlated with portfolio returns. The steeper these slopes, the higher the aversion to a risky portfolio. The discontinuous fall in the consumption policy function when investment is lumpy implies a risk loving region: just before the discontinuity, the marginal utility of consumption is positively correlated with the return on the financial portfolio. This correlation is due to the fact when the return on the financial portfolio increases, the project is more likely to be continued. In this case, consumption in the current period falls and the marginal utility rises.

[Figure 3]

To investigate when the presence of personal projects is likely to be quantitatively important in portfolio choice, we simulate the model with the following parameters. The return on cash and on stocks are the historical moments over the last century for US Treasury bills and for stocks reported in Kocherlakota (1996). The gross rate of return on cash, R^b, is constant and equals 1.01 per annum. The gross rate of return on stocks, R^s, is a discretized lognormal stochastic variable with mean 1.07 per annum and variance 0.0274 per annum.[13] For comparison purposes, we also consider 1.06 as the mean of R^s. We have little information on the expected return on personal projects R^k, and it probably differs substantially across individuals. For our purposes, interesting effects arise when R^k is relatively high, so we consider the values 1.09 and 1.12 per annum. For the coefficient of relative risk aversion, we assume realistic values of 2 and 3. The parameter β is adjusted so that consumption would grow at the historical rate of 1.018 per annum if the individual could borrow and save freely at R^k (the return of the main asset the individual holds in our simulations). Finally,

[13] The distribution of the variable $(\ln R^s - \mu)/\varsigma$ is a discrete approximation of a truncated standard normal distribution. That is, it is a stochastic variable with 7 possible values (-3, -2, -1, 0, 1, 2, 3) with probabilities (0.006, 0.0605, 0.242, 0.383, 0.242, 0.0605, 0.006). These are the probabilities of a standard normal taking values in the intervals ($-\infty$, -2.5), (-2.5,-1.5), (-1.5, -0.5), (-0.5, 0.5), (0.5, 1.5), (1.5, 2.5) and (2.5, ∞). The values of μ and ς have been adjusted so the meand and variance of R^s are the moments reported in the text.

the simulated frequency of the model is quarterly, so we adjust the above annual rates to quarterly rates.[14]

In Table 2, we report the optimal portfolio for an individual in odd periods. That is, when the individual has collected the output from the previous personal project, and is about to start the next one. The holdings in this portfolio are proportional to the initial wealth because preferences are homothetic, and the personal technology yields constant returns to scale. Therefore, we can normalize the portfolios by adjusting the initial wealth so that the capital immediately invested in the personal project k_t is one. Each pair of numbers denotes the holdings of stocks (first number) and cash (second number), respectively. When cash holding is zero, we report the gross risk-free rate, R^b, at which the individual would choose zero cash in the current period.

[Table 2]

In the first four columns in Table 2, we evaluate the convex investment model using the CES production function:

$$F(k_1, k_2) = A \left[\left((1-\alpha)\, k_1^{1-\frac{1}{\rho}} + \alpha k_2^{1-\frac{1}{\rho}} \right)^{\frac{1}{1-\frac{1}{\rho}}} \right] \tag{21}$$

where ρ is the intertemporal elasticity of substitution between k_1 and k_2, and α measures the relative importance of k_2. The parameter A is chosen to match the internal rate of return of the personal project with the rates R^k in the table.[15] The first column assumes that the parameter α is zero. Hence, all investment takes place at the first stage of the personal project, and financial assets are only held to buy consumption. In this case, the individual finds it optimal to hold a fairly risky portfolio with zero cash holdings throughout the column. In columns (2) to (4), financial assets are used to finance investment at the second stage. In this case, the individual is much more risk averse in her portfolio choice and we observe positive cash holdings for some parameter configurations. The second and fourth columns evaluate the convex investment model with a symmetric production function F ($\alpha = 0.5$). We consider two cases with respect to the elasticity of substitution, ρ, between the investments at the two stages of the project. In column (2), we assume that F is Cobb-Douglas, so $\rho = 1$. In column (4), we assume that $\rho = 0.1$, hence there is a much stronger complementarity between the two inputs in F. Finally, in column (3), we assume that F is Cobb-Douglas, but $\alpha = 0.9$ so most of the investment takes place at the second stage of the project.

As expected, the willingness to hold cash increases with the coefficient of relative risk aversion, σ, and decreases with the expected return on stocks, ER^s. More interestingly for our purposes, the willingness to hold cash increases with the degree of complementarity between the capital inputs at stages 1 and 2 of the project. As the elasticity of substitution, ρ, falls, any cut to the investment at stage 2 due to a liquidity shortfall becomes more costly. To avoid this shortfall, the individual chooses to hold a relatively large, and safe, financial portfolio at stage 1. The opportunity cost of a large financial portfolio increases with the productivity of the personal project. Hence, as R^k increases, the individual relies less on the size of the financial portfolio and more on its safety to

[14]The mean of quarterly rates is the 4th root of annual rates. The variance of quarterly rates is one quarter of annual rates.

[15]These internal rates of return are evaluated at the optimal k_2/k_1 when only cash is used to finance k_2.When stocks are used for this purposes, the internal rates of return are stochastic.

avoid a liquidity shortfall. Finally, a liquidity shortfall has an impact on investment only when planned investment is large compared to consumption. Otherwise, changes in consumption can be used to ensure the proper continuation of the personal project with minor effects on the financial portfolio. Therefore, the proportion of cash in the financial portfolio increases with α.

The last four columns in Table 2 evaluate the lumpy investment model (14). Columns (6) and (8) evaluate the symmetric case in which $\gamma = 1$. In column (8), the penalty for failing to continue the project is the smallest compared with the other scenarios. This penalty consists of only the missed opportunity of investing in the personal project at stage 2. The capital invested at stage 1 is productive and generates a rate of return equals to R^k until the project is discontinued. Thus, the salvage rate R_0 is $\sqrt{R^k}$. In column (6), the capital invested at stage 1 is not productive if the project is discontinued, although this capital is preserved without depreciation. This penalty is more severe, but far from harsh. Columns (5) and (7) evaluate the asymmetric case in which $\gamma \neq 1$. In column (5), the required investment at stage 2 is a quarter of the initial investment. In contrast, in column (7), the required investment at stage 2 is ten times the initial investment.

With lumpy investment, even if the initial capital at stage 1 is preserved, discontinuing the project can create a significant penalty when the project yields a high rate of return. In column (7), for example, the initial capital requirement is small and its integrity is preserved, but the individual is willing to hold a fair amount of cash for most parameter values to ensure the continuation of the project. In this case, the penalty of discontinuing the project is almost exclusively having to give up a good investment opportunity.

As with the convex investment model, the willingness to hold cash increases with the coefficient of relative risk aversion and the rate of return of the personal project, and decreases with the expected return on stocks. Also, as γ increases, consumption becomes small compared to the investment required to continue the project. Therefore, as γ increases, changing consumption at stage 2 is not a viable alternative for ensuring the continuation of the personal project. In order to avoid large swings in consumption or failing to continue the project, the safety of the financial portfolio increases. Finally, the safety of the financial portfolio is inversely related to the salvage rate R_0, because a lower R_0 implies a harsher penalty for discontinuing the project. However, the effect of R_0 on the composition of the portfolio is quite small because for the parameters considered, the individual continues the project most of the time.

III. Empirical Analysis

A. Description of Data

We employ data from the 1995 Survey of Consumer Finances (SCF). The SCF is a rich source of information on the financial characteristics of U.S. households. Detailed information is collected on household assets and liabilities, as well as accompanying household characteristics such as labour force activities, demographics, attitudes, income from various sources and so on.[16] The SCF is conducted every three years. When we began this study in 1999, the 1995 SCF was the

[16] Each observation corresponds to a household. A household consists of an economically dominant single individual or couple and all other persons in the household who are financially dependent on that individual or couple. A financially self-sufficient grandparent, for example, would be excluded. The SCF is conducted every three years by the Board of Governors of the Federal Reserve System and the Statistics of Income Division (SOI) of the Internal Revenue Service (IRS).

most recent survey with a complete public data set. In our empirical analysis, we employ the Repeated-Imputation Inference (RII) technique described in Montalto and Sung (1996). This estimation methodology takes into account the sample-selection bias in the SCF,[17] and incorporates the variability in the data due to missing information (the standard errors are adjusted accordingly to generate the correct inference).[18]

In the SCF, there is a section on miscellaneous opinion variables. The useful variables for our purpose are the questions on saving motives. Respondents are asked to choose, from a list provided by the interviewer, their top reasons for saving.[19] We group the list of reasons into eight categories. Our hypothesis is that those categories that fit the description of an investment in a personal illiquid project will be significant for determining the amount of cash held in housholds' financial portfolios. The eight categories of saving motives are:

Saving motive	Description
Education	Own, spouse's, children's, grandchildren's
Invest in own home	To buy own house/cottage
Household purchases	Appliances, furnishings, cars, special occasion and hobby items
Travel	Vacations, time off
Invest in own business	To buy own business/farm, equipment for business/farm
Retirement	Including funeral and burial expenses
Emergency	Unemployment, illness, "rainy" days
Living expenses and bills	Including tax and insurance bills, other contractual commitments

We convert each category into a dummy variable, assigning the value "1" if a respondent chooses it as one of her top three reasons for saving, and zero otherwise.[20] Of these categories, "invest in own home" and "invest in own business" best fit the description of an investment in a personal illiquid project. Also, there is information on whether or not the respondent already owns a home or a family business. We will also include them in the regression analysis.

[17]The survey is based on a dual-frame sample design, incorporating both a standard multi-period national area-probability design and a list-sample design. The list sample is selected from a set of tax returns developed by the SOI. It is intended to provide a disproportionate representation of wealthy households, who own a large percentage of skewed assets such as stocks, options and antiques. To compensate for this unequal probability in the sample design and for failure to obtain an interview with some of the selected households, a set of analysis weights is included in the data set.

[18]The public data set consists of five implicates as a result of multiple imputation technique used to handle missing data. (Some data may be missing because respondents are unable or unwilling to provide certain pieces of information. See Kennickell (1998) for a discussion of multiple imputation in the SCF.) Each implicate has 4299 observations, corresponding to the number of households surveyed in 1995. We utilize information contained in all five implicates. Using the RII technique, we include both the within-imputation variance and the across-imputation variance in generating inference.

[19]Readers should note that the definition of saving here does not refer to putting money in a savings account. As in flow of funds constraint (2), whatever is not consumed or used in production is saved. The amount saved becomes part of the financial portfolio.

[20]The 1995 SCF public dataset lists the top five reasons for saving for each respondent. We feel that, on the one hand, less important reasons may not have a significant impact on portfolio choice, and on the other hand, including only the top reason may not generate enough non-zero observations for the dummy variables. As a tradeoff, we include the top three reasons from the list.

B. Model and Results

In Table 3, we report the average age of the households who chose the various categories as their top three reasons for saving. We also report the standard error of the mean and the sample count.[21]

[Table 3]

From Table 3, we can see that younger households have a tendency to choose what we consider personal illiquid projects as their top saving motives. The average age for "invest in own home" and "invest in own business" - all in the thirties - are the lowest among the eight categories.

Using the Repeated-Imputation Inference (RII) technique for regression analysis (see Montalto and Sung, 1996), we estimate the following model:

$$Cash_i = \alpha + \beta Age_i + \gamma Age_i^2 + \sum_{j=1}^{6} \delta_j X_{ij} + \sum_{k=1}^{8} \lambda_k D_{ik} + \epsilon_i \tag{22}$$

where i = the ith household, $Cash$ = percentage of (relatively) safe and liquid assets in the financial portfolio, X_j = explanatory variable in addition to Age, D_k = dummy variable for saving motive.

The types of financial assets that we include in $Cash$ here are the same as those in section 1. To capture the nonlinear "age effect" depicted in Table 1, we use Age and Age^2 in the regression. In addition to age and the dummy variables for saving motives, we employ six other control variables. They are: X_1= financial net worth, X_2 = financial net worth^2, X_3 = relative housing value, X_4 = risk attitude, X_5 = relative business value, X_6 = labour income.

First, we use financial net worth to control for wealth in the portfolio decision.[22] Second, we include the square of financial net worth to account for possible nonlinearity in the relationship. For example, we may expect risk aversion to decline as financial net worth increases. However, households with very high financial net worth may be more risk averse if their financial net worth is a significant part of their total wealth and is highly correlated with consumption.[23] Third, we control for home ownership using housing value relative to total net worth, and expect the sign of the parameter estimate to be positive. Not only residential housing is a risky investment but also is a personal illiquid project that generates regular liquidity needs (e.g., mortgage, property tax and utility payments, and maintenance costs), so households may prefer safer financial assets. Fourth, there is a self-reported risk attitude variable in the survey, based on a hypothetical investment question. This variable takes on four possible values, 1 to 4. A larger number implies a higher degree of risk aversion.[24] Fifth, some households in the survey own private businesses, which are

[21] Based on all five implicates in the public data set.

[22] Financial net worth is defined as the difference between the value of the financial portfolio (as defined in section 1) and the amount of financial debt (credit card balance, line of credit and other loans not related to fixed assets).

[23] As opposed to a household in which labour income, a proxy for human capital (holding other characteristics constant), is the significant part of total wealth. This household will be less risk averse in its portfolio choice as long as its labour income is not highly correlated with stock returns.

[24] Past studies often use age as a proxy for risk aversion. It is interesting to note that in our sample, age and risk attitude have a correlation coefficient of only 0.04.

prime examples of personal illiquid projects that generate liquidity needs. We use private business value (which includes personal assets used as collateral for business loans) relative to total net worth as a proxy for this effect. We expect a positive sign for the parameter estimate.[25] Last but not least, we have labour income.[26] We use the log of labour income in the regression to dampen the effects of extreme values. This variable can be interpreted as a measure of human capital (holding other characteristics constant).[27] Since households with more human capital are less vulnerable to the risk of their financial portfolios, we expect a negative sign for the parameter estimate.

Since we are trying to analyze portfolio choice, we exclude households that do not have sufficient funds to form a reasonable portfolio. We exclude observations with financial net worth smaller than \$1000. We also screen out observations with zero or negative total net worth, particularly since this variable appears in the dominator of two explanatory variables. Further, we exclude households which report zero labour income since we take the log of this variable in the definition of X_6.[28] In total, we eliminate 39.72% of the sample.[29]

We estimate three versions of (22) to show the reduction in the "age effect" as we add more explanatory variables. In Table 4, we present the regression results. An asterisk denotes significance at the 5% level. Probability values are reported in parentheses.

[Table 4]

From Table 4, we can see that the influence of the variable *Age* drops significantly as we include additional explanatory variables in the regression. The parameter estimate for *Age* is -0.0137 in model 1, and it is reduced to -0.0078 in the full model.

Let us now turn to the results of the full model. All of the X variables are statistically significant and have the expected signs. The results confirm a U-shape relationship between *Cash* and *Age*, and between *Cash* and financial net worth. They also show that a higher self-reported degree of risk aversion lead to a safer financial portfolio. In contrast, higher labour income, holding age, wealth and other characteristics constant, tends to reduce the share of safe assets in households' portfolios. In terms of the personal illiquid projects, a larger housing value and a greater business value both lead to a significantly safer financial portfolio. However, since residential housing and private businesses are risky assets, there may be a diversification motive for holding safer financial

[25] Heaton and Lucas (1999) provide a related explanation. These authors consider the impact of entrepreneurial risk on portfolio composition and asset pricing. They conclude that investors would hold a safer financial portfolio when faced with entrepreneurial risk, since the latter is difficult to insure and has a large covariance with common stocks. We will attempt to distinguish between the two explanations (i.e., liquidity versus diversification) when we discuss our regression results.

[26] Labour income consists of wages, salaries and professional income including farm income.

[27] One might argue that education level can be used to control for human capital and knowledge of the capital market. Unfortunately, this variable is not included in the public data set of the 1995 SCF.

[28] As a result of this constraint, our sample is probably not very representative of the retired population.

[29] Other authors in this literature use more stringent sample selection rules. For example, Heaton and Lucas (1999) exclude households with less than \$500 in stock holdings, and those with less than \$10,000 of financial net worth.

assets, in additional to liquidity needs. This is particularly true for private businesses, which have a high correlation with stock returns (see Heaton and Lucas, 1999). It is therefore difficult to disentangle between the two effects based on these results alone.

Looking at the saving motives allows us to focus on the liquidity effect. For example, when an entrepreneur is saving to invest in her private business (say, to expand her business or to buy a piece of equipment), she is doing so for liquidity reasons and not because of diversification. Out of the eight dummy variables, "invest in own home", "invest in own business" and "retirement" are statistically significant. The first two categories lend support to our theoretical hypothesis. In particular, the quantitative effect of "investing in own business" is very large: this motive increases household's cash holdings by 26%. Since we already control for business value in the regression, this result suggests that entrepreneurs may hold a safer financial portfolio beyond a pure diversification reason, and that the liquidity needs of a personal project are important for portfolio choice. Further, unlike the prediction of previous studies which examine the effects of liquidity constraints on portfolio choice, the strong liquidity effect that we observe does not apply only to households with low wealth. In fact, the average total net worth of the households who pick "invest in own business" as a top saving motive is close to $800,000. The average value of their financial portfolios is about $50,000, and their average cash holding is an astonishing 65%!

The results also suggest that saving for retirement actually leads to a riskier financial portfolio. Curiously, this is the only saving motive that has a significant negative sign. Note that education is not a statistically significant factor in explaining portfolio choice, even though one may argue that investment in human capital fits our description of a multi-period personal illiquid project. One reason could be that education expense is spread over a long time, and rarely constitutes a large portion of consumption.

IV. Conclusion

Our analysis of the SCF 1995 shows that when individuals save to invest in their own businesses or their own homes, they seek a portfolio of financial assets that is safer than we would expect given their characteristics. These characteristics include measures of how exposed the individuals are to entrepreneurial risk and home ownership risk. Hence, we think that this fact cannot be solely explained by a pure diversification motive. Instead, we propose an explanation based on the interaction of the liquidity needs of physical investments and the formation of the portfolio of financial assets along the lines of Froot, Scharfstein, and Stein (1993) and Holmström and Tirole (1998).

Numerically, we show that individuals engaged in personal illiquid projects are likely to have a high demand for safe assets, such as cash, when they are penalized for either discontinuing their projects or continuing them at an inappropriate scale for lack of funding. The penalties do not need to be harsh to yield strong numerical effects. In our numerical examples, investors never loose a portion of their capital for lack of liquidity. The harshest penalty they face is a zero return on their physical investment for one quarter. Strong numerical effects do require several ingredients. First, planned investment must be large compared to consumption. Otherwise, changes in consumption are used to ensure the proper continuation of personal projects with minor effects on the portfolio of financial assets. Second, personal projects must be highly productive to induce investors to seek large personal projects and small financial portfolios. Finally, for the penalties to be significant, investment in a personal project must either be lumpy, in which case the penalty is missing an investment opportunity, or be a strong complement to earlier investments, in which case the penalty is the low return on the earlier investments.

Our inquiry contributes to the resolution of two puzzles from the portfolio literature. First, our results help to explain why holdings of cash are much higher than the standard portfolio theory with low risk aversion predicts. Second, our results help to explain why young investors hold safer portfolios of financial assets than those of individuals close to retirement.

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Table 1
Mean percentage of cash in financial portfolio, by age

Age	<25	25-34	35-44	45-54	55-64	65-74	75+
Mean	0.6417	0.4138	0.3801	0.3358	0.3730	0.4249	0.4745
Standard error	0.0073	0.0014	0.0030	0.0036	0.0032	0.0023	0.0066

Note: The means and standard errors are estimated using the Repeated-Imputation Inference (RII) technique. See Montalto and Sung (1996). Data source: 1995 Survey of Consumer Finances.

Table 2
Financial Portfolio at stage 1

Parameters			Convex Investment Model				Lumpy Investment Model			
R^k	ER^S	σ	$\alpha = 0$	$\alpha = 0.5$	$\alpha = 0.9$	$\alpha = 0.5$	$\gamma = 0.25$	$\gamma = 1$	$\gamma = 10$	$\gamma = 1$
				$\rho = 1$	$\rho = 1$	$\rho = 0.1$	$R_0 = 1$	$R_0 = 1$	$R_0 = 1$	$R_0 = \sqrt{R^k}$
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1.09	1.07	2	0.0190 $0^{1.062}$	1.084 $0^{1.036}$	9.277 $0^{1.018}$	1.165 $0^{1.032}$	0.3239 $0^{1.045}$	1.2332 $0^{1.029}$	11.972 $0^{1.014}$	1.2135 $0^{1.031}$
		3	0.0194 $0^{1.061}$	1.076 $0^{1.021}$	7.191 1.992	1.161 $0^{1.016}$	0.3265 $0^{1.036}$	1.2321 $0^{1.013}$	8.060 3.424	1.2135 $0^{1.014}$
	1.06	2	0.0188 $0^{1.049}$	1.070 $0^{1.025}$	8.865 0.334	1.156 $0^{1.020}$	0.3234 $0^{1.031}$	1.2251 $0^{1.017}$	9.952 1.733	1.2045 $0^{1.019}$
		3	0.0190 $0^{1.047}$	1.063 $0^{1.010}$	5.945 3.195	1.006 0.127	0.3254 $0^{1.023}$	0.9658 0.2239	6.232 4.969	0.9950 0.1852
1.12	1.07	2	0.0262 $0^{1.055}$	1.070 $0^{1.033}$	9.222 $0^{1.018}$	1.145 $0^{1.026}$	0.3260 $0^{1.034}$	1.2289 $0^{1.022}$	11.773 0.129	1.2096 $0^{1.024}$
		3	0.0264 $0^{1.053}$	1.066 $0^{1.019}$	7.160 2.028	1.044 $0^{1.010}$	0.3296 $0^{1.025}$	1.1079 0.1072	7.299 4.047	1.1477 0.0567
	1.06	2	0.0260 $0^{1.043}$	1.066 $0^{1.023}$	8.819 0.385	1.140 $0^{1.014}$	0.3258 $0^{1.020}$	1.2236 0.0012	8.733 2.762	1.2070 $0^{1.012}$
		3	0.0262 $0^{1.040}$	1.032 0.029	5.963 3.217	0.864 0.240	0.3288 $0^{1.012}$	0.7643 0.3971	5.361 5.691	0.8081 0.3510

Note: Portfolios are represented by a pair of numbers. The first number denotes stocks. The second number denotes cash. Superscripts on zero cash reports the gross risk-free rate for the current period at which the investor would choose zero cash. With convex investment, R^k is the internal rate of return of the personal project when only cash is used to finance k_2. With lumpy investment, R^k is the paramater in (14).

Table 3
Mean age and sample count for various saving motives

	Mean age	Standard error	Count
Education	38.9725	0.0202	1716
Invest in own home	35.1804	0.2470	518
Household purchases	44.5382	0.0805	267
Travel	46.7434	0.1083	270
Invest in own business	37.1380	0.1438	74
Retirement	52.5223	0.0309	4567
Emergency	50.5134	0.0370	3527
Living expenses and bills	52.2474	0.1656	366

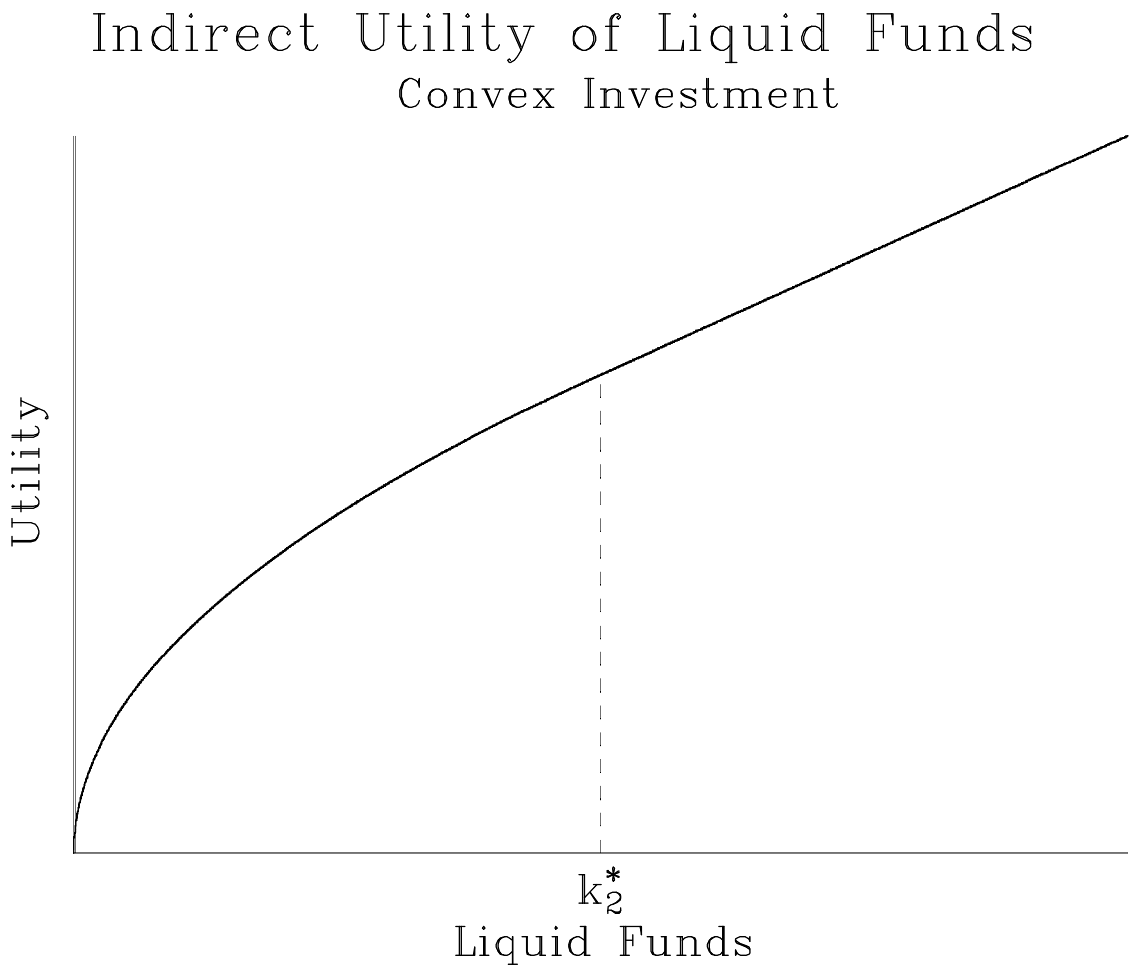
Note: The means and standard errors are estimated using the Repeated-Imputation Inference (RII) technique. See Montalto and Sung (1996). Data source: 1995 Survey of Consumer Finances.

Table 4
Regression results

	Model 1	Model 2	Full model
Intercept	0.6222*	0.6916*	0.5987*
	(0.0000)	(0.0000)	(0.0000)
Age	-0.0137*	-0.0115*	-0.0078*
	(0.0000)	(0.0000)	(0.0059)
Age^2	0.0001*	0.0001*	5.91E-5*
	(0.0000)	(0.0008)	(0.0326)
Financial net worth		-3.11E-6	-3.75E-6*
		(0.0570)	(0.0223)
Financial net worth^2		2.21E-11	2.54E-11*
		(0.0679)	(0.0366)
Relative housing value		0.0254*	0.0309*
		(0.0071)	(0.0012)
Risk attitude		0.0341*	0.0319*
		(0.0000)	(0.0000)
Relative business value		0.1441*	0.1404*
		(0.0000)	(0.0000)
Labour income		-0.0234*	-0.0217*
		(0.0000)	(0.0000)
Education			-0.0380
			(0.1028)
Invest in own home			0.1013*
			(0.0022)
Household purchases			0.0097
			(0.8220)
Travel			-0.0289
			(0.5332)
Invest in own business			0.2562*
			(0.0012)
Retirement			-0.0521*
			(0.0044)
Emergency			0.0011
			(0.9570)
Living expenses and bills			0.0009
			(0.9805)

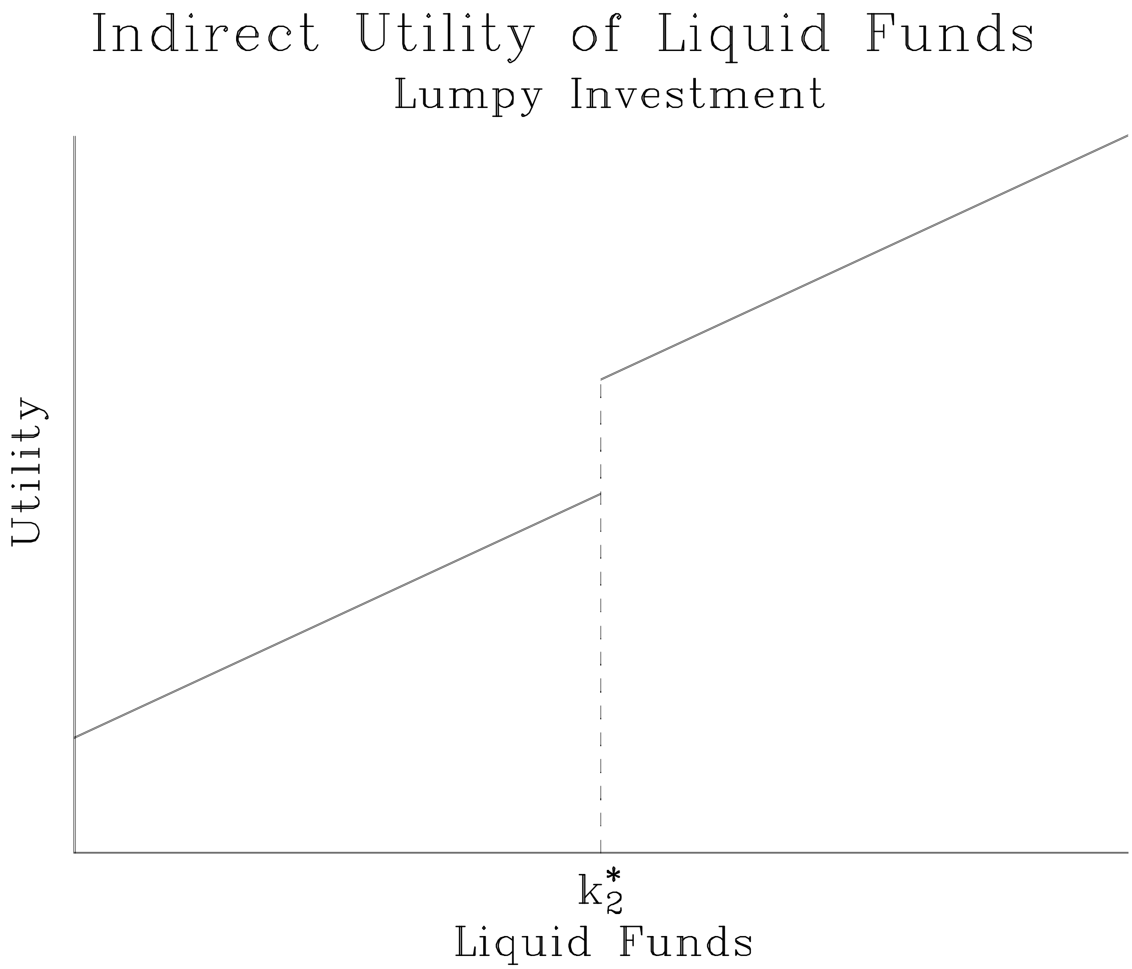
Note: The coefficients and their probability values (in parentheses) are estimated using the Repeated-Imputation Inference (RII) technique. An asterisk denotes significance at the 5 % level. In all three regressions, the F statistic is significant at the 1% level. The average adjusted R^2 across the five implicates is 8%. Consistent with past studies, there is a lot of noise in households' portfolio decisions. Data source: the 1995 Survey of Consumer Finances.

Figure 1



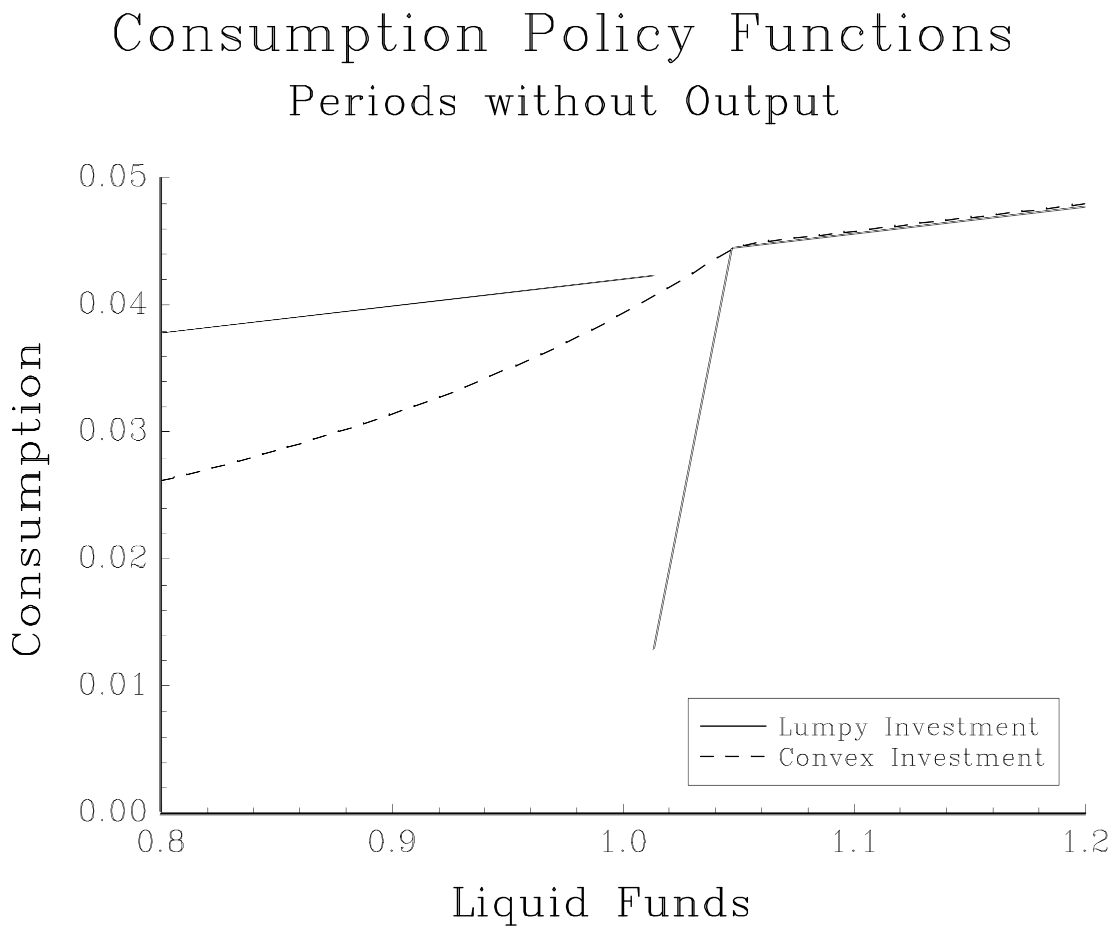
Note: Liquid funds consist of the individual's financial portfolio at the beginning of period 2 plus her debt capacity, $a_2 + d$.

Figure 2



Note: Liquid funds consist of the individual's financial portfolio at the beginning of period 2 plus her debt capacity, $a_2 + d$.

Figure 3



Note: Liquid funds consist of the individual's financial portfolio at the beginning of period 2 plus her debt capacity, $a_2 + d$.