The Life-Cycle Hypothesis: An Assessment of Some Recent Evidence

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This essay first reviews the basic empirical predictions of the life cycle hypothesis of consumption, namely that individuals should try to smooth intertemporally the marginal utility of consumption, that young workers should be accumulating resources for retirement, and that the elderly should be decumulating these resources. In the second part of the essay, we assess recent empirical evidence on these predictions. [JEL Classification: D91, E21, J26]

Nella prima parte di questo saggio si rivisitano le principali previsioni empiriche della teoria del ciclo vitale del consumo, ossia che gli individui dovrebbero cercare di egualizzare nel tempo l'utilità marginale del consumo, che i giovani dovrebbero accumulare ricchezza in vista del pensionamento, e che gli anziani dovrebbero decumulare tali risorse. Nella seconda parte del saggio si analizza l'evidenza empirica più recente su tali previsioni.

Keywords: consumption, retirement, saving.

1. - Introduction

«Have you ever wanted something so bad that you'd actually save up the money to buy it?» (Two guys walking down city street, hands in pockets, with baseball caps on backwards, The New Yorker 2/21/2000)

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* *<pista@stanford.edu>*. The Author would like to thank Orazio Attanasio, Luigi Guiso, Tullio Jappelli and Costas Meghir for teaching him the life cycle hypothesis. Parts of this essay have appeared in Jappelli T. and Pistaferri L. (2001, 2010*a*, 2010*b*). All the usual disclaimers apply.

The Life Cycle Hypothesis (LCH), due primarily to the contribution of Modigliani and Brumberg (1954, 1979), is the mainstream theoretical framework used by economists to understand the dynamic behavior of consumers. The main idea is simple: in deciding how much to consume in any given period, individuals consider their long-term resources, not just their current income.

The life cycle hypothesis shares many features with the permanent income hypothesis (PIH) of Friedman (1957). Indeed, in most papers the two hypotheses are treated as a unified framework, known as the Life Cycle-Permanent Income Hypothesis (LC-PIH) of consumption. The main difference between the two models is the planning horizon, which is assumed finite in the LCH, and infinite in the PIH. Of course, no consumer lives literally forever, so the infinite horizon assumption is more a metaphor for altruistic behavior. This is not a trivial difference, however. For example, Barro's (1974) celebrated result on the irrelevance of debt requires altruism linking individuals intergenerationally.[1]

The LC-PIH is now part of any respectable macroeconomics curriculum and its main principle, *i.e.*, the fact that people choose consumption as a function of long-run, life-cycle (or permanent) income rather than current income, is generally well understood. In this paper, I first review the main insights of the theory and then discuss recent approaches to testing its main implications. To conclude, I will discuss evidence from behavioral economics.

2. - The "Stripped-Down" Version of the LCH

> *«Here is your Life Cycle» (Room with entrance marked "birth" and exit marked "death", in the center of the room is a washing machine marked "life" with a person spinning inside, The New Yorker 1/10/2000)*

Consider a consumer with finite horizon who lives from 0 to T. Assume that the life-cycle has three stages: school (from 0 to

[1] The result says that if taxes are lump sum and agents are part of dynasties linked by operative transfers (which only appear under altruism), then both initial debt and the entire evolution path of debt are irrelevant.

S), work (from S to N), and retirement (from N to T). Individuals earn income only during the work phase. There is no uncertainty about income, return on savings, and the life horizon. Also, the individual has no bequest motive for saving. As a consequence, he will exhaust his accumulated wealth by the time of death. This is because there are no incentives "to leave money on the table" (assets must be non-positive), and on the other hand credit markets will prevent consumers to borrow more than they can repay (assets must be non-negative).

Assume finally that there is no social security system or access to parental resources or government scholarships. This means that the only way to avoid starving to death in the first S periods of life is by borrowing, *i.e.*, transferring resources from the work phase to the school phase. Similarly, to avoid starving to death in the last (T-N) periods of life, people must save, *i.e.*, transfer resources from the work phase to the retirement phase. This motive for saving is known as the life-cycle motive for saving;[2] it is sometimes also called "saving for a rainy day" motive (although this more correctly refers to a version with uncertainty, see Campbell, 1987). The idea is that people save when they expect their income to fall (as after retirement), and borrow when they expect it to go up (as during the school phase). The key assumption for these behaviors to emerge is that credit markets work. In particular, there is a storage technology that allows people to save, and a technology that allows people to borrow subject only to a terminal condition on wealth.

From now on, assume for simplicity that the school phase is absent, so that $a = 0$ denotes the age of entry in the labor market. The consumer solves the following problem:

$$\max \sum_{a=0}^{T} \frac{u(c_a)}{(1+\delta)^a}$$

[2] KEYNES J.M. (1948) also mentioned this as a motive for saving, when he wrote that people saved «to provide for an anticipated future relationship between the income and the needs of an individual».

subject to

$$A_{a+1} = (1+r)(A_a + y_a - c_a)$$
$$A_0 \text{ given}$$
$$A_T = 0$$

where δ is the intertemporal discount rate and r the interest rate, assumed to be constant over time. Also assume that earnings follow the deterministic profile:

$$y_a = \begin{cases} y & \text{for } 0 \le a \le N \\ 0 & \text{for } a > N \end{cases}$$

We can find a simple expression for consumption (a "consumption function") by making a few extra assumptions: $\delta = r = 0$ (to avoid confusing the life-cycle motive for saving with the intertemporal motive for saving), and $A_0 = 0$ (to eliminate the influence of initial conditions). Under these conditions, $u'(C_a) = u'(C_{a+1})$ (marginal utility is constant over time), and hence after replacing in the budget constraint:

$$c_a = \frac{N}{T} y \qquad \forall a$$

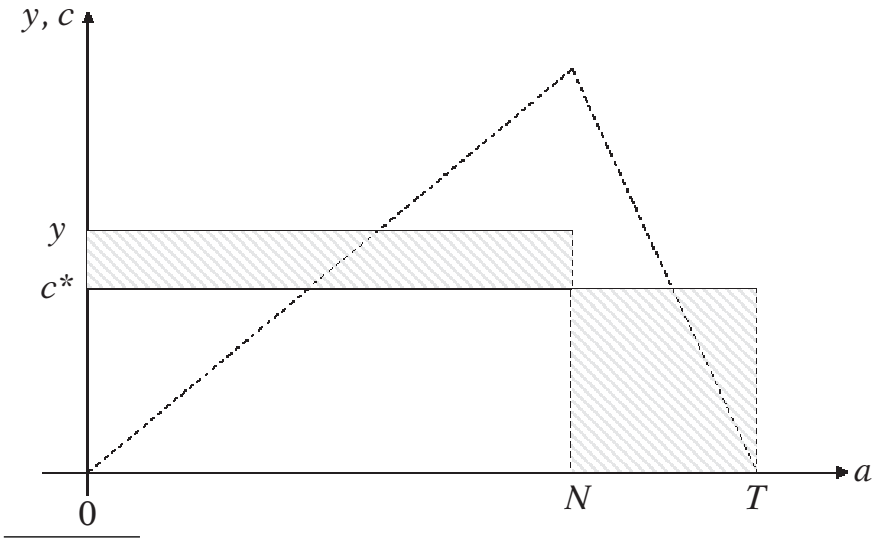
i.e., consumption is a constant fraction $(1/T)$ of lifetime income (Ny). It is easy to show that the idea that consumers set consumption as a function of a long-run concept of income survives the relaxation of the many simplifying assumptions made in this section.

Let's now derive the asset accumulation function. Given that people save a constant fraction of their income $(1 - N/T)y$ while working and decumulate a constant fraction $-(N/T)y$ of their wealth while retired, the asset accumulation function is

$$A_a = \begin{cases} \left(1 - \frac{N}{T}\right) ay & \text{for } 0 \le a \le N \\ Ny - \frac{N}{T} ay & \text{for } a > N \end{cases}$$

GRAPH 1

SAVING AND DISSAVING OVER THE LIFE CYCLE



Source: Author's own elaboration.

Graph 1 provides a graphical representation. The dashed area during the work phase represents the positive savings that individuals are making in the expectation of the looming retirement. The dashed area in the retirement phase represents the dissaving done during retirement when income falls to zero. The dashed line is the asset accumulation as a function of age. It has positive slope during the work phase (equal to the rate at which people are saving, or $((1 - N/T)y)$, reaches a maximum value at retirement $((1 - N/T)Ny)$ before declining at the dissaving rate $-(N/T)y$ and reaching value 0 at the expected date of death.

Even this stripped-down version of the LCH already delivers the most important microeconomic empirical implications of the theory:

1. Individuals attempt to smooth intertemporally the marginal utility of consumption (which here means that they also smooth consumption);

2. Young workers should be accumulating resources for retirement, and hence have an adequate amount of resources at retirement;

3. The elderly should be decumulating resources, ideally at a rate that is consistent with dying with zero wealth left at the date of death.

There is a vast literature that is concerned with testing proposition 1. I refer the interested reader to Jappelli and Pistaferri (2010*a*) and Meghir and Pistaferri (2010) for more details. Here, I am more interested in discussing approaches to testing propositions 2 and 3.

Two approaches have been followed in the literature, one "global" and one "local". The global approach tests a unified version of propositions 2 and 3, *i.e.*, check whether assets follow a concave profile over the life cycle as in Graph 1. The local approach tests the two propositions separately, *i.e.*, tests if the young are accumulating and if the old are decumulating in manners that are consistent with the life cycle hypothesis. I discuss these two approaches in turn.

3. - A "Global" Testing Approach

> *«I'll have someone from my generation get in touch with someone from your generation». (Young man to older man sitting across his desk, The New Yorker 5/20/1996).*

Do assets follow a concave profile over the life cycle of an individual? That is, if we write the asset accumulation equation as:

$$A_{ia} = \beta_0 + \beta_1 a_1 + \beta_2 a_i^2 + x_i' \beta_3 + u_i \tag{1}$$

is it the case that $\beta_1 > 0$, $\beta_2 < 0$ and $-(\beta_1/2\beta_2) = 0$ around retirement age? This apparently simple empirical question has been very difficult to answer. The reason is that we rarely if ever observe the entire life cycle history of asset accumulation for an individual (or multiple individuals).

The earlier attempts to estimate the main prediction of the

LCH globally used a single cross-section of assets, where individuals differ by their age. Unfortunately, the presence of time and cohort effects in asset accumulation decisions makes this kind of regressions in a single cross-section not very useful for testing the theory.

Why should there be cohort and time effects? Time effects are easy to justify: business cycles may induce wealth destruction at an aggregate level which may affect all households equally. For example, the financial crisis of 2008-2009 resulted in a massive decline in the price of houses and prices of equities, which may have affected many individuals simultaneously. Cohort effects may come from shocks that affect entire generations. For example, the generation that was coming of age during the Great Depression (the "depression babies") may have developed a strong aversion to stockholding, and this may of course have affected their asset accumulation strategies later in life (see Malmendier and Nagel, 2007). As another example, the baby-boom generation may have had fewer opportunities for accumulating assets due to increased competition in the market for education, the labor market, etc. induced by their sheer size.

The econometric problem is one of population multicollinearity. Suppose we consider equation *(1)* adding time and cohort effects (also in quadratic form):

$$(2) \qquad A_{iat} = \beta_0 + \beta_1 a_{iat} + \beta_2 a_{iat}^2 + \gamma_1 t_{iat} + \gamma_2 t_{iat}^2 + \delta_1 c_{iat} + d_2 c_{iat}^2 + u_{iat}$$

where c is the year of birth of the individual and t the year the data refer to. Age, time and cohort are related by the identity: $a = t - c$. Moreover, in a single cross-section t is the same for everybody. Hence equation *(2)* becomes:

$$(3) \qquad \begin{aligned} A_{iat} &= \left(\beta_0 + \left(\gamma_1 + d_1\right)t_{iat} + \left(\gamma_2 + \delta_2\right)t_{iat}\right) + \left(\beta_1 - \delta_1 - 2\delta_2 t_{iat}\right)a_{iat} \\ &+ \left(\beta_2 + \delta_2\right)a_{iat}^2 + u_{iat} = \rho_0 + \rho_1 a_{iat} + \rho_2 a_{iat}^2 + u_{iat} \end{aligned}$$

and the "age" effect (β_1 and β_2) cannot be separately identified from the cohort effect (δ_1 and δ_2). Indeed, one may find that the

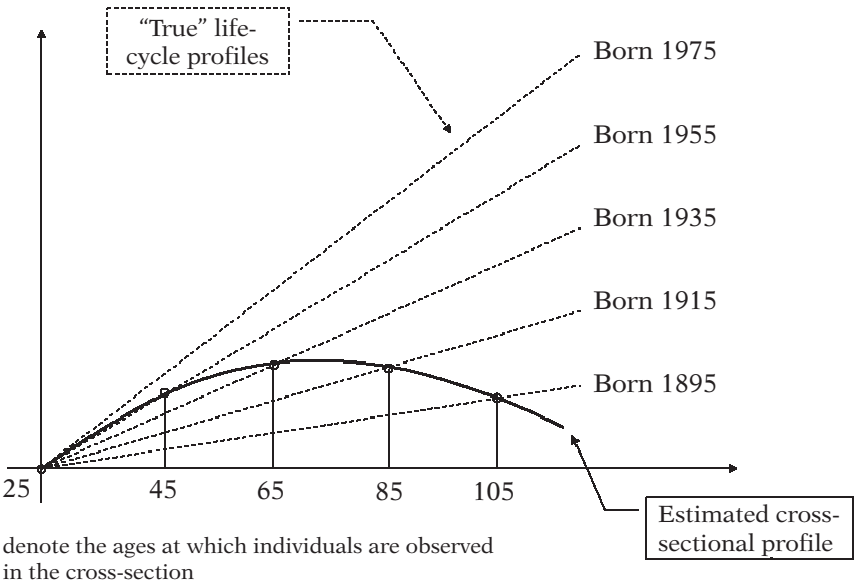
estimated age effects agree with the life cycle hypothesis ($\rho_1 > 0$, $\rho_2 < 0$) even when the pure effect of age is absent ($\beta_1 = \beta_2 = 0$). For an example, set $\delta_1 < 0$, $\delta_2 < 0$ and $t_{iat} = 0$ (a normalization).

To see with a graphical example how misleading it can be to interpret the coefficient on age in regression *(3)* as a pure age effect in the presence of confounding time and cohort effects, consider the following extreme example. Assume asset accumulation is given by the *linear* function (*i.e.*, assume that the LCH is *false*):

$$A_{iat} = \begin{cases} 0 & \text{for } 0 \le a \le 25 \\ \pi(a-25)e^{g(t-a)} & \text{for } a > 25 \end{cases}$$

GRAPH 2

A MISLEADING GRAPH



▫ : denote the ages at which individuals are observed in the cross-section

Source: Author's own elaboration.

This means that each cohort has an asset accumulation profile given by the dashed lines in Graph 2. The slope is constant but decreases with the year of birth (that is, younger cohorts ac-

cumulate assets faster, albeit still linearly). Suppose that we have data for a single cross-section, 2000. In 2000, we observe only one point of the entire life cycle asset profile of the cohort born in 1975, the red circle corresponding to their age 25; for the cohort born in 1955, we also observe a single data point, corresponding to their profile at age 45, and so forth. The estimated cross-sectional profile (the continuous red line) appears perfectly consistent with the life cycle (the profile is concave and the maximum wealth is at the age of retirement), even though the life cycle hypothesis is false.

What if we have repeated cross-sections? Unfortunately this does not solve the problem either. In fact, equation *(3)* becomes:

$$A_{iat} = \beta_0 + (\beta_1 - \delta_1)a_{iat} + (\beta_2 + \delta_2)a_{iat}^2 + (\gamma_1 + \delta_1)t_{iat} + (\gamma_2 + \delta_2)t_{iat}^2 -$$
$$-2\delta_2 t_{iat}a_{iat} + u_{iat} = \rho_0 + \rho_1 a_{iat} + \rho_2 a_{iat}^2 + \rho_3 t_{iat} + \rho_4 t_{iat}^2 + \rho_5 t_{iat}a_{iat} + u_{iat} \quad (4)$$

and the only parameters that are identified are those on the quadratic terms. It is easy to see that the use of panel data does not solve the identification problem either (although it may allow controlling for fixed unobserved heterogeneity). The conclusion is that it is very hard to learn anything substantive about the life cycle asset profile using this "global approach", unless one is willing to make arbitrary identifying assumptions. Among the various identifying assumptions made in the literature, one can recall: uniform (neutral) growth across cohorts; non-neutral growth rates across cohorts, but attributable to non-stationarities affecting permanent income growth; parametric restrictions, such as absence of time or cohort effects, or that time effects sum to zero and are orthogonal to a time trend; or that time effects are entirely attributable to, say, fluctuations in unemployment rates. A point that is unfortunately not well understood is that there are no solutions to the multicollinearity problem, only untestable restrictions.

4. - A "Local" Testing Approach

«Do you have a minute to talk about your retirement years?» (One small child, dressed as a businessman, to another, The New Yorker 4/28/1997)

Instead of testing "globally" the theory (a concave asset profile), one could test it locally. That is, are young people saving (enough) for their retirement? Are the elderly decumulating assets at a rate consistent with the predictions of the theory?

4.1 *Do the Young Accumulate?*

«Winning is crucial to my retirement plans». (Homeless man says to another as they look at a sign in a window which reads: "Lotto; $15,000,000", The New Yorker 2/1/1993).

There is a vast literature, particularly in the US, which reaches the conclusion that the young are not saving *enough* for their retirement. For example, Bernheim (1993) studies the behavior of individuals belonging to the baby-boom generation (where cohort effects may be quite important) and uses consumption as a measure of the current standard of living. Bernheim asks the following question: How much should younger workers save in order to maintain their standards of living unchanged when they retire? Bernheim's answer is that they should be saving a lot more of what they are actually doing. In particular, Bernheim calculates that younger workers are saving only about a third of what would be needed to maintain their standards of living unchanged after retirement.

While Bernheim (1993) is probably the most convincing study to appear on this topic, his conclusions are shared by many other papers using different empirical strategies and data. Indeed, the recurrent finding or conclusion that younger workers do not save enough for retirement may be the reason behind the introduction and expansion of retirement savings instruments that are favored by the tax code (such as 401k, IRAs, etc.) as well as endless articles

in the popular press about saving inadequacy. Even more telling is the fact that some researchers design randomized experiment based on the *premise* that people are not saving enough for their retirement, rather than trying to find corroborating evidence for it.[3]

But is the conclusion that the young are not saving enough for their retirement really warranted? First, are people really planning for a smooth consumption profile? In fact, if $r < \delta$, it is actually optimal to have high consumption today and less when old, so current standard of living are not a sufficient statistic for consumption at retirement. Second, is saving enough for *whom*? The LCH is a theory that describes a single consumer, but in practice people live in households of different size, different ages, and different life expectancies. The level of consumption of a household headed by a younger person includes a variety of expenditures (for example those associated with having children), that are typically (and hopefully) not faced after people retire (such as diapers, daughters' wedding celebrations, and school tuition). Third, what is saving for retirement exactly? People arrive at retirement with a variety of assets classified by liquidity, from very liquid assets (cash, deposit, saving accounts, etc.), to illiquid (housing, durables), to entitlements (pensions, typically paid out as annuities). Most calculations of saving adequacy exclude illiquid assets such as housing, but liquidating such assets in case of needs may be an extreme way of financing consumption after retirement (and a form of saving done while young).[4]

4.1.1 The Fall of Consumption at Retirement

> «*If we take a late retirement and an early death, we'll just squeak by*». *(Husband, talking to wife in living room, The New Yorker 7/7/2003)*

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[3] Some economists have even patented softwares designed to help individuals assessing whether they are on the right track to fulfill their retirement needs: see *http://www.esplanner.com*. There is also a burgeoning literature on the importance of financial literacy (see LUSARDI A., 2008).

[4] Even though in practice very few people sell their houses, downsize, or purchase reverse annuity mortgages (see MUNNELL A. *et* AL., 2007).

The inadequacy of resources for retirement is sometimes inferred by the fact that consumption falls discretely at retirement. The first paper to look at this issue is Banks, Blundell and Tanner (1998), who used repeated cross-sectional data drawn from the UK Family Expenditure Survey (FES), and found a remarkable drop in consumption after retirement. Bernheim, Skinner, and Weinberg (2001) repeated the test for the US using the PSID, and also found evidence of a substantial consumption drop at retirement (24 percent for the first income quartile, 15 percent for the second quartile and 9 percent of the third and fourth quartiles). The main limitation of their study is that the only consumption information available in the PSID is food consumption.[5]

Given that retirement is a perfectly anticipated event and people prefer a smooth consumption profile, this fall appears against the main tenet of the life cycle hypothesis. The explanation favored by those who believe that the young are not saving enough for retirement is that people do not adequately foresee the reduction in resources that comes with retirement (Bernheim, Skinner and Weinberg, AER, 2003). Once retired, the receipt of their first social security check delivers the bad news – hence individuals must reduce their consumption immediately if they want to make ends meet over their remaining horizon. A corollary of this is that people should also try to go back to the labor market. This may actually help in the sense of reducing the drop in consumption (people reduce their consumption of leisure as well as their consumption of goods). I'm not aware of a systematic attempt of looking into this.

Myopic behavior is only one possible explanation for this apparent "puzzle". The decline in work-related expenses is another possible explanation. At retirement, some work-related expenses (such as work-related clothing, transportations, etc.) may no longer be nec-

[5] Studies that use more comprehensive consumption measures find little or no consumption drop in the US. HURD M.D. and ROHWEDDER S. (2006), using a special module in the Health and Retirement Survey (HRS) find that for the average household there is no consumption drop. However, their sample size is rather small. ATTANASIO O.P., MEGHIR C. and AGUILA E. (2008) using panel data from the CEX find that food consumption declines by 6 percent, but detect no decline for non-food consumption. These papers also provide a detailed survey of the relevant literature.

essary. The corollary of this is that if we decompose expenditure into its various components, we should see a decline primarily in work-related consumption components. However, the evidence is that even expenditure on food at home declines at retirement.

The literature has focused on a number of other, more plausible explanations. First, retirement may be an unplanned event (a shock) – and consumption does react to shocks. For example, a health shock may force people into early retirement. Haider and Stephens (2007) emphasize that for most workers the timing of retirement is uncertain, and that it is sometimes forced upon the individuals by events such as prolonged unemployment or disabilities. Blau (2008) shows that uncertainty about retirement age can go someway towards resolving the puzzle. Second, there may be important non-separabilities between consumption and leisure. For example, write utility as $u(c, l)$ and note that, under non-separability, $(\partial u/\partial c)$ depends on l. At retirement the amount of leisure l available increases abruptly (by around 2000 hours). If consumption and leisure are Frisch substitutes, one may see a discontinuous jump at retirement. In reality, some types of leisure are Frisch-substitutes with respect to consumption (such as gardening), some are complements (travel), and some are neutral (listening to music), so the global effect depends on the relative weight of the various consumption components on an individual's total budget.

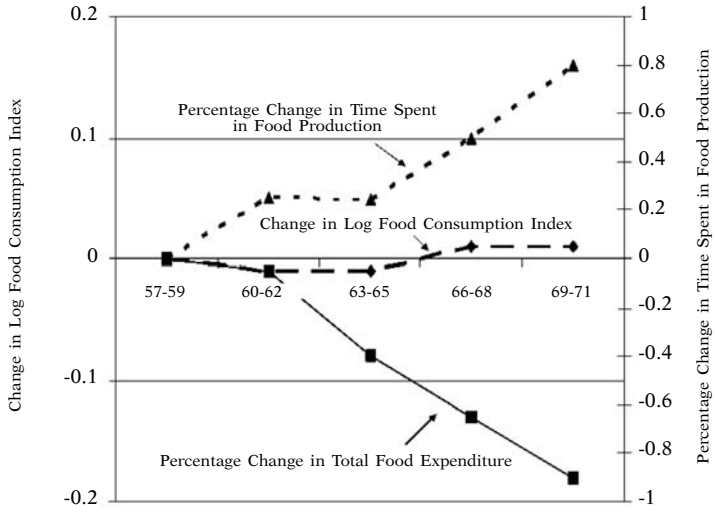
A further explanation for a decline in consumption at retirement is home production, an issue stressed in Hurd and Rohwedder (2006) and Aguiar and Hurst (2007). The idea is that consumption (and in particular food consumption, the only consumption indicator available in the PSID) is just an input to a home production function, which also uses as other factors leisure time, shopping, and housework. Retirement brings about a sharp increase in the amount of time available for shopping and housework, so individuals may choose to substitute, say, tomatoes purchased in a grocery store with tomatoes grown in their own garden. Similarly, they may spend more of their time looking for cheaper items. Indeed, Aguiar and Hurst (2005) use the Continuing Survey of Food Intake of Individuals (CSFII), collecting in-

formation on food expenditure and calories intake, and the National Human Activity Pattern Survey (NHAPS), a time use survey, to show that while food expenditure does decline at retirement, food intake does not, consistent with the home production story. In a follow-up paper, Aguiar and Hurst (2006) use individual scanner data on grocery expenses from the ACNielsen's Homescan Survey to find that the elderly shop more frequently and buy cheaper goods (or manage to find the same goods at a lower price) than younger individuals who have less leisure time available.

Graph 3 illustrates the difference between food consumption and food expenditure using data from the CSFII. The data confirm evidence from other data sets that there is a large fall in food expenditure at retirement (and beyond). It also shows, however, that food consumption (*i.e.*, the caloric intake) remains constant. This discrepancy is explained by the large increase in the amount of time spent on food production that happens around the same time. In practice, retired consumers substitute pre-cooked lasagnas with home-made lasagnas.

GRAPH 3

FOOD CONSUMPTION *VS.* FOOD EXPENDITURE



Source: Adapted from AGUIAR M. and HURST E. (2005).

The idea that the individuals are not saving enough for their retirement has also been strongly challenged by Scholtz *et* al. (JPE, 2006). They solve a complicated life cycle model, featuring progressive taxation, government transfers, social security, defined-benefit pensions, and medical expenditures. The utility function they use is CRRA with a risk aversion coefficient of 3. They assume that income follows an AR(1) process plus an individual fixed effect and that medical expenditure (which are completely unproductive) follows an AR(1) process. They also allow for equivalence scales in consumption (which turns out to be quite important).

The main point of the paper is empirical. Usually, we observe households only for a portion of their life cycle, so we can only compare actual households with simulated households facing various realistic shocks. Scholz *et* al. (2006) match HRS families with Social Security records and hence observe the *entire* history of earnings. The optimal wealth is "re-evaluated" at each node (age) following realizations of the income process. They can then compare each specific household with its simulated counterpart.

The main result they find is that more than 80 percent of households are accumulating enough wealth to maintain pre-retirement consumption levels through retirement (if home equity is included in wealth). If only half of home equity is included, their conclusion is that about 60 percent of households are accumulating sufficient wealth. If Social Security benefits are cut by 25 percent in the future, 64 percent of households are accumulating enough wealth (even with all home equity included in the measure).

The general conclusion is that, once we introduce realistic features into the picture (such as for home production or non-separability between consumption and leisure), the life cycle hypothesis can rationalize some empirical puzzles. We will examine more in details some "behavioral" deviations in a later section.

4.2 *Do the Elderly Decumulate?*

> *«Gee whizz, Mr. Curtis, a million dollars isn't old!». (Young attractive woman dining at restaurant with old man, The New Yorker 12/7/1998)*

Another important question is: are the elderly dissaving (enough) to be consistent with the life cycle hypothesis?

Most papers find that decumulation by the elderly is slower than predicted by a stripped-down version of the LCH. We now discuss a number of explanations for this apparent puzzle.

4.2.1 Mortality Bias and Accounting Issues

> *«I'd die, but I have a season ticket at the Met». (One elderly wealthy woman to another, The New Yorker 5/22/2001)*

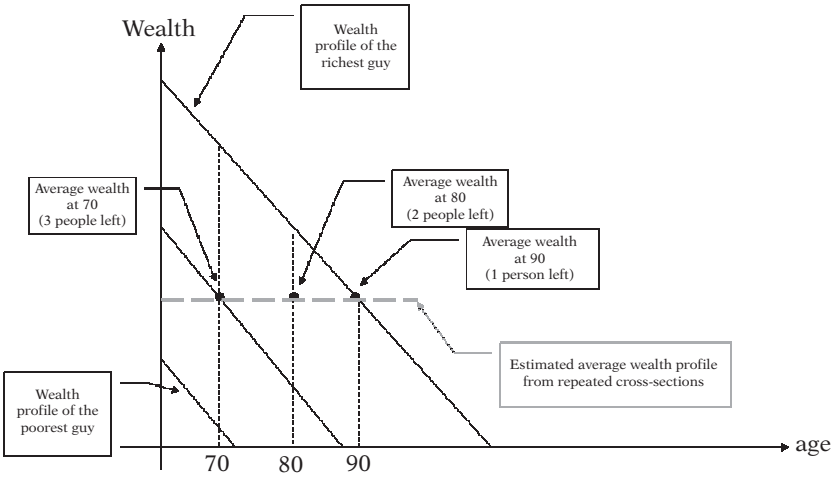
Let's start by considering measurement issues. In repeated cross-sections, there may be a systematic bias induced by differential mortality. Suppose wealth and mortality are related (*i.e.*, poorer consumers die younger). The average wealth profile estimated from repeated cross-sections may be upward biased – that is, it mighty provide evidence of lack of decumulation even though all consumers decumulate, a point originally made by Attanasio and Hoynes (2000).

Graph 4 provides a simple example with three individuals who differ by their initial wealth. These individuals follow the life cycle hypothesis exactly, have identical decumulation rates of their wealth but die at different ages (the poor die earlier). At age 70 the average wealth profile estimated from repeated cross sections is given by the red dot. At age 80 the poorest consumer has died and the average wealth appears constant simply because of a compositional effect. At age 90 there is only the richest consumer left, and again the composition of the sample has changed providing misleading evidence of a constant wealth profile even though all consumer decumulate wealth consistently with the LCH. How important is the adjustment for mortality bias?

Graph 5, adapted from Attanasio and Hoynes (2000), shows

GRAPH 4

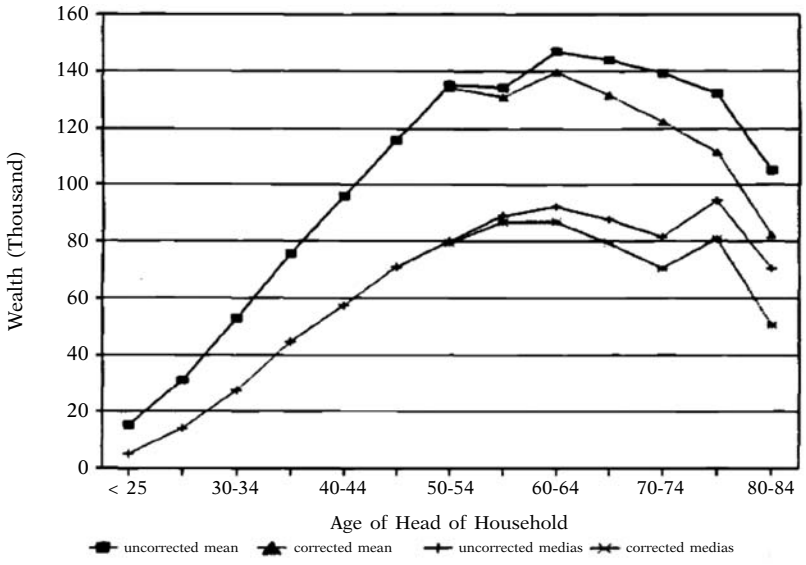
CORRECTING FOR MORTALITY BIAS



Source: Author's own elaboration.

GRAPH 5

ADJUSTING FOR MORTALITY BIAS



Source: ATTANASIO O.P. and HOYNES H.W. (2000).

that the correction does make some difference, although not an enormous one. By age 84, average wealth is roughly 25% less once the adjustment has been implemented.

The next "measurement" explanation is due to Jappelli and Modigliani (2003). It is based on the fact that the way saving is traditionally measured may create an accounting bias against the life cycle hypothesis.[6] In particular, it is standard practice to consider Social Security contributions as taxes (indeed, they are called "payroll taxes"), and pensions received when retired as income. However, social security contributions entitle the payer to a pension later in life. Similarly, most individuals fail to count as income their employer's contribution to pension plans, and they report as income the payments (annuities) from these plans. All these procedures underestimate "saving" when young, and exaggerate income when old, hence providing evidence of less decumulation that it actually exists. In particular, pensions should not be interpreted as income, but as a run down of accumulated (Social Security) wealth. However, it is worth stressing that we cannot use this argument to validate or test the LCH. Indeed, Social Security wealth is a form of "forced saving". We ignore whether an individual would have saved as predicted by the life cycle hypothesis in the absence of a Social Security doing it on his behalf.

There are three other explanations that have been proposed to explain the puzzle of slow decumulation of wealth after retirement: uncertainty about the date of death, bequest motive, and health Risk.

4.2.2 Uncertainty about the Date of Death

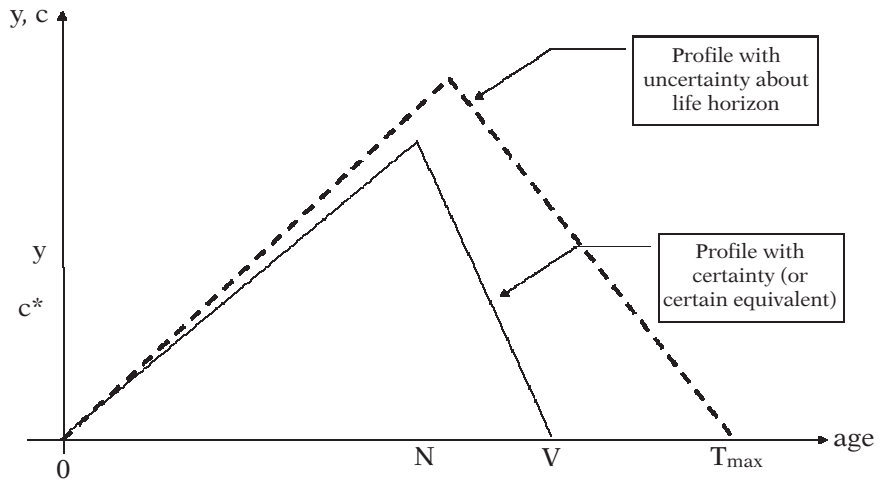
> «*In my day, people died*». *(Old woman to old man on a park bench, The New Yorker 4/10/2000)*

[6] As forcefully argued in the original, "In this paper we demonstrate why [standard] tests throw no light whatsoever on the empirical relevance of the LCH, and are at best a test of a mockery of that hypothesis. A simple explanation for this error is that individuals have forgotten that there are multiple ways of defining income and consumption, and hence numerous ways of measuring saving, which is essentially the difference between the two" (page 142).

The stripped-down version of the LCH assumes that the date of death is known with certainty. In reality, of course, people are uncertain about their date of demise and they optimize assuming they can live at most, say, T_{max} years. Formal models with uncertainty about the date of death (such as those proposed by Davies, 1981, or Yaari, 1965) show that people make savings choices to deal with two types of risk: the risk of dying too early (and hence leaving unspent wealth) and the risk of living too long (and not having enough resources to finance consumption). In most circumstances (*i.e.*, with risk averse consumers and no access to an annuity market) the second risk dominates and hence people prefer decumulating assets at a lower rate than predicted by the life cycle hypothesis. This is shown graphically in Graph 6. V represents the average date of death given by, say, mortality tables. Individuals who are risk averse will not plan to exhaust their wealth by age V because there is a chance of surviving past that age and having no resources to finance consumption. Instead, they will decumulate assets at a rate that is consistent with dying at the maximum age T_{max} (even though in practice most people die earlier than that).

GRAPH 6

UNCERTAINTY ABOUT THE DATE OF DEATH



Source: Author's own elaboration.

While uncertainty about the date of death can be a plausible explanation for the slow decumulation of wealth of the retired, it raises a different kind of puzzle though. If uncertainty about the date of death is really the motive behind the slow decumulation of wealth, why don't people buy annuities? Purchasers of life annuities exchange a fixed sum of money with a continuous stream of benefits until they die. If people have no bequest motive, they should actually have an incentive to annuitize *all* of their wealth. According to Johnson, Burman, and Kobes (2004), however, only 4 percent of workers with Defined Contribution pension plans who left their jobs after age 55 converted their retirement plan assets into annuities; for workers who left after age 65, the percentage increases to 10 percent, still way below the 100% predicted by the LCH.[7]

There are many reasons why the annuity market remains underdeveloped. First, there may be adverse selection. Those who demand annuities may be concentrated among individuals in good health who expect to live longer. Insurance companies that want to be in business will fail to offer annuities in this case. Another possibility is emphasized by Brown and Poterba (2000). They note that the utility gain from annuitizing wealth is smaller for couples than for singles. Since most potential buyers of annuities are married, this may explain the low size of the annuity market in most countries. Next, there may be inflation risk which may discourage people from annuitizing their wealth if annuities are not indexed. However, while inflation risk was important in the 1970s and 1980s, it is unlikely to be a good explanation for the paucity of the annuity market in the 1990s and 2000s. Are annuities actuarially unfair? This may be an obvious reason for people not being attracted to them. However, Friedman and Warshawski (1985) show that the loads on annuity insurance are not higher than the loads on casualty or property insurance. Finally, annuitizing all of one's wealth leaves households without resources to face unexpected emergencies such as health shocks.

[7] The puzzle refers to "private" wealth, as Social Security wealth and Medicare benefits are annuitized. Again, these annuities cannot be used as a test of rationality because there are no individual choices involved.

4.2.3 Bequests

> *«She was a sweet old lady whose kids never called». (A dog with a bag of cash speaks to another dog, The New Yorker 8/3/2009)*

A different explanation for the slow decumulation of wealth after retirement points to bequest motives. If people want to leave some of their wealth to their offsprings, their rate of asset decumulation will be slower even if there is no uncertainty about the date of death. This explanation finds some empirical validation in the fact that most people do die with positive wealth. An explicit bequest motive (altruism) can be an obvious explanation for this empirical fact. A corollary to this observation is that if altruism is important, we should also observe *in vivo* transfers – which in fact are not very large. Moreover, positive wealth at the time of death could be also generated by a model with no altruism and uncertainty about the date of death. Bequests will be left, but they would be *accidental*. Finally, altruism is not needed to explain positive wealth at the date of death even when the date of death is known. As argued by Bernheim, Schleifer and Summers (1985), bequests could be *strategic*: parents leave only in exchange of services provided to them by their children. To test whether bequests are strategic, Bernheim, Schleifer, and Summers (1987) look at children's behavior in families with an only child and families with 2+children. If the strategic motive is important, we should observe more competition among children in families with 2 or more children. They look at visitation rates and find that indeed they are higher in families with 2 ore more children.

In trying to understand whether bequests are important, the literature has traveled into two directions. One is measurement, another is testing. In measuring how much wealth accumulation can be explained by the bequest motive, two different positions have emerged. Kotlikoff and Summers (1981; 1988) conclude that the bequest motive can explain at least 50% of all US wealth; Modigliani (1988) concludes that it is no more than 20%. Why such large differences? It depends on what is believed to represent bequeatable wealth. Kotlikoff and Summers include in "be-

quests" all resources transferred from parents to children in life (college tuition, transfer of businesses, gifts, etc.); moreover, they also include in "bequests" (and exclude from life cycle wealth) the capital income generated by previous intergenerational transfers.

By far the most convincing test for bequests is performed by Hurd (1987). His intuition is that a bequests motive should be important only for families with children. There are two good elements about his test. First, it is based on observable behavior, *i.e.*, on what people do, not what people say. Second, zero bequests do not necessarily mean absence of a bequest motive, just that it is not operative (for example, it would be unsurprising if Bill Gates' father did not have an operative bequest motive). Hurd uses 10-years wealth changes from HRS for people aged 58-73, with and without children, and finds little evidence in support of a bequest motive. In particular, wealth declines 17% among married couples with children, and only 2% among married couples without children. The results are confirmed if he conditions on initial wealth levels or annuity quantities.

Hurd's finding can be explained in many ways. First, it is not clear that only couples for children have a bequest motive. Indeed, childless people may care for some other relatives (such as nephews, nieces, etc.). Kopczuk and Lupton (2007) note that Hurd's test requires a known sample separation rule (couples with children *vs.* childless – or child-free – couples). They estimate a switching regression model with sample separation unknown and find that 75% of the elderly have a bequest motive. Bequeated wealth accounts for 78% of all wealth at death – and they calculate that half of it is for an explicit bequest motive. Second, couples with children could feel that the presence of children is an insurance against health or other shocks, while couples without children need to keep a higher level of assets to self-insure against such events because they cannot rely on children. There are indeed important differences in wealth and mortality rates of people with and without children. Hurd (1989) estimates a structural model using data on wealth changes from the HRS, where utility depends on own consumption and bequests, and finds that the marginal utility of bequests is small.

4.2.4 Health Expenditure Risk

> *«Good news, Mr. Murdock! You can go home as soon as you fork over $4702.12». (Excited nurse running into an elderly patient's room, The New Yorker 10/15/1955 – adjusted for inflation)*

The last explanation for the slow decumulation of wealth after retirement is the presence of substantial health spending risk. In the US Medicare provides insurance against health shocks during retirement. However, some health expenses are covered only partially (nursing home and drugs). They can represent a large out-of-pocket shock to consumption. Indeed, 10% of the elderly spend more than 20% of their income on health (not including nursing home expenses). The likelihood that a 65-years-old would enter nursing home at some point in his or her life is about 50%. The average stay is longer than a year. About 5% of the elderly have nursing home expenses that exceed 40% of their income. Faced with these large potential costs, it is not surprising that the retired are reluctant to spend down their wealth if they face considerable (uninsured) health risk.

The first paper to look seriously at this issue is Palumbo (1999). He assumes that health status h evolves exogenously as a Markov process. Health costs m depend on h and a random term – that is, health expenditure is not a normal consumption good that is freely chosen. Instead, it may be interpreted as "maintenance expenditures" needed to keep a machine (the body) in a well-functioning state.

Palumbo (1999) assumes that utility is not state-dependent, *i.e.*, $\partial u^2/\partial c \partial h = 0$. This can be a strong assumption. The idea is that bad health may reduce the enjoyment of certain goods. For example, food consumption may go down during an illness because people lose appetite. In this case, (good) health and consumption are Frisch complements, or $\partial u^2/\partial c \partial h > 0$. Bad health may also increase the consumption of certain goods. For example, individuals with a broken leg may need to hire a taxi if they need to go out, or will rent more DVDs if they stay at home. In this case (good) health and consumption are Frisch substitutes, or

$\partial u^2/\partial c \partial h < 0$. Papers that use consumption and health data (Low and Pistaferri, 2010; Lillard and Weiss, 1997) find evidence that consumption and good health are Frisch substitutes; while papers that use "proxies" for utility such as happiness (Finkelstein *et* al., 2008) find evidence of Frisch complementarity.

Palumbo (1999) finds some improvement relative to the standard life cycle model, but the puzzle of slow decumulation remains ("elderly families typically dissave their financial assets more slowly than even the baseline health uncertainty model predicts is optimal", p. 395).[8]

Another important paper on this topic is De Nardi, French and Jones (2010). They estimate a rich structural model of behavior in old age using AHEAD data. They show that for many elderly the risk of expensive health care expenses at very old ages is a more important explanation of the slow decumulation of wealth (or even positive "saving" rates) than the bequest motive. What their paper stresses is also the role of social insurance programs. On the one hand, a program such as Medicaid discourages asset accumulation of the very poor, who fear losing eligibility for it if they save more than the asset test threshold. On the other hand, Medicaid is the health insurance program of last resort even for wealthier families, who may access it in the worst possible state of the world in which they are either unable to afford the medical care they need or are left destitute by huge medical bills.

5. - Behavioral Economics and the Life Cycle Hypothesis

(«The 1040-F.I. Form – The tax return for the financially incompetent. 1) How much money do you guess you made last year? A) Under $10,000 B) Somewhere between $10,000 and $100,000 C) More than $100,000, but I don't know how or why. 2) Did you save any receipts? A) I tried, but I just couldn't. B)

[8] Another observation may also be consistent this conclusion. In most European countries almost all health shocks are insured, yet there is slow decumulation of wealth there too. Of course, there may be perceptions of bad quality of health care provided that may be relevant and explain the puzzle even in the presence of "full insurance" of health shocks.

> *I think there's some in a shoebox. I'll go look. C) No. What am I, an accountant? 3) Check payment preference. A) How could I owe anything? My year was lousy. B) Here's $15,000. If you need more, let me know. C) Blank check enclosed. You fill it in. Whatever», The New Yorker 4/7/1997)*

Some of the facts that appear in contrast with the main tenets of the life cycle hypothesis have fueled the growth of behavioral approaches to the life-cycle model. Shefrin and Thaler (1988), for example, argue that the "fact" that young workers do not save enough for retirement can be explained if the standard model is enriched with two features: self-control and mental accounting.[9] Consumers with self-control problems are those who know they have to save for retirement (they are "planners"), but are also tempted by the fact that a high level of income today could be used to increase consumption today ("doers"), rather than save it for the future. That is, the problem with the life-cycle hypothesis is not the ability to plan, but the will and the determination to stick to the plan – people value instant gratification. In support of this idea, countless laboratory experiments typically show that subjects prefer good x now rather than $x(1 + \alpha)$ (with $\alpha > 0$) tomorrow. However, the same subjects are willing to make choices that are more consistent with exponential discounting (the "mainstream" form of discounting) if the two alternatives are far away in time. Like Zeno Cosini in Svevo's novel, we promise ourselves to quit smoking, but we terribly enjoy our last cigarette and so keep smoking.[10]

The laboratory evidence (and lots of real life evidence) suggests that some people have hyperbolic, rather than exponential preferences. In other words, some people are dynamically inconsistent: preferences held in period t differ from preferences held in subsequent periods. As shown by Harris and Laibson (2002), the main difference between exponential and hyperbolic discounting is not much the total level of wealth accumulated, but

[9] People use mental accounting when they treat different sources of income or wealth differently (*i.e.*, regular income *vs.* bonuses, assets held in checking accounts *vs.* assets locked in 401(k) accounts), and hence have different propensities to consume.

[10] Lack of self-control may also explain the underdevelopment of an annuity market for retirement wealth.

its composition. Since hyperbolic discounters know that they have a self-control problem, they'll do like Ulysses who tied himself to the mast while sailing by the mermaids, and will over-invest in illiquid assets that are hard to liquidate due to penalties and other transaction costs. On the other hand, the impatience of the present time may lead individuals who can't tap their illiquid wealth into excess borrowing from expensive sources like credit cards.[11]

One of the most interesting areas of research in behavioral economics explores the policy implication of hyperbolic discounting and lack of self-control. If individuals have self-control problems, it could be optimal from a welfare point of view to offer products that implement the first best ("saving for retirement") while exploiting individuals' inertia, procrastination, and other non-rational traits of their personality. For example, research shows that default options are rarely undone. If the default is to enroll in a 401(k) plan, rarely people do switch to non-contribution; if the default is not to contribute, only half of the subjects switch to the (more convenient, given employer's matching) contribution option.[12] One possible policy option would be to introduce automatic enrollment in retirement saving products. In other cases, however, such as when individuals are sufficiently heterogeneous in their saving preferences and have a strong tendency to procrastinate, it would be optimal not to have a default at all, but to constraint the individuals to make an active choice (Laibson, 2008).

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[11] What's behind the instant gratification effect? According to LAIBSON D. (2008) time discounting results from the combined influence of two systems of our brain, the mesolimbic dopamine (which is "impatient") and the fronto-parietal (which is "patient"). MRI research shows that the fronto-parietal system becomes increasingly active when confronted with the choice between something available in the immediate present and the same thing available, with a reward, in the future. The area of the brain that eventually "dominates" determines the types of decisions made by the individuals. The study of how brain activity affects choice ("neuroeconomics") is still in its infancy, but it holds considerable promise for understanding various anomalies in saving and financial decision behavior. However, it is probably too early to say whether its findings will ever become universally accepted.

[12] The power of default options is more general than retirement saving, for example in "deciding" whether to be an organ donor when renewing driving licenses.

6. - Conclusions

> *«Remember, son, it's never too early to start saving for retirement». (Eskimo father talking to son as he pushes an elderly Eskimo out to sea on an ice floe, The New Yorker 11/26/2001)*

What have we learned? My view is that the life cycle hypothesis is (still) the most important theoretical framework for thinking about consumption decisions in the long run. Of course, the life cycle hypothesis does not quite explain *all* the facts that happen over the life cycle (such as why people borrow on outrageously high interest rates on credit card when they have funds available on their saving accounts). Taken literally, the LCH would require a level of financial sophistication that many people, including professors, lack.[13] As George E.P. Box famously said, all models are false but some models are useful. I think the life cycle hypothesis is one such useful model. In this paper I have tried to discuss some recent evidence concerning tests of the life cycle hypothesis. By and large, this recent evidence shows that one can reconciliate some puzzling facts in the data (such as the fall of

[13] Speaking of savvy economists, a personal anecdote (with some simplifications) is in order. My employer, Stanford University, offers two pension plans, A and B. Plan A attracts matching contributions. In particular, if the employee contributes at least 4% of his/her salary, Stanford contributes another 6%. Plan A does not attract any matching, just the regular 4% contribution by the employer. For tax reasons, during the first year of employment only plan A is available. However, people may contribute 4% into plan A and receive the employer's match as cash. Starting in the second year, employees who desire to receive matching contributions must remember to shift their 4% contribution to plan B. I forgot to do that in my second year of employment. And also in my third and fourth. I kept contributing 4% of my salary to plan A without receiving any matching contribution. By the end of my forth year of employment the "losses" amounted to about $ 20,000. Obviousy I wasn't very happy. At a party, I had the good fortune of meeting the Dean, a sociologist. She asked me if there was something the University could do for me. I told her about my personal plight. She could not resist some jokes about even economists making mistakes, but sure enough, three weeks later my pension plan had received all the matching contributions I had stupidly forgotten. The funny thing (and this time the joke is on me) is that during the three years in which I failed to receive the contributions, the stock market was in free fall. Had I received the matching contributions, I would have invested them almost entirely in the stock market, and hence lost most of them. Receiving the contributions in nominal terms meant that I actually had a positive return from my "mistake".

consumption at retirement) with simple modifications to the basic version of the theory, such as home production and nonseparability in preferences between consumption and leisure. However, one requires more important modifications to the standard framework (such as hyperbolic discounting or mental accounting) in order to explain other "anomalies" observed when studying the saving and financial behavior of individuals. Recent developments in behavioral economics could be interpreted as a further evolution of the life cycle hypothesis, rather than a revolution (Deaton, 2005). As discussed, in the models proposed by most behavioral economists, agents understand that it would be in their best interest to be diligent life-cycle consumers, but end up succumbing to the temptation of instant gratification. In other words, even in these models the life cycle is the right framework of reference, but (brain and other mental) frictions prevent behavior to be fully consistent with the theory.

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