

# Franco Modigliani and the life-cycle theory of consumption \*

ANGUS DEATON

Once upon a time, before we had quite the high status that we enjoy today, it was common for economists to be harassed by scientists (high status of yesterday) who wanted to know whether we had ever come up with anything that was neither trivial nor obvious. Such questions were asked in the clear expectation that the answer would be no, or would be so unsatisfactory as to lead quickly to that conclusion. When faced with such a challenge, I would always talk about Franco Modigliani and his life-cycle theory of saving.

I would explain that Modigliani had noted that one of the most important motives for putting money aside was the need to provide for retirement. Young people will save so that when they are old and either cannot or do not wish to work, they will have money to spend. This start did not usually impress my inquisitors; it is an insight, but hardly a new or original one. The next step did better. The life-cycle story is one in which the wealth of the nation gets passed around; the very young have little wealth, middle aged people have more, and peak wealth is reached just before people retire. As they live through their golden years, retirees sell off their assets to provide for food, housing and recreation in retirement. The assets shed by the old are taken up by the young who are still in the accumulation part of the cycle. “I hadn’t thought of that”, would be the usual answer. “I’d always thought that the wealth in society had been accumulated not by people like us, but by the Rothschilds, the Rockefellers and the Kings and Queens of England, who left it to their heirs.”

---

□ Princeton University, Research Program in Development Studies and Center for Health and Wellbeing, Woodrow Wilson School, Princeton (USA); e-mail: deaton@Princeton.edu.

\* I am grateful to Anne Case, Daniel Kahneman and Jonathan Skinner for comments on an earlier draft.

The next step in the argument is the best one. Think about an economy in which the population is growing, or one in which incomes are growing so that each generation is better off than their parents. With population growth, there are more young people than old, more people are saving than are dissaving, so that the total dissaving of the old will be less than the total saving of the young, and there will be net positive saving. If incomes are growing, the young will be saving on a larger scale than the old are dissaving so that economic growth, like population growth, causes positive saving, and the faster the growth, the higher the saving rate. In fact, it does not much matter whether it is population growth or growth in per capita incomes, what matters for saving is simply the rate of growth of total income. The *level* of income itself does not matter, and poor countries save the same share of their income as rich countries. In an economy with no growth, wealth will just be passed around, no new wealth will be created. The total wealth in the economy depends on the length of retirement, and in simple cases, the ratio of a country's wealth to its income is a half of the average length of retirement, a prediction remarkable for its precision, simplicity and lack of unspecified parameters. More generally, the ratio of wealth to income is lower the faster is the rate of growth of the economy, and is at its largest when the rate of growth is zero.

These links between growth and saving are far from obvious; yet they are the logical consequences of a simple insight about the motivation for saving. "OK", would say the scientists, "we are impressed, but is any of it true?" And indeed the theory does well. On perhaps the least obvious prediction, it is consistently found that saving rates are higher where growth is higher, from the first time that Modigliani looked at the evidence until today when we have more and better data.

Of course, I was careful never to tell the scientists just how unusual was Modigliani's work. Or to admit that testing theoretical predictions is far from automatic in economics. Or to explain that many economists tend to think of the aggregate economy as if it were a single individual writ large, a 'representative agent', instead of following Modigliani, and deriving a theory in which the distinction between individuals and aggregates is not only taken seriously, but is used positively, to derive predictions for the economy that are quite different from the predictions for an individual, or a family. That

growth should increase saving rates is a prediction for the aggregate economy that has no counterpart for individuals or families, even though it follows from their behavior. That conversation is another one, in which Modigliani's admirers explain to other *economists* how economics ought to be done.

Modigliani's life-cycle theory is a fine piece of theory, supported by many years of empirical work, both by supporters and detractors. But it is more than that. It is life-cycle theory that helps us think about a host of important policy questions about which we would otherwise have very little to say. One of the most hotly debated issues today, in both Europe and in the US, is how societies should collectively make provision for the increasing numbers of elderly. How does government provision interact with private provision? Is a state pension a substitute for private retirement saving and, if so, to what extent? How do changes in retirement behavior affect the economy? Do social security systems affect the age at which people retire, and with it the amount of wealth in the economy? How does a stock market boom affect people's spending and saving? More broadly, anyone who thinks about economic development has to think about the role that saving plays in economic growth. Is thrift the wellspring of growth or simply its consequence? What about demography? Will the aging of China bring down its saving rate and bring its growth to a halt? Is that what happened in Japan? Is the wealth of the nation simply a vehicle for retirement provision? And what about the Rothschilds, the Rockefellers and the Queen of England, not to mention Bill Gates? Is it really true that they do not play an important role in national wealth accumulation?

These are among the grandest issues in economics, and our thinking about all of them has been fundamentally shaped by Modigliani's work. Indeed, his influence is so deep, and so automatic in economists' thinking that it is no longer easily documented. Life-cycle analysis is so much a part of our regular everyday toolkit, that we pay Modigliani the great compliment of not citing him.

## 1. The theory and its origins

Life-cycle theory makes its first appearance in two papers that Modigliani wrote in the early 1950s with a graduate student, Richard Brumberg (Modigliani and Brumberg 1954 and 1980). The implications of the theory were too rich to be easily contained in one paper, and the second was fated not to be published for many years. After Brumberg's early death from long-standing heart disease, Modigliani could not bring himself to pursue the revisions that would have been required to send it to a standard economics journal, and it became a famous unpublished paper (I was sent to read it in the Marshall Library as a Cambridge undergraduate in the 1960s). It did not appear in print until it was included in the second volume of Modigliani's collected papers in 1980.

Prior to Modigliani and Brumberg's collaboration, and inspired by the central role of the relationship between consumption and income in Keynes' *General Theory*, there had been an explosion of empirical analysis of consumption and saving, using both time-series, particularly by Simon Kuznets, and cross-sections, particularly by Dorothy Brady and Rose Friedman and by Margaret Reid. The empirical work had thrown up a great number of stylized facts, but no consistent story of how they hung together. Reviewing the theory after twenty years, Modigliani (1975, p. 5) wrote that

“The challenge that Brumberg and I faced as we began our collaboration around 1950 was that of building, from the received theory of consumer choice over time *à la* Fisher, and a minimum set of plausible postulates, a unified model of consumption and saving behaviour, capable of accounting for, and integrating, all the macro and micro evidence cited above and which could, in turn, lead to new, testable implications”.

The consistency of the life-cycle hypothesis with the received theory of consumer choice not only guaranteed its internal consistency, but also provided it with a generality that accounts for much of its durability. The original theory offers a specific account of consumption and saving, but it is derived from fundamental underlying principles that could be used to extend the model to deal with a wide range of issues about consumption and saving, many of which had not

been thought about in 1950. Social security is a key policy issue now and, although it plays little role in the original formulation, the framework can readily be extended to help us think about the consequences of alternative policies. Economic theory and its methods change over time, and life-cycle theory has been enriched and extended in ways that were not possible in the 1950s. Assumptions that were originally necessary for tractability have been relaxed. For example, Modigliani and Brumberg's original formulation recognized that life-cycle planning requires people to look into an uncertain future, and that it is difficult to formulate theoretically satisfactory and tractable models of how people behave in the face of uncertainty. In the subsequent half century, economists and others have developed methods for dealing with uncertainty, and economics has absorbed tools from the statistical analysis of time-series that enable us to handle expectations about the future in a more coherent way, and much recent work has been devoted to reworking life-cycle theory so as to rigorously incorporate an uncertain future. The tools were not available to undertake such a task in 1950.

Modigliani and Brumberg (1954) is primarily concerned with the cross-section or microeconomic implications of the theory, while Modigliani and Brumberg (1980) looks at the time-series and macroeconomic implications. For each individual, it is assumed (by appropriate assumptions about preferences) that increases in life-time resources lead to proportionate increases in consumption in all periods of life. As a result, consumption is proportional to life-time resources or, what is more or less the same thing, to average income over the life span. Yet it was well-known prior to 1950, and it remains true today, that the share of consumption in income is lower for better-off households or, equivalently, that the saving rate rises with income. Indeed the data often show *negative* saving rates among those in the lower part of the income distribution. These facts had influenced the way that Keynes thought about consumption, and his 'fundamental law' that consumption increased with current income, but not so rapidly. Modigliani and Brumberg (1954) argue that the proportionality of consumption and income in the long run is entirely consistent with the cross-sectional facts because, as we move up the income distribution, a higher and higher fraction of people are there on a temporary basis, with high transitory income, and thus a temporarily high saving ratio. The same argument explains why saving rates rise more rapidly

with income among households who are farmers or small-business proprietors, whose income tends to be relatively volatile, and why, at a comparable income level, black families save more than white families. Black families have lower incomes than whites on average, so for a black group and a white group with the same average income, transitory income is higher among the former. In the macroeconomic context, argued in Modigliani and Brumberg (1980), the same line of argument shows that, for the economy as a whole, the saving ratio should be constant over the long run (provided the rate of growth of the economy does not change), but will vary pro-cyclically over the business cycle. Over the business-cycle, as over the life-cycle, consumption is smoother than income.

Modigliani and Brumberg (1954 and 1980) contain the same basic theory, but the later paper makes a series of bold empirical predictions about the relationship in the aggregate economy between saving and growth and about the ratio of wealth to income in relation to the retirement span. It also develops a time-series aggregate consumption function, linking aggregate consumption to aggregate income, aggregate income expectations and aggregate assets, with coefficients that are affected by, among other things, the demographic structure of the population. This aspect of the life-cycle model was later developed jointly with Albert Ando (Ando and Modigliani 1963), and this work was also used for the consumption sector of the Federal Reserve-MIT-Penn large-scale macro-econometric model of the American economy in the 1960s, a time when such efforts were of serious academic as well as policy interest. The aggregate consumption function of the life-cycle hypothesis was not very different in practice from those developed from other approaches, particularly Milton Friedman's permanent income hypothesis, and by the early 1970s, empirical consumption functions had settled down to a formulation in which consumption responded with a lag to current income, and sometimes to various measures of wealth, a cross-breed that paid homage to various theories, but in practice had no clear rationale. The study of aggregate consumption was revived by the papers of Hall (1978) and Flavin (1981), which used ideas from time-series analysis and the theory of rational expectations to derive new insights about aggregate consumption regarded as a stochastic process.

The implications of the life-cycle theory for growth, saving, and the wealth to income ratio were to have a very different future. In the

1950s, these predictions could only be wildly speculative, because there existed none of the long-run historical or comparative cross-country data that could have been used to test them. According to Modigliani, the first attempts to use cross-country data to test the growth effects on saving were made by Houthakker (1965). Building on this, Modigliani (1970) provided confirmatory evidence of his own, in a study published in a *Festschrift* for Roy Harrod, whose own theory of 'hump-saving' (Harrod 1948) was an important forerunner of the life-cycle hypothesis. Modigliani (1992) later assembled more comprehensive and better evidence on saving and growth in developing countries in his plenary address to the World Congress of the Econometric Society in Barcelona in 1990. According to that comprehensive review, both growth and demographic structure are powerful predictors of national saving, with little or no role for the level of national income, exactly as Modigliani and Brumberg had predicted 40 years earlier. Later in life, Modigliani repeatedly argued that these growth effects were the essence of the life-cycle hypothesis, that the life-cycle hypothesis *was* the growth to savings hypothesis. And indeed this mechanism, with its precise theoretical derivation and its very specific predictions, not only about saving and growth, but also about saving and demographic structure, is unique to the life-cycle hypothesis.

## 2. Long-standing debates

One of the oldest challenges to the life-cycle hypothesis is the question of whether the data really support the fact that people save when they are young and run down their assets when they are old. Many investigators have found that the elderly do not dispose of their assets in the way that the theory requires, and indeed that many of the elderly appear to save part of their incomes. Saving for retirement, when we observe it at all, seems to start only in middle age and to be insufficient to prevent a sharp fall in consumption at retirement, and such a fall has been well documented (see for example Banks, Blundell and Tanner 1998).

Crude versions of these criticisms are sometimes in error. For example, I remember Modigliani being driven to something close to

apoplexy by the (once upon a time often-heard) suggestion that the life-cycle hypothesis is a theory for bachelors, that it ignores both the presence of children early in the life-cycle and bequest motives at its end. This ‘bachelor’ claim can only reflect a failure to read the work. The existence of bequests is recognized from the earliest papers, and the argument is not that they are not important, but that it is possible to go a long way without dealing with them, the same claim that is made for uncertainty, the effects of positive real interest rates, and other factors that complicate the analysis by more than they elucidate it. That the presence of children postpones saving for retirement was also always recognized, though it was perhaps given less attention than it deserved.

Critics also made another mistake that Modigliani turned to late in life, in a paper with Jappelli (1998), and his interview with Barnett and Solow (2000, p. 240), where he writes “the poor guys have just done the thing wrong”. When household surveys ask people to state their income, young people will typically exclude contributions to their pension plans by their employers – which they do not normally think of in the same way as take-home pay, and may be poorly informed about – while retired people will include as income the payments from the plans, a substantial fraction of which represent not income, but the drawing down of assets. Annuities are part interest and part principal. In consequence, the use of uncorrected household survey data is systematically biased against the life-cycle hypothesis, understating both the (youthful) saving and (elderly) dissaving components. Modigliani argued that much the same was true for state-provided pension schemes (in the US, social security), though this argument is a good deal less straightforward. While it is certainly true that we should take social security into account when thinking about people’s private saving plans, one can hardly validate life-cycle saving behavior by appealing to a government scheme that enforces it.

Errors aside, these critiques have had some impact on the way that we think about the life-cycle model, as was recognized by Modigliani, for example in his 1986 Nobel address, and in his review of the role of life-cycle saving in accounting for national wealth (Modigliani 1988). Uncertainty about the date of death may limit the extent to which retirees are willing to run down their assets, which in itself will generate ‘unintended’ bequests (though, if this is true, there is still the puzzle of why retirees do not make greater use of annuities), and

bequest motives may themselves be more important than allowed for in simple versions of the theory. Upgrading the importance of bequests, and downgrading the amount of private retirement saving (though private saving is notoriously hard to measure in household surveys) means that a smaller proportion of national wealth should be attributed to life-cycle saving and a correspondingly larger share to bequests. How much of each is still a matter for debate, and although Modigliani conceded some ground to the arguments of Kotlikoff and Summers (1981), it was a good deal less than his critics would have liked (Kotlikoff 1988).

That economic growth must necessarily increase saving rates was challenged in an early critique by Tobin (1967). He noted that, if each person expects their incomes to grow throughout their life, then the life-cycle hypothesis would mean that they should consume *more* than their income in early life, so that there would be dissaving at both ends of the life cycle, financed by saving in middle age. In extreme cases, and with high enough growth rates, such behavior can lead to a *negative* relationship between growth and saving rates and, indeed, the same effect can come about if young couples with children systematically spend more than they earn. Modigliani accepted this argument in theory, but doubted its force in practice, because it seems unlikely that young people would be able to borrow enough to secure living standards that were much beyond their current means. And as they move into middle age, there will come a point where they need to start accumulating assets for retirement, even if they would have liked to have borrowed at the beginning of the life cycle.

Modigliani had no time for the version of the life-cycle hypothesis in which families are assumed to live for ever, in the sense that they are assumed to maximize, not only their own lifetime utility, but a dynastic utility, including also the utility of all of their descendants. In this model of behavior, Barro (1974) established the so-called Ricardian equivalence hypothesis, that government surpluses and deficits have no effect on national saving, because the dynasties perfectly anticipate the implications for future taxation, and can always rearrange their own plans so as to offset government actions and restore national saving to its desired level. Modigliani certainly used theory to help understand the economy. But the man who had meticulously constructed a theory of aggregate consumption by rejecting the idea of a representative agent had predictably little interest in a theory that was

based on such a story. While his work often uses assumptions to simplify, Modigliani was always careful to justify the simplification, and he never relied on the idea that, if the model fits the data, it does not matter if its assumptions are preposterous.

### 3. Current topics in life-cycle saving

For a theory that is so central to economic analysis, and that has been worked on by so many people, the life-cycle hypothesis has aged well. And although the ways in which the theory is used have changed, the hypothesis continues to provide the framework in which economists think about intertemporal issues at both the individual and economy-wide levels. Over the last decade, new work had continued to modify and to challenge, both theoretically and empirically. We are still far from the sort of integration that Modigliani and Brumberg so successfully produced half a century ago, but there are results and ideas that are not easily reconciled with the life-cycle theory as Modigliani thought about it.

One issue is whether cross-country and long-term within-country differences in saving rates are really attributable to differences in growth rates. In the United States, the long-run decline in the private saving rate cannot be blamed on demographic changes, nor on the productivity slowdown after 1970; the aggregate decline comes from a decline in saving rates for all age groups, not from a redistribution of lifetime income from young to old. The cross-country correlation between saving and growth has been analyzed in an important and imaginative paper by Carroll and Summers (1991) who start from the fact that, in more rapidly growing economies, the young are relatively much richer than the old. If the life-cycle hypothesis is correct, even in part, the age profile of consumption should be relatively higher for the young than the old in more rapidly growing economies, so that higher growth should rotate the cross-sectional age-profile of consumption clockwise. This does not appear to be the case; if we plot average consumption against age for a range of economies, the graphs are essentially on top of one another, with little evidence of tipping. This finding is consistent with the failure to find much life-

cycle saving in the household survey data, and certainly not enough to drive the growth to saving mechanism. Yet the test does not depend on the shaky information on household saving from the surveys, relying only on the much more robustly measured age-profile of consumption. Perhaps the causation runs, not from growth to the saving rate, but from the saving rate to growth, something that is consistent with standard models of economic growth if transitions to equilibrium are very slow, and given that national rates of investment are (still) closely correlated with national rates of saving. While there is currently broad agreement on the existence of a correlation between saving and growth, there is no consensus on its causes.

The relationship between saving and the age-structure of the population is also a current topic of debate. Cross-country regressions regularly find that aggregate saving rates are lower when the population share of the elderly is high and when the population share of children is high, predictions that are in accord with the life-cycle theory if saving takes place in middle-age when earnings are high, after the child-rearing ages, but prior to retirement. Such regressions have strong negative predictions for currently high saving countries whose populations are aging, particularly countries in South and East Asia. Yet, once again, the microeconomic evidence on the age-profiles of saving are not consistent with the large effects that are estimated from the cross-country regressions. The cross-country analysis also seems to be fragile to econometric technique, with results quite sensitive to plausible changes in statistical specification.

Another challenge to the life-cycle hypothesis has come from thinking about uncertainty, something that Modigliani recognized as an unresolved issue from the earliest days. But he argued that the main effect of uncertainty would be to generate a demand for precautionary saving – a motive that had been recognized at least as early as Keynes – and that, except perhaps among the very young, the accumulated assets of life-cycle savers could serve a double purpose, not only for retirement, but as a buffer against unexpected emergencies. So he doubted that uncertainty would change the picture much. Theoretical results by Merton (1971) provided further support. Merton showed that if risk is confined to financial assets, the basic rule for life-cycle consumers of setting consumption proportional to assets remains true when utility maximization was replaced by expected utility maximization. Of course, that leaves a hole in the argument – earnings them-

selves are uncertain – and that hole turns out to be important, at least in some cases.

Work on precautionary saving, particularly by Carroll (1997), has shown that people with uncertain future earnings who are sufficiently prudent will never borrow, if there is the possibility, however remote, that they will not earn enough to be able to repay their debts. If such people expect their earnings to grow over time, they will nevertheless keep their consumption within their current incomes, thus inducing a close articulation, or ‘tracking’, between consumption and income. In this case, although people are maximizing their expected lifetime utility, as postulated by the life-cycle theory under uncertainty, their consumption is effectively constrained by their current incomes. Such behavior is directly contrary to one of the central insights of the Modigliani model, that the profile of consumption can be detached from the profile of income, and much more like the pre-Modigliani and Keynesian accounts of saving. Very much the same result can be obtained in a theoretical model in which people want to borrow but cannot. People can save to smooth out their consumption, but they cannot have consumption greater than their income, except when they already have some assets in the bank. In these extreme precautionary or ‘liquidity constrained’ accounts of saving, consumption is smoothed, not over the whole life cycle, but over much shorter periods of a few years at a time (see again Carroll 1997 and Deaton 1991). In the literature, this is often referred to as “high-frequency” smoothing of income, as opposed to the “low frequency” or “life-cycle frequency” smoothing that was postulated by Modigliani and Brumberg.

These results are not inconsistent with Modigliani’s argument about precautionary saving for (possibly the majority of) consumers who, under the original life-cycle model, wish to save, not borrow. These will be people who are sufficiently patient so as to be happy to postpone their consumption, or who do not expect much income growth in the future. Indeed, it is possible to reconcile the traditional and the new view by noting that it is the youngest families who are likely to want to borrow, but either cannot or are too prudent to do so, and are therefore more or less constrained by their current earnings, while those in middle age behave in the traditional life-cycle way. That such a formulation is consistent both with expected utility

maximization and with the survey data has been shown in an important paper by Gourinchas and Parker (2002).

Perhaps the most fundamental challenge to the life-cycle model has been directed at its basic underlying assumption, that people make rational, consistent, intertemporal plans, that they act as if they are maximizing a utility function defined over the periods of life, according to “the received theory of consumer choice over time *à la Fisher*” (Modigliani 1975, p. 5). Economists behavioral assumptions about consumer choice have long been challenged by psychologists and others but, until recently, these critiques have not had much effect on mainstream economic analysis. Many anomalies and paradoxes have been identified over the years, often associated with the way that people deal with the uncertainty that is inevitable when making choices that involve comparisons of consumption today with consumption in the future. Even commercial financial planners advise their clients about retirement planning according to rules and recommendations, such as target wealth to income ratios that, under some circumstances, are wildly inconsistent with life-cycle theory. These commercial plans are not *better* than life-cycle plans, and can lead to disaster under some circumstances, but they attest to the implausibility that individuals, who lack the resources and computer facilities of financial planners, do better in following life-cycle rules. Yet this evidence has not had a large impact on the mainstream if only because a collection of anomalies by itself provides no alternative to enable us to think coherently about saving. Economists often express the concern that, if we abandon utility maximization, we can explain anything, or nothing. And after all, at least some people (including most economists!) do make provision for retirement, above and beyond state schemes, so that life-cycle theory captures some of the truth, even if it is clear that the details are wrong.

In recent years, there has been a flowering of the field of behavioral economics, a joint enterprise between economists and psychologists, including among the latter those who study the neural circuitry of the brain. This work shows some potential for a truly integrative theory. One strand formalizes procrastination using the concept of ‘hyperbolic discounting’ (Laibson 1997 and Laibson and Harris 2001). Unlike standard life-cycle consumers, people who are ‘hyperbolic discounters’ do not consistently rank their consumption at different periods in their life, independently of their current position, as one

might imagine doing before being born, but change their views of each period depending on where they currently are. In particular, there is always a large discount placed on tomorrow relative to today although, after tomorrow, relatively far off dates are discounted sensibly relative to not-so-far-off days. Savers are like St Augustine, who prayed for chastity and obedience, but not today. They are happy to sign up for rational, life-cycle saving plans, provided they start tomorrow. Such models are supported by biological evidence on the structure of the brain, which employs quite different neural systems to deal with immediately available rewards (the limbic system) from those that are used to deal with rewards at different times in the further future (the prefrontal cortex) (McClure *et al.* 2004); emotions color immediate choices, calculation dominates for more distant ones. As is the case for life-cyclers, the consumption and saving behavior of people who behave this way can be rigorously analyzed, and the work is beginning to yield interesting, testable and useful predictions.

Under hyperbolic discounting, people wait too long to get started on saving for retirement, something that is consistent with the very limited life-cycle saving that we see in the data, and which can be a costly error given the power of compound interest. More generally, default options in saving plans matter, because people procrastinate on changing the default; Thaler and Benartzi (2004) have analyzed (and trade-marked) a plan called “Save more tomorrow™”, whereby people who are typically reluctant to save will willingly sign on to a plan that triggers a fractional salary deduction for saving starting ‘tomorrow’, with the fraction escalating thereafter until a target saving ratio has been met. Like Thaler, David Laibson and his coauthors have worked extensively on various behavioral influences on saving, and have thought about how to design saving and pension schemes that make it easier for people to save, and to help people participate in a way that is in their own interests.

The ‘in their own interests’ is important in this context. Unlike standard utility-maximizing economics, where people are always assumed to act (optimally) in their own interests, behavioral economics frequently describes cases in which people do not or cannot do so. This can easily lead to a paternalist welfare economics, in which the state or others tell people what is in their own good, but it need not do so, particularly if it is clear that people would like to behave in the way that economics thinks they ought to, but have difficulty in doing

so. This observation helps us think about the place of the life-cycle theory within the new behavioral economics of saving. As far as I am aware, no one has challenged the view that, if people were capable of it, they ought to plan their consumption, saving and retirement according to the principles enunciated by Modigliani and Brumberg in the 1950s. But life is complicated, choice under uncertainty is particularly so, and even when we know what is best for us, we do not always do it, and would often appreciate help in doing better. Even if behavioral economics manages to replace the life-cycle theory in providing a successful empirical description of the way that people actually behave – and it is still some way from having achieved that aim – the life-cycle model will still be the baseline to which people aspire. The role of behavioral perspectives is to help make people better-off by making life-cycle behavior a better description of behavior. Perhaps we are witnessing the movement of Modigliani's life-cycle hypothesis from a positive to a normative theory, away from description and towards prescription.

#### REFERENCES

- ANDO, A. and F. MODIGLIANI (1963), "The 'life-cycle' hypothesis of saving: aggregate implications and tests", *American Economic Review*, vol. 53, no. 1, pp. 55-84.
- BANKS, J., R. BLUNDELL and S. TANNER (1998), "Is there a retirement-savings puzzle?", *American Economic Review*, vol. 88, no. 4, pp. 769-88.
- BARNETT, W.A. and R.M. SOLOW (2000), "An interview with Franco Modigliani", *Macroeconomic Dynamics*, vol. 4, no. 2, pp. 222-56.
- BARRO, R.J. (1974), "Are government bonds net wealth?", *Journal of Political Economy*, vol. 82, no. 6, pp. 1095-117.
- CARROLL, C.D. (1997), "Buffer-stock saving and the life-cycle/permanent income hypothesis", *Quarterly Journal of Economics*, vol. 112, no. 1, pp. 1-55.
- CARROLL, C.D. and L.H. SUMMERS (1991), "Consumption growth parallels income growth: some new evidence", in B.D. Bernheim and J.B. Shoven eds, *National Saving and Economic Performance*, Chicago University Press for NBER, Chicago, pp. 305-43.
- DEATON, A. (1991), "Saving and liquidity constraints", *Econometrica*, vol. 59, no. 5, pp. 1221-48.
- FLAVIN, M. (1981), "The adjustment of consumption to changing expectations about income", *Journal of Political Economy*, vol. 89, no. 5, pp. 974-1009.
- GOURINCHAS, P.-O. and J.A. PARKER (2002), "Consumption over the life-cycle", *Econometrica*, vol. 70, no. 1, pp. 47-89.

- HALL, R.E. (1978), "Stochastic implications of the life cycle-permanent income hypothesis: theory and evidence", *Journal of Political Economy*, vol. 86, no. 6, pp. 971-87.
- HARROD, R.F. (1948), *Towards a Dynamic Economics*, Macmillan, London.
- HOUTHAKKER, H.S. (1965), "On some determinants of saving in developed and underdeveloped countries", in E.A.G. Robinson ed., *Problems in Economic Development*, Macmillan, London, pp. 212-24.
- JAPPELLI, T. and F. MODIGLIANI (1998), "The age saving profile and the life-cycle hypothesis", *CSEF Working Paper*, no. 9, Dipartimento di Scienze Economiche, Università degli Studi di Salerno, Centre for Studies in Economics and Finance; reprinted in *Collected Papers of Franco Modigliani*, vol. 6, MIT Press, London, 2005, pp. 141-72.
- KOTLIKOFF, L. (1988), "Intergenerational transfers and savings", *Journal of Economic Perspectives*, vol. 2, no. 2, pp. 41-58.
- KOTLIKOFF, L. and L.H. SUMMERS (1981), "The role of intergenerational transfers in aggregate capital formation", *Journal of Political Economy*, vol. 89, no. 4, pp. 706-32.
- LAIBSON, D.I. (1997), "Golden eggs and hyperbolic discounting", *Quarterly Journal of Economics*, vol. 112, no. 2, pp. 443-77.
- LAIBSON, D.I. and C. HARRIS (2001), "Dynamic choices of hyperbolic consumers", *Econometrica*, vol. 69, no. 4, pp. 935-57.
- MCCLURE, S.M., D.I. LAIBSON, G. LOEWENSTEIN and J.D. COHEN (2004), "Separate neural systems value immediate and delayed monetary rewards", *Science*, vol. 306, no. 5695, pp. 503-07.
- MERTON, R.C. (1971), "Optimal consumption and portfolio rules in a continuous-time model", *Journal of Economic Theory*, vol. 3, no. 4, pp. 373-413.
- MODIGLIANI, F. (1970), "The life-cycle hypothesis of saving and intercountry differences in the saving ratio", in W.A. Eltis, M.F.G. Scott and J.N. Wolfe eds, *Induction, Growth, and Trade: Essays in Honour of Sir Roy Harrod*, Clarendon Press, Oxford, pp. 197-225.
- MODIGLIANI, F. (1975), "The life-cycle hypothesis of saving twenty years later," in M. Parkin and A.R. Nobay eds, *Contemporary Issues in Economics*, Manchester University Press, Manchester, pp. 2-35.
- MODIGLIANI, F. (1986), "Life-cycle, individual thrift, and the wealth of nations", *American Economic Review*, vol. 76, no. 3, pp. 297-313.
- MODIGLIANI, F. (1988), "The role of intergenerational transfers and life-cycle saving in the accumulation of wealth", *Journal of Economic Perspectives*, vol. 2, no. 2, pp. 15-20.
- MODIGLIANI, F. (1992), "Saving in developing countries: growth, income, and other factors," in S. Ghon Rhee and R.P. Chang eds, *Pacific Basin Capital Markets Research*, vol. 3, North-Holland, Amsterdam, pp. 23-35.
- MODIGLIANI, F. and R. H. BRUMBERG (1954), "Utility analysis and the consumption function: an interpretation of cross-section data", in K.K. Kurihara ed., *Post Keynesian Economics*, Rutgers University Press, New Brunswick, pp. 388-436.

- MODIGLIANI, F. and R.H. BRUMBERG (1980), "Utility analysis and aggregate consumption functions: an attempt at integration", in A. Abel ed., *The Collected Papers of Franco Modigliani*, volume 2, *The Life Cycle Hypothesis of Saving*, The MIT Press, Cambridge, Mass., pp. 128-97.
- THALER, R. and S. BENARTZI (2004), "Save more tomorrow™: using behavioral economics to increase employee saving", *Journal of Political Economy*, vol. 112, no. 1, pp. S167-87.
- TOBIN, J. (1967), "Life-cycle saving and balanced growth", in W. Fellner *et al.* eds, *Ten Economic Essays in the Tradition of Irving Fisher*, John Wiley, London and New York, pp. 231-56.