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THE LIFECYCLE MODEL OF CONSUMPTION AND SAVING

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The life-cycle framework is the standard way that economists think about the intertemporal allocation of time, effort and money. The framework has a venerable history in the economics profession with roots in the infinite horizon models of Ramsey (1926) and Friedman (1957) and the finite horizon models of Fisher (1930) and Modigliani and Brumberg (1956). Developments since the 1950's have considerably increased the breadth, depth and coherence of the framework so that the modern version provides a guide to thinking about the modeling of many life-cycle choices (such as consumption, saving, education, human capital, marriage, fertility and labor supply) while taking account of uncertainty in a rigorous way. However, the life-cycle framework is held in increasing disrepute within the profession. We believe that reports of the demise - or even ill health - of the theory are much exaggerated. In this article we provide a defence of the life-cycle *framework* as a source of models that can be taken to the data. We emphasize this distinction between the life-cycle framework (or tradition) and particular models with empirical content. The life-cycle framework is a conceptual framework within which we can develop useful models; in this view, there is no such thing as *the* life-cycle model, only particular life-cycle models.

In its most general formulation, the life-cycle framework simply asserts that agents make sequential decisions to achieve a coherent (and 'stable') goal using currently available information as best they can. This is a catholic view which does not rule out many models which would not be consistent with earlier restrictive models in the life-cycle tradition (such as variants of the permanent income model). For example, we would certainly include within the framework the Deaton (1991) 'buffer stock' model which assumes that agents cannot borrow

and that they are impatient, even though this predicts much more 'tracking' of consumption with income than earlier 'permanent income' models can accommodate. More generally we would not rule, *a priori*, potentially important features such as habits, imperfections in capital markets, disagreements between husband and wife about how much to save, limited computational powers and discounting of the future that changes over time (as, for example, in the hyperbolic discounting model of Laibson (1997)). We would, in fact, go much further and include, for example, models that do not assume expected utility so as to allow that agents may have a preference for the early or late resolution of uncertainty even when this does not confer any planning advantages (see Kreps and Porteous (1978) and Epstein and Zin (1992)). What the framework does rule out is 'rule of thumb' ('Keynesian') behavior, in which households simply spend a fixed fraction of their income. It also rules out many psychological or behavioral explanations such as those of Thaler (1994) and Levin (1998).

Thus for us the life-cycle framework is very wide and includes very many possible empirical models. Given this view, the challenge is to develop models from within the framework that are analytically tractable, have empirical content (so that they can be rejected) and capture important features of intertemporal decisions. The coherence and depth of the life-cycle framework is a major advantage in this choosing of models. Life-cycle models aspire to be an explanation of many aspects of behavior, and a life-cycle model developed to fit one data feature will have many other testable implications. As will be illustrated below, this disciplines the model builder, and means that life-cycle models can be enriched with realistic features while maintaining rejectability. These virtues should not be given up lightly with the appearance of so-called 'anomalies' that

cannot be reconciled with the simplest models within the framework.

One example of the coherence of the life-cycle framework is that it provides a way of thinking about intertemporal allocation at all frequencies; we shall concentrate on this in this article. Specifically, we discuss a selected set of issues concerning how well households ‘smooth’ consumption at different frequencies: high (within the year); medium (year to year or across the business cycle); low (across the working life) and very low (across stages of the life-cycle). It is important to emphasize that within the life-cycle framework ‘smoothing’ does *not* mean keeping consumption or expenditures constant; far from it. Rather, smoothing means that agents try to keep the marginal utility of money constant over time, which may involve quite variable expenditures. Our broad conclusion is that although there are many features of the data that cannot be reconciled with simple life-cycle models, more sophisticated variants are largely successful; even so, some significant puzzles and challenges remain, which suggest areas for future work. We shall not discuss at length many other facets of intertemporal allocation that have recently received attention, such as Euler equation modeling or the importance of the pre-cautionary motive, but we do provide a brief discussion of some other issues in the penultimate section.

To illustrate many of the empirical issues below, we use U.K. Family Expenditure Survey data.¹ This provides a long time series (1968 to 1995 in the version used here) of cross-section information on family expenditures, income and demographics. This survey is run continuously with about 7000 households

¹The FES was made available to the Institute for Fiscal Studies (IFS) by the ONS through the ESRC Data Archive and is used by permission of the controller of HMSO. Neither the IFS, ONS nor the ESRC Data Archive bear responsibility for the analysis or the interpretation of the data reported here.

each year keeping two-week diaries of their expenditures on all goods. The long time series allows us to treat business cycle and life-cycle effects in a satisfactory way. Attanasio and Weber (1995, sec. 2), provides an accessible and authoritative discussion of the Family Expenditure Survey data. We also present some evidence from the Canadian Out of Employment Panel (COEP). This survey follows for two years 20,000 individuals who separate from a job in either 1993 or 1995 and collects very detailed information about household finances and expenditures as well as information about the respondents' labor market experiences. More detail about this survey can be found in Browning and Crossley (2001)²

Evidence on Smoothing at Different Frequencies

Within the year

In considering the evidence on how consumption is allocated within a year it is important not to miss the forest by looking too closely at particular trees. The key implication of a simple life-cycle model is that the path of consumption expenditures in the year should be independent of the anticipated income path within the year (except for the latter setting a budget constraint).³ Thus in the FES data, average monthly income is relatively constant throughout the year but expenditures in December are about 21 percent higher than in the other

²The COEP data were generously provided by Human Resources Development Canada which is not responsible for the interpretation given the data here.

³This will not be true if anticipated changes in income are associated with changes in uncertainty. However, we think that is unlikely that this caveat is important for the examples we consider at this time horizon. However, it may be important at lower frequencies and we return to this point below when we discuss the role of the precautionary savings motive in the comovements of income and consumption over the working life.

months of the year. This very robust finding that income and consumption are not highly correlated within the year is consistent with life-cycle models, but not with rule of thumb behavior. It also tends to be overlooked because it is so familiar. Note that in this illustration we have reversed the usual roles of income and consumption. In many illustrations of life-cycle models, the example involves income varying and consumption being less variable. In this case, income is relatively smooth and consumption varies. This example helps emphasize our warning in the introduction that ‘smoothing consumption’ does not mean keeping it constant.

There has also been a recent spate of papers which use micro data to conduct more focused tests of whether household spending responds to anticipated within-year income changes. These papers follow on from earlier studies of aggregate data (see Poterba (1988) and Wilcox (1989)). Although aggregate evidence is appropriate for assessing changes that affect a sizable proportion of the population, much more can be learned from micro studies that examine differences between households. The micro studies offer mixed support for the life-cycle hypothesis – but we will offer an interpretation to reconcile the mixed evidence.

Some micro studies have found that households overreact to changes that do not appear to alter expected lifetime income. Shapiro and Slemrod (1995) present survey evidence on the response to a change in tax withholding in the United States that involves only the timing of tax payments, with no effect on lifetime income. They found that a significant proportion of respondents reported that they would change their expenditure plans. They also found that being in the ‘over-reaction’ group is not correlated with conventional indicators

for being liquidity constrained such as having low income. Ruling out liquidity constraints as an explanation of the observed behavior presents a challenge for the life-cycle framework. Similarly, Souleles (1999) and Parker (1999) present evidence using U.S. Consumer Expenditure Survey data that anticipated within-year income changes are synchronized with expenditure changes. Souleles uses the receipt of income tax rebates whereas Parker uses changes in take-home pay that result from the cessation of Social Security taxes within the year for higher earners. In both cases it is plausible that the income changes are anticipated. Both Souleles and Parker find significant increases on some expenditures in the months when the income increases take place. In Parker (1999) these changes are concentrated on durables, semi-durables and goods where the purchase can be postponed more than other goods. Just as for Shapiro and Slemrod (1995), Parker does not find any evidence that those who might conventionally be considered liquidity constrained are more likely to react to the anticipated change in income. Finally, Hsieh (2000) presents a Souleles-style analysis of expenditure reactions to income tax refunds in Alaska and, just like Souleles (1999), finds that household expenditures ‘over-react’ to these.

Hsieh also presents some other evidence which seems very important to us. He shows that the same households who overreact to the income tax refund do *not* ‘over-react’ to payments from the Alaska Permanent Fund that are made regularly every fall. Hsieh suggests that the differences arise since the Fund payments are very reliable and can be used as collateral for borrowing. However, this stress on liquidity constraints is at odds with the findings discussed above that those who ‘over-react’ are not strong candidates for being constrained. The final piece of evidence we present is from Browning and Collado (2000) who con-

sider within-year expenditures in Spain. A majority of Spanish workers receive a double-payment bonus in June and December. This bonus is automatic and is *not* related to performance. Using a Spanish consumption panel data set which follows households for up to eight quarters, they show that the expenditure paths of ‘bonus’ and ‘non-bonus’ households for durable and non-durable goods over the 12 months of the year are indistinguishable. There is no effect of receiving the bonus on expenditure patterns within the year.

Can we reconcile these different results within the life-cycle framework? Browning and Collado (2000) suggest that agents have bounded rationality and choose not to calculate the optimal consumption response to an income change when the latter is small and variable. This explanation is closely related to investigations of ‘near-rational’ behavior (for example, Akerlof and Yellen (1985) and Cochrane (1989)). To explore the plausibility of Browning and Collado’s suggestion, we have calculated, for three of the ‘natural experiments’ described above, the welfare cost of simply setting consumption equal to income, rather than following an optimally smoothed path.⁴ In the first experiment, taken from Parker (1999), the average household stops paying a Social Security deduction of 7% at the end of September so that income is $0.93Y$ for the first nine months of the year and Y for the last three months. The second path,

⁴We consider a model in which utility within the year is additive over monthly consumption with the same sub-utility function for each month. We also set the discount factor and the interest rate factor over the year to unity. Given this, the optimal monthly allocation path $(\hat{c}_1, \hat{c}_2, \dots, \hat{c}_{12})$ is to keep consumption constant over the year, $\hat{c}_t = c^*$. For a given utility function we can calculate the exact utility from such a program. For illustrative purposes, we use a constant relative risk aversion (or iso-elastic) subutility function with a coefficient of relative risk aversion of 2. We then calculate the compensation an individual following such a nonoptimal path would require to have the same utility as the optimal path. These calculations are similar to those of the cost of deviations from optimal consumption paths at business cycle frequency presented by Cochrane (1989). We calculate exact welfare costs over certain paths while Cochrane uses a convenient second-order approximation.

taken from Hsieh (2000), has average household income of \$2,664 per month with an average Alaska permanent fund pay-out of \$1,648 in October. Third, the bonus scheme in Browning and Collado (2000) has households receiving 1/14 of annual income in 10 months and 2/14 in the other two months⁵. For these three studies, the welfare costs as a percentage of annual expenditures are approximately 0.1, 2 and 7 percent respectively. Thus, the welfare costs of ignoring the Spanish bonus system are equivalent to an annual loss of almost a month's consumption, while ignoring the Alaska Permanent Fund schedule costs a week of consumption, and for the Social Security pattern, the annual loss is equivalent to an afternoon's consumption. With such disparate welfare costs, it is no surprise that agents take account of some paths and not others. While the deviations from complete smoothing that we see in the data may be inconsequential in terms of individual households' welfare, the work of Akerlof and Yellen (1985) and of Gruen (1997) suggests that they could be important in aggregate, and in terms of policy. Thus, it is important to understand them. To accommodate all of the results presented, we introduce notions of 'near rationality' or transactions costs. This illustrates well how failures of simple models lead us to develop new models that are still within the life-cycle framework.

Year-to-Year and Business Cycle

Turning to consumption over the medium run of a few years or over a business cycle, a new set of issues arise. Figure 1 presents some evidence on consumption over the business cycle using the U.K. Family Expenditure Survey data. We plot three-year running means of (the log of) consumption of nondurables consump-

⁵Our calculations here overstate the welfare costs of ignoring the bonus scheme since it does accommodate the extra consumption that agents make in December.

tion over the years 1969 to 1994 for three cohorts of couples with and without children: those born between 1928 and 1935 (for the years 1968 to 1987); those born between 1936 and 1943 (for all years) and those born between 1944 and 1951 (for 1976 to 1995). The reason for dropping the later years for oldest cohort is to exclude households in which the husband is aged 60 or over and thus avoid the issue of retirement. For the youngest cohort, we choose years so that no household with a husband aged 24 or less is included. Following Attanasio and Browning (1995), we have also taken out the trend and life-cycle effects by first regressing cohort mean log consumption on mean demographic variables and then plotting residuals.

A first pattern visible in Figure 1 is that consumption swings for the three cohorts are relatively synchronized with obvious business cycle peaks in 1972-74, 1978- 80 and 1989-91, albeit with different amplitudes for different cohorts. A second feature of the figure is the size of the swings; for example, from 1982-84 mean consumption for the youngest cohort rises by about 11 percent to the peak in 1989-91. These patterns and variations are comparable to those seen in aggregate time series data; Attanasio and Weber (1994) offer a thorough discussion of the comparability with the aggregate data.

This connection of consumption to the business cycle is potentially worrisome for life-cycle models, since it seems to imply that people are not smoothing consumption over this time horizon. However, within the general context of the forward-looking life-cycle framework, several explanations for these patterns have been proposed. Consider, for example, a business cycle downturn which leads to an increase in unemployment. It is plausible that labor supply and consumption (or more correctly, consumption of market goods) are complements,

both because there are costs of going to work and because those who are out of work can substitute home production for market expenditures. Baxter and Jermann (1999) and Apps and Rees (2001) suggest that consumption/labor supply complementarities may constitute a significant part of the explanation for the correlation between consumption and the business cycle. Our own feeling is that although this effect may be important for certain individual households, it is difficult to believe that it can have much macro impact since cyclical unemployment hits a relatively small proportion of workers and the costs of going to work are not a large proportion of any household's consumption.⁶

A second possibility is that the correlation of consumption with business cycles could be explained by some form of intertemporal substitution. This would follow if household consumption reacts to interest rates and interest rates are correlated with the business cycle. This appears unlikely for two reasons. First, most studies find that the size of intertemporal substitution – that is, the effect of changes in interest rates on consumption – are weak at best (Hall, 1988; Browning and Lusardi, 1996). However, this issue is not settled. For the United States, Parker (1999) reports that the real interest rate is more strongly correlated with consumption growth in recent years than in the past. A second issue is that real interest rates do not appear to track the business cycle very closely. For example, real interest rates moved from being substantially negative for some years in the 1970s as inflation soared to being quite high in the mid-1980s as inflation declined, without much synchronization with the peaks and troughs of the business cycle. As a result, any changes in consumption

⁶However, the authors cited suggest mechanisms by which nonseparabilities between labor supply and the consumption of market goods might be important more generally.

in response to real interest rates are unlikely to explain the pattern in Figure 1.

Finally, cyclical downturns may also represent net bad news about future prospects for workers (even for those whose employment status is not initially affected) and for capitalists. If downturns do represent, in part, shocks that are unanticipated and persistent, then they will lead to downward revisions in desired consumption for many households which will have an effect on aggregate consumption. Consumption growth and income growth move together quite strongly over the business cycle (using data for the groups in Figure 2, the coefficient in a regression of consumption on income is 0.5 with a t -value of 6), and this cyclical tracking of consumption with income may seem to have too little smoothing for life-cycle models. However, it's hard to draw this conclusion rigorously. In fact, formal 'excess sensitivity' tests *on micro data* typically cannot reject the hypothesis that the co-movements in consumption and income at this frequency are driven by unanticipated movements in income. As we discuss in the next section, the issues of how to model income processes, the persistence of income changes, and the information that agents can extract from these changes, is still very much an open question. Thus, we conclude that it is not yet possible to offer a convincing assessment of the compatibility of this feature of the data with the theory.

As well as common movements of consumption and income over the business cycle, we can also consider a much more focused issue: do households manage to smooth consumption over unemployment spells? After all, the unemployed probably have both temporarily lower income and less access to credit markets, which suggests that they should be less able to smooth consumption. Table 1 presents the distribution of changes in household income and household expen-

diture for a group of households in which a member moved from employment into unemployment. The data are drawn from the Canadian Out of Employment Panel. The changes in income and expenditure are all self-reported and refer to the change between the month just prior to the interview (which is typically six to nine months after the job loss) and the month just prior to job loss. It is quite clear that some smoothing is going on, since expenditure changes are much smaller than income changes. Second, it is nevertheless true that job and income loss appears to be associated with some expenditure fall. Should this finding be interpreted as a failure of the life cycle framework?

When unemployment occurs, household expenditures can change for three reasons: the costs of working decline; as a response to the fact that the unemployment represents ‘news’ and as a response to the downward ‘transitory’ income change. The first two responses are consistent with a life-cycle approach. However, the last factor is not consistent with standard life-cycle models. One approach to isolating the “transitory income” response associated with becoming unemployed is to examine the situation of unemployed workers who have different levels of their original income replaced by unemployment insurance. If the difference in replacement rates is not correlated with either the costs of working or with the news about permanent income contained in job loss, then the connection between variations in replacement rate and consumption changes (that is, not the changes reported in Table 1, but rather the changes in those changes, as we move across benefit levels) will identify the transitory response. Thus, Gruber (1997) uses variation in unemployment insurance replacement rates across U.S. states and through time to estimate that a ten percentage point cut in benefit levels (from 60 percent to 50 percent replacement, for example)

would lead to an average fall of 2.5 percent in food expenditures. In Browning and Crossley (2001), we use a series of legislative reforms to the Canadian unemployment insurance system to estimate that a benefit cut of ten percentage points leads to a fall in total expenditures of less than 1 percent. Moreover, when we split the data by whether the households report having liquid assets prior to job loss, we find absolutely no effect of the replacement rate on those households who report having such assets. The largest replacement rate effect we find is about 3 percent, among those respondents (9 percent of our sample) whom one might expect to be most vulnerable (and credit constrained): those with families, but whose spouse has no labor force attachment and whom had no liquid assets at job loss. This correlation of the response with liquidity constraint indicators suggests that the responses we do observe are the result of liquidity constraints rather than non-optimizing (rule-of-thumb) behavior.⁷ Moreover, the Gruber and Browning and Crossley estimates imply a marginal propensity to consume out of transitory income (benefits) which is much less than one. For example, for our ‘most vulnerable’ group, a dollar cut in unemployment insurance benefits leads to an average fall in total expenditures of only 25 cents - considerably less than the dollar-for-dollar responses predicted by rule-of-thumb or liquidity constraint models. Thus we conclude that life-cycle models provide at least a useful starting point for thinking about the impact of unemployment benefit levels on the living standards of the unemployed.

Another interesting aspect of expenditure patterns around spells of unem-

⁷The evidence noted above from Parker (1999) and Shapiro and Slemrod (1995) suggests that liquidity constraints are not a likely explanation of responses to transitory income among the general population. Our evidence suggest that they may be a factor in the behaviour of the unemployed.

ployment is the role of durables. Expenditures on durables are more volatile than on nondurables over the business cycle (Attanasio, 1999). Indeed, expenditures on durables fall with unemployment by more than nondurables among low education households, who are also most likely to be liquidity constrained (Gruber and Dynarski, 1997). In Browning and Crossley (1999), we develop the idea that agents have access to “internal capital markets” by postponing the purchase of some kinds of durables during a spell of unemployment. For example, the service flow from an old but undamaged winter coat is almost as great as that from a new one. In this case, large changes in durable expenditures may not be reflected in large changes in service flows and hence welfare. This mechanism breaks the chain that smoothed marginal utility should result from smoothed consumption and smoothed expenditures. In an empirical analysis based on the Canadian unemployment survey, we find that expenditures on small durables are much more sensitive to unemployment insurance replacement rates than expenditures on food (Browning and Crossley, 1999). In theory, the effect should manifest itself primarily among households who are likely to be liquidity constrained - and this is also confirmed empirically. Moreover, this greater sensitivity of durable expenditures is measured *conditional* on total expenditure levels, and thus cannot be attributed to the fact that small durables are often luxuries while food is a necessity.⁸

The general point this discussion illustrates is that extending a life-cycle model - in this case, allowing for the fact that households purchase both durables and non-durable goods - can lead to a much richer set of predictions for the

⁸See Browning and Crossley (1999) for more detail on why this is so, and why it also means that differences across goods in intertemporal substitution elasticities cannot explain the result.

link between income and expenditure. It is also important to note that the particular model we present is an example of a life-cycle model being relaxed in a plausible way within the life-cycle framework without losing rejectability. This model with durable and nondurable goods and in which total expenditure can track income, remains empirically distinguishable from models with a liquidity constraints (but no durable goods) and from models with rule of thumb behavior.

Within the Working Life

A working life runs from the completion of schooling up to retirement. Thurow (1969) was the first to raise explicitly the concern that the correlation between income and consumption over the working life might not fit with the implications of a very basic life-cycle model. Thurow noted that in U.S. cross-sectional data, both income and consumption had a similar inverted U-shape with peaks of both paths occurring at a roughly similar age. Figure 2 presents a version of this pattern for a sample of U.K. couples (with and without children) in which the husband was born between 1936 and 1943 (so that households are ‘aged’ between 25 and 32 in 1968 and between 52 and 59 in 1995. (This is the ‘middle’ cohort used in the previous sub-section). Again, cyclical and growth effects are taken out of these data.⁹ This pattern has also been observed in many other data sets (Browning, Deaton and Irish, 1985; Carroll and Summers, 1991; Attanasio and Weber, 1995). A number of alternative explanations have been suggested for this correlation. First, it may be that most households set current consumption to some constant fraction of current income. This “rule of thumb”

⁹To do this, we take residuals from a regression of log income and consumption on year dummies for all households in the Family Expenditure Survey (about 200,000 households over 28 years). We then take means for the sample discussed in the text.

behavior, as it is called, is not compatible with the life-cycle framework. A second explanation, the one suggested by Thurow (1969), is that households are liquidity constrained; that is, they would like to spend more than their current income when they are younger but they cannot borrow. A third explanation was suggested by Nagatani (1972). He argued that instead of being liquidity constrained, households are “prudent”.¹⁰ Prudence leads households to treat future uncertain income cautiously and not to spend as much currently as they would if future income were certain (with a value equal to its mathematical mean). Thus, prudence is the precautionary motive for saving. Both the liquidity constraint and prudence explanations offer a reason for consumption to track income in early life, but both have some difficulty in explaining the simultaneous downturn in income and consumption in later working life. A fourth reconciliation of consumption tracking with income over the working life is due to Heckman (1974). He suggested that wages have an inverted U-shape. Labor supply responds positively to this pattern of wages, leading income to also follow an inverted U-shape path. If, moreover, consumption and labor are complements (again, because there are costs of going to work and also possibilities for substituting market purchases for home production), then consumption will track income. A final possible explanation is that the path of children present in the household follows an inverted U-shape and this drives consumption (Tobin, 1967; Browning, Deaton and Irish, 1985). This last explanation leaves some-

¹⁰It is important to distinguish risk aversion (the within period utility function having a negative second derivative) from prudence (a positive third derivative). For example, quadratic preferences display risk aversion but no prudence. The analysis of the role of prudence in consumption and saving decisions has been one of the central themes in the literature for the last 15 years; see Deaton (1992), Browning and Lusardi (1996) or Carroll (this JEP) for further references.

thing of a mystery as to why income is then correlated with consumption.¹¹

In a widely cited paper, Carroll and Summers (1991) present evidence against the rule of thumb explanation. Basically the correlation is too strong unless almost everyone uses a rule of thumb. They also argue against the Heckman rationalization, by showing that it requires what seem to be implausibly high labor supply elasticities. They come down in favor of liquidity constraints and prudence, while remaining agnostic about the importance of children. There is now an emerging consensus that this important empirical regularity can be explained by some combination of precautionary savings (prudence) and demographic changes over the life-cycle (children). Carroll (1994) and Hubbard, Skinner and Zeldes (1994) match the observed inverted U-shape in consumption with life-cycle models that include a prudent precautionary motive but which do not account for demographics.¹² Attanasio, Banks, Meghir and Weber (1996) and Gourinchas and Parker (1999) argue that whilst accounting for family size can go some way to removing the ‘excessive’ correlation between consumption and income over the working life, they also need to introduce a precautionary motive. In contrast, Browning and Ejrnæs (2000) find that if the numbers and ages of children are taken into account – for example, assuming that older children “cause” higher expenditures than younger ones – then there is no need to invoke prudence and all of the inverted U-shape in consumption

¹¹A possibility also remains that the correlation partly reflects a sampling phenomenon. All of the studies referenced are based on married households. Since households with high lifetime wealth tend to marry later, Browning and Ejrnæs (2000) suggest that some of the coincident rise in consumption and income in the earlier part of the life-cycle is due to sample selection. That is, as we follow groups from, say, age (of husband) 25 to age 40, we are gradually introducing more high income and high consumption households.

¹²Note, however, that the principal focus of the Hubbard *et al* paper was on consumption and asset behavior at the end of the working life.

can be attributed to the presence of children.

There are two primary lessons we draw from this recent literature. The first is that all of the disputants are using models that are located well within the life-cycle tradition. The models simply have plausible specifications of preferences: non-quadratic within period utility functions which allow for prudence and which allow that the marginal utility of expenditure depends on the presence of children (an assumption that will seem natural to most parents!). The issue is no longer whether the data are consistent with any reasonable empirical model within the life-cycle framework, but rather, which of several reasonable life-cycle models is the correct one. The second point is that, with respect to sorting out these competing life-cycle models, researchers currently reach varying conclusions, even when they use very similar (or even identical) data. This troubling observation leads us to conclude that richer data is needed to resolve the source of the ‘consumption tracking’ seen in the data. In particular, long panel data sets with good consumption information and information about prospective fertility plans and income expectations would allow researchers to control for some of the different explanations above. For example, as Browning and Ejrnæs (2000) note, finding that consumption tracks income even for households that start off with significant assets would make one skeptical of the liquidity constraint or prudence explanations.

Stages of the life cycle

The life cycle model predicts that individuals should smooth consumption, in the sense of holding marginal utility constant, across stages of life. The model predicts borrowing prior to labor market entry, wealth accumulation during the working life, and dissaving in retirement. Issues around such low frequency

smoothing are currently the subject of considerable research activity.

Beginning with the early life-cycle transitions, one might ask: why do students (who have high expected lifetime wealth) spend so little? Browning and Lusardi (2001) discuss eight possible answers. These include using a rule of thumb, liquidity constraints, prudence and non-separabilities between time and consumption (so that students have no time to spend!). However, there has been little empirical exploration of these alternatives.

Turning to the transition to retirement, one is confronted with several seeming puzzles. Apparently similar households reach retirement with very different wealth levels (See Bernheim, Skinner and Weinberg, 1997, and the references therein) and some researchers has suggested that many arrive with little or no wealth at all (see, for example, Lusardi, 2000). Moreover, a first pass at the data would suggest that households fail to smooth consumption across the retirement threshold; that is, consumption appears to fall with retirement (Banks, Blundell and Tanner, 1998; Bernheim, Skinner and Weinberg, 1997). A careful reading of the literature, however, suggests that the dust certainly has not settled on whether many households arrive at retirement with assets that are too low to maintain material living standards. A crucial issue seems to be whether one counts only financial wealth, or whether one instead tries to measure a broader notion of wealth including wealth held in housing, and in entitlements to social security and occupational pensions (compare, for example, Lusardi, 2000 and Gustman and Steinmeier, 1999). While we have several sources of survey data on financial wealth, this is not the case for pension and social security wealth, and these must often be imputed or estimated from secondary sources.

The issue of whether the heterogeneity of wealth at retirement is consistent

with the life-cycle model is also somewhat controversial. Bernheim, Skinner and Weinberg (1997) suggest that the standard life cycle model has great difficulty in explaining the heterogeneity in retirement wealth, in the sense that each of the candidate explanations they consider appears to be inconsistent with either the consumption level or consumption growth patterns in the data. These authors are illustrating one of the virtues of the life-cycle framework that we mentioned in the introduction. Because the framework is coherent story about many aspects of behavior, it imposes a stiff discipline on the ways in which heterogeneity can be introduced. Heterogeneity introduced to fit one feature of the data must also be consistent with other features of the data. As one example, say that high wealth households are households with low discount rates; that is, very patient households who are exceptionally willing to defer consumption. However, the life cycle model argues that households with low discount rates will have high consumption growth. Thus, if heterogeneity in discount rates underlies the observed heterogeneity in retirement wealth, then preretirement consumption growth rates should be correlated with retirement wealth levels – but this does not appear to be true.

On the other hand, Engen, Gale and Uccello (2000) argue that substantial heterogeneity in wealth at retirement is not inconsistent with reasonable life-cycle models. They emphasize that different realizations of earnings shocks will lead even identical households to end up with different wealth levels at retirement. They compare simulations of a life-cycle model that allows stochastic income shocks with data from the Health and Retirement Survey and the Survey of Consumer Finances. They find that more than half of the households in the data have wealth-earnings ratios that exceed the median target ratio

for households with the same characteristics in their simulated model. Less positively for the theory, they find oversaving by some households with high wealth-earnings ratios and undersaving by some households with low wealth-earnings ratios (when compared to their simulated results). But the details of their results aside, the key point is that a life-cycle model is capable of explaining a considerable amount of heterogeneity among households with identical preferences but different life experiences.

In using life-cycle models to explain the observed fall of consumption at retirement, the basic insight is that households experience a number of changes around retirement, including lower labor supply, greater mortality risk, smaller family size, and reduced health status. Some of these factors will reduce household consumption directly, for example through lower costs of going to work or smaller family size. These factors can reduce the marginal utility of consumption, which is what the life-cycle framework argues should actually be smoothed. For example, it is surely very plausible that the marginal utility of consumption depends on age and health status. Banks, Blundell and Tanner (1998) assess the degree of smoothing across the retirement threshold, while controlling for many of the factors listed above. They find that changes in household size, composition, mortality risk and labor supply can explain a decline of about 2 percentage points in consumption at retirement – however, actual consumption growth falls by some 3 percent points around retirement. This additional fall in consumption does appear to provide an important challenge to the life-cycle framework. Interestingly, the unexplained dip in consumption growth is only in the years immediately around retirement. Thus, it appears that households at retirement recognize that they have made a mistake in consumption smoothing

and that they need to scale back, but they do so fairly quickly and then smooth expenditures over the rest of life.

Some authors have characterized this residual fall in consumption at retirement as “small in economic terms” (Engen, Gale and Uccello, 2000). This appears to be accurate. We carried out the same kind of welfare calculations as we presented earlier, and we calculate that a retirement dip of the size reported by Banks, Blundell and Tanner (1998), about 1 percent, implies a welfare cost of 0.003 percent of lifetime consumption, or less than a day’s consumption (spread over an entire lifetime). A retirement dip of 5 percent implies a welfare loss of just over a week’s consumption.¹³ These calculations suggest that perhaps mistakes of these magnitudes just aren’t costly enough for individuals to care much about. On the other hand, it’s important to note that the welfare loss is nonlinear in the size of the dip. A retirement dip of 20 percent implies a welfare loss of 0.68 percent, or almost half a year’s consumption, and larger falls are even more costly. As they employ quasi-panel data, Banks, Blundell and Tanner (1998) can only estimate the mean dip. Some individuals, perhaps especially poor individuals, may be drastically undersaving, and thus enduring considerable welfare losses. Better estimates of the distribution of consumption dips at retirement are needed, along with the correlation of those dips with consumption or wealth levels. Such estimates require true panel data on consumption.

Finally, we turn to the post retirement stage of the life-cycle. Many au-

¹³We assume that preferences are additive over annual consumption, with the same, isoelastic sub-utility function for each year. Individuals have a working life of 40 years and an exogenous and certain period of retirement of 20 years. We set the interest rate equal to the discount rate, so that the optimal program is constant consumption. As before we take a coefficient of relative risk aversion of 2. We then calculate the compensation (increased lifetime wealth) that an individual would need so that a nonoptimal program (with consumption too high before retirement, and to low thereafter) would deliver the utility of the optimal program.

thors view dissaving after retirement as an acid test of the life cycle model. The empirical evidence seems to be that the elderly do not dissave as much as predicted by common life-cycle models. Some savings in retirement may be attributable to the risk of a longer life than expected (Davies, 1989) or to risks of large medical expenditures (Palumbo, 1999). Nevertheless, Palumbo's simulations suggest that even the combination of these risks cannot explain the slow rate of dissaving that is observed in the data. A bequest motive is another possible explanation for post-retirement savings within the life-cycle framework. However, Hurd (1987) reports that elderly persons with living children actually save less than those without living children. This would seem to undermine an explanation for post-retirement saving which is based on a bequest motive.

Here again, however, researchers face important data problems. In micro surveys, pension payouts are typically recorded as income, but in fact a considerable portion of these payments represents dissavings as the value of the remaining annuity declines. It is also the case that several modelling and econometric problems in this area that have yet to be dealt with in a satisfactory way. For example, researchers are only now beginning to model linkages between labor supply, health, and consumption. Finally, there is also a need for more consideration of the institutional arrangements that affect households planning at low frequency, such as the means-testing of public pensions, in the spirit of Hubbard, Skinner and Zeldes (1994). Thus, while the apparent lack of dissaving after retirement does pose an important challenge to life-cycle models, we expect this to be a lively area of research for some time to come.

Other Challenges for the Life Cycle Model

The life cycle framework faces a number of other challenges that don't fit naturally into our survey of smoothing at different frequencies.

First, as we have noted above, the life-cycle framework proposes to integrate many aspects of behavior in a coherent and disciplined way. Examples (beyond consumption and savings) include portfolio choice, fertility and retirement. Building empirical models within the life-cycle framework that successfully integrate these different aspects of behavior is obviously a daunting task. Apparent failures in this context should not lead us to a wholesale abandonment of the framework: it is still very early days.

A second area in which the life-cycle framework faces important challenges is in explaining cross-national differences in savings rates (Deaton, 1992). This subject was one of the original motivations for Modigliani style life-cycle models, but the attempt to relate aggregate savings rates to differences in population structure and economic growth has not been a success. Assessing this literature is somewhat like determining whether a glass is half-empty or half-full. Recent microdata analysis of the savings behavior of different cohorts in different countries (Deaton and Paxson, 2000) is more favorable to life-cycle models, but they still fail to provide a complete account of the aggregate relationship between growth and savings.

A final issue is the ability of the standard model to provide an explanation for various aggregate consumption and savings episodes. Attanasio and Weber (1994) discuss the U.K. consumption boom in the late 1980s and provide plausible explanations that are founded in the life-cycle framework. On the other hand, there are no widely accepted explanations for the decline in the U.S. sav-

ings rate in the mid-1980s. It is important to note, however, that the definition of savings reflected by the National Income and Product Accounts is not the same as savings as defined by life-cycle models, because the latter includes several components - such as capital gains - which the former does not (Gale and Sabelhaus, 1999). Thus it is perhaps not surprising that life-cycle models are not entirely successful in explaining the movements of this aggregate.¹⁴

Future Research Directions for the Life Cycle Model

The life-cycle framework is just reaching its prime of life. In many of the areas in which the framework currently has problems – for example, savings before and after retirement – it is only very recently that good micro panel data has become available. Here, we wish to mention some of the key directions which we think the framework, and in particular its empirical implementations, can be developed.

First, we believe that there is much to be gained from modelling consumption jointly with other choices such as fertility or education. For example, Browning and Ejrnæs (2000) demonstrate that the life-cycle hump in consumption can be “explained” by the time path of fertility. But this answer begs a further question: why is the time path of income correlated with the time path of fertility? It may be that capacities for earning, fertility and consumption are driven by the same set of biological and time constraints. For example, students who invest heavily in human capital may also be people who postpone both earnings and fertility. Completion of their training would then be associated with both

¹⁴Lusardi, Skinner and Venti (2001) point out the important corollary to this point: the NIPA savings rate is not particularly informative about many life-cycle issues, such as whether households are saving adequately for retirement.

rising income and fertility-driven consumption growth, a perspective that would be quite consistent with the forward looking, optimizing behavior posited by life-cycle models. On the other hand, it may well be that some households postpone fertility until they "have enough money to start a family." From this perspective, capital market imperfections or a precautionary savings motive may be determining household's decisions regarding education or fertility. In either case, modeling fertility and education along with consumption may uncover important aspects of the world that are difficult to discern from looking at consumption patterns alone. Indeed it may be that capital market imperfections or a precautionary savings motive have a much bigger impact on fertility and education decisions than they do on nondurable consumption. If so then treating such decisions as exogenous 'conditioning' variables may lead researchers to miss most of the action.

A second area that seems potentially fruitful to us is to examine the different properties of goods that households consume. Some goods are durable. Some goods are habit forming. Some goods are indivisible. Some goods must be purchased irreversibly, while for others there are well-established second-hand markets. Some goods are purchased for direct consumption while others are intermediate goods to be combined with labor in home production. Remember, the broad theme of the life-cycle framework is that people seek to smooth their marginal utility of consumption. However, in a world of goods with all of these characteristics, some optimal purchase strategies may imply quite volatile expenditures. Browning and Crossley (1999), as noted earlier, focus on how households should synchronize purchases of durables with fluctuations in income. Baxter and Jermann (1999) and Apps and Rees (2001) develop models

in which smooth marginal utility is associated with volatile market expenditures as households move back and forth between home production and market expenditures. Examples such as these represent only a beginning in the modeling of how households combine different goods, including durables and nonmarket time, to produce a flow of consumption.

A third area for investigation focuses on the differences between the various financial and real assets that households can hold. Assets differ not only in their expected financial return and riskiness, but also in their liquidity and, in the case of an asset such as housing, the flow of consumption services they provide. Researchers are only just beginning to accumulate data on the portfolios that households hold, and are nowhere near understanding why they hold them.¹⁵ For example, if households are faced with illiquid assets, then they may smooth short run income fluctuations by manipulating their stock of durable goods, rather than by drawing upon their accumulated assets. Allowing assets to differ in qualities other than risk and return may lead researchers to relax the ‘fungibility’ assumption (Thaler, 1990). We see this as completely appropriate. And again, within the life-cycle framework this assumption can be relaxed while maintaining coherency and rejectability. by requiring that behavior be related to the properties of assets in a theoretically consistent way.

The three directions just cited— modelling consumption choices jointly with other choices, looking at specific features of goods, and looking at specific features of assets — are tightly interwoven. Indeed, choices about children can be

¹⁵These issues are not only relevant for wealthy households. Edin (1991) and Edin and Lien (1996) have documented the rich variety of strategies that welfare mothers use to make ends meet, including informal credit and insurance markets, the sale of durables, home production, and work in informal and underground labor markets. Thus they can be viewed as holding a complicated portfolio of assets.

viewed as choices about a consumption good with particular attributes, while choices about education can be viewed as a choice about an certain asset. Many assets, like housing and durables, are also goods.

Finally, the most important issue may well be the need to allow for heterogeneity. Heterogeneity is usually the most important feature of any analysis using micro data and usually the most difficult issue with which to deal. It is uncontroversial that agents have different preferences, face different opportunity sets, and have access to different information sets. But researchers are only just beginning to develop data sources and statistical methods that allow us to handle heterogeneity in a satisfactory way (Browning, Hansen and Heckman, 1999). As a result, many empirical studies necessarily have to invoke strong homogeneity assumptions to get results.

Our belief is that relatively parsimonious models drawn from the life-cycle framework have had more successes than failures. But the economics profession is just at the start of a systematic application of theoretical models to micro-data. The research agenda described here emphasizes incorporating realistic features into life-cycle models. Because of the theoretical coherency of the life-cycle framework, building additional complications into life-cycle models need not compromise - and indeed may even strengthen - the chance that the data will reject them.

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TABLE 1: Income and Expenditure Changes with Unemployment				
Percentile	10th	25th	50th	75th
household income	-1500\$	-800\$	-400\$	0\$
household expenditure	-700\$	-300\$	0\$	25\$
<p>Note: 'Percentile' refers to the position of the household in the distribution of changes (as the respondent enters unemployment) in total expenditure. Expenditure changes are in Canadian Dollars. Source: Authors' own calculations on the COEP.</p>				

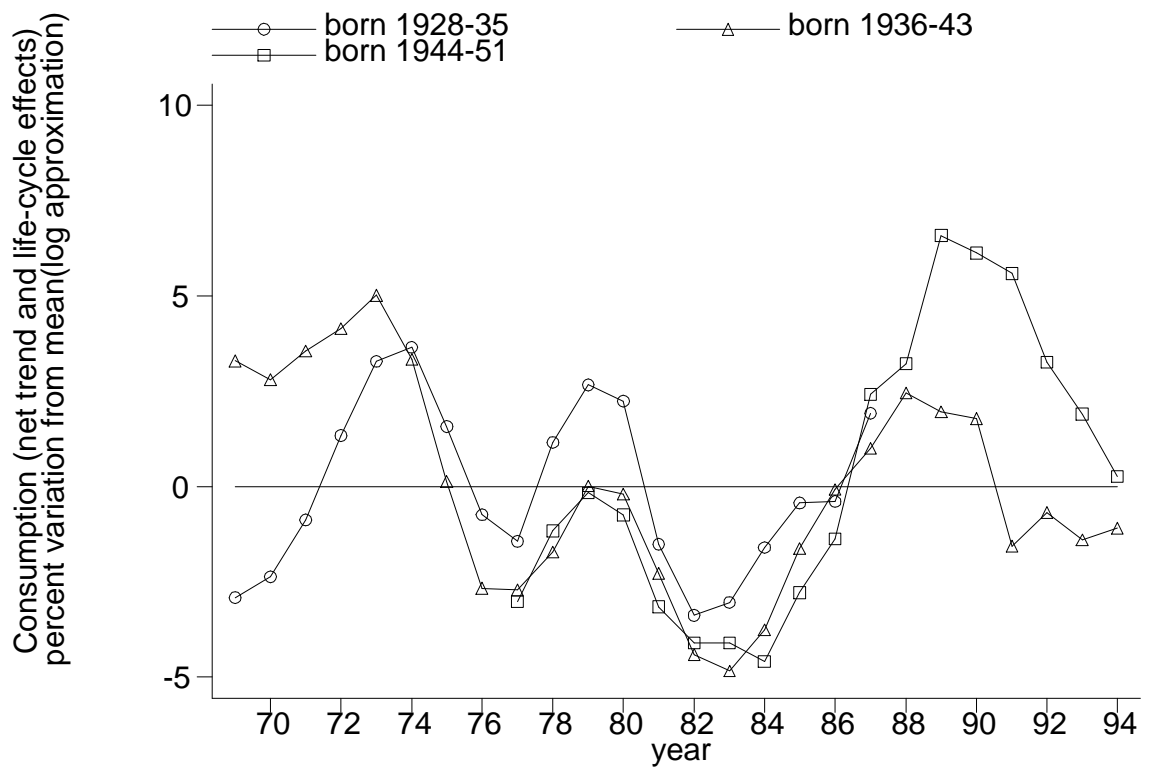


Figure 1: Business Cycle Patterns of Income and Consumption.

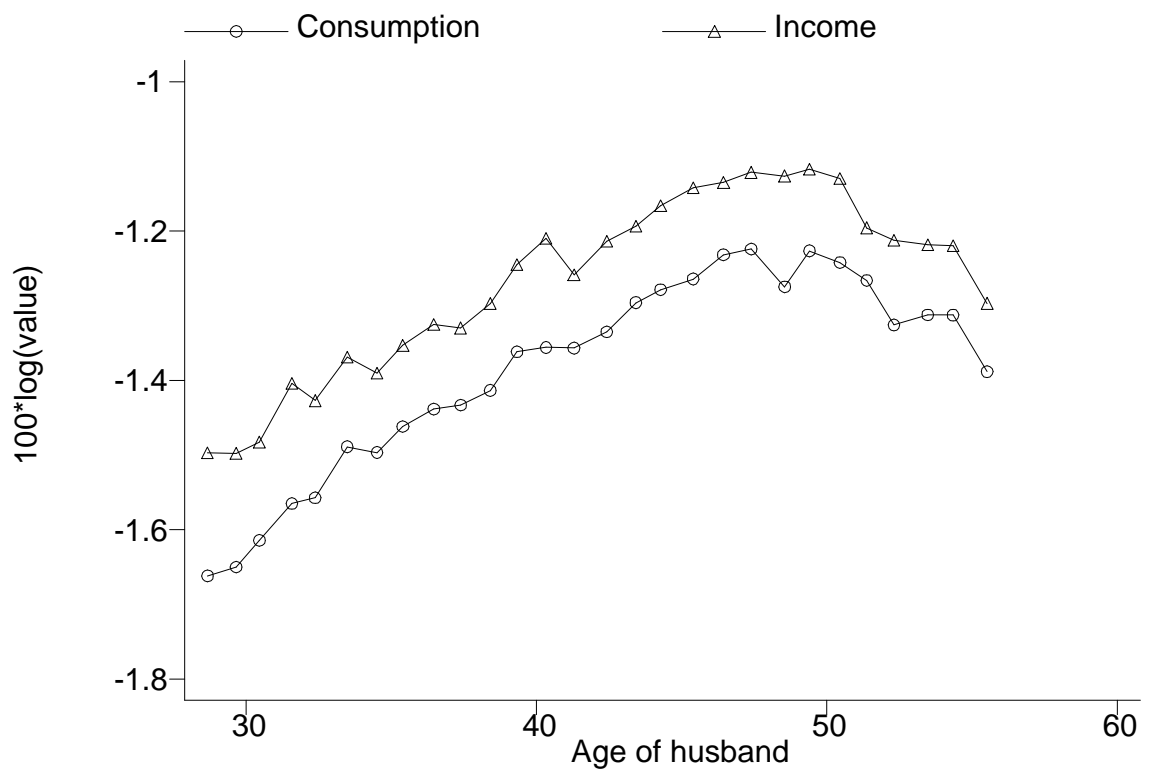


Figure 2: Life-cycle Patterns of Income and Consumption.