Do Consumers Behave as the Life-Cycle/ Permanent-Income Theory of Consumption Predicts?

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The best known and most widely used theories of consumer behavior were developed almost 40 years ago by Modigliani and Brumberg (the "life-cycle" theory), and by Friedman (the "permanent-income" theory). Both theories suggest that consumers choose current consumption after considering the state of resources available to them *over their entire lifetime.* Hall (1978) extended the theories in the late seventies to include an explicit description of how consumers estimate expected lifetime resources.

These theories build on sensible implications of basic economic principles, yet they imply very specific (and very restrictive) predictions about how consumers should respond to changes in income, and these predictions have recently been called into question. More recent studies suggest that while the life-cycle/permanent-income theories may at best hold up on average over the long run, they do not provide an adequate description of consumer behavior over the short run—for example, over the duration of a business cycle.[1] These more recent findings are important because (1) consumer expenditures account for over two-thirds of real GNP, and thus weigh heavily in the minds of policymakers, and (2) the pure life-cycle/permanent-income theories of consumption and more recent theories of consumer behavior differ markedly in their predictions for the timing and magnitude of the effects of fiscal and monetary policy on consumption.

I. The Simple LC/PI Description of Consumer Behavior

The life-cycle/permanent-income (LC/PI) theory of consumption begins with an assumption that most economists would feel perfectly comfortable with: Consumers generally prefer a relatively steady lifetime profile of consumption to a widely fluctuating time profile.[2] How-

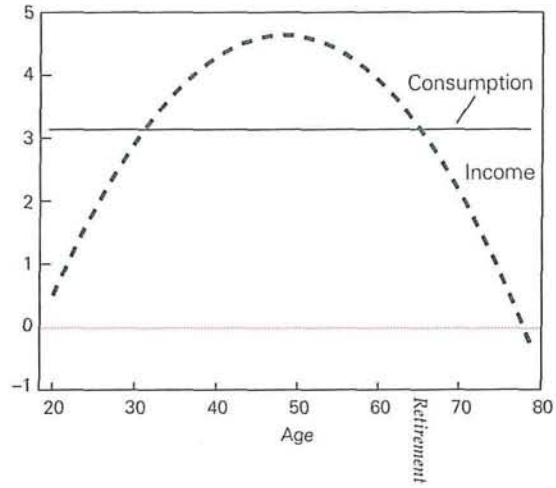
ever, the income accruing to individual consumers over their lifetimes may not follow such a stable time profile. If consumers were to spend in direct proportion to current income, they would face a time profile of consumption expenditures that might be much more volatile than they desire. Expenditures need not move in lockstep with current income if consumers can draw down savings or borrow when income falls, or if consumers save when income rises. Thus, consumers' desire and ability to buffer income shocks will determine the extent to which they will smooth fluctuations in consumption relative to income.

The LC/PI theory of consumption suggests that consumers view the resources available to them for current consumption from a lifetime perspective. Equivalently, consumers behave as if their "budget" must be met not on a period-by-period basis, but on a lifetime basis. Consumption need not equal income in every quarter, but the (present discounted) value of consumption over the consumer's lifetime must equal the (present discounted) value of income available from all sources over the consumer's lifetime.[3] This lifetime consumer perspective implies that the impact of a change in current income on current consumption should reflect the effect of the income change on the present discounted value of all resources expected to accrue to the consumer over her lifetime. While a $1,000 change in current income may be large relative to this month's paycheck, it represents a small fraction of the lifetime resources accruing to the average consumer. Thus the LC/PI theory predicts that the impact of a one-time $1,000 drop in income on current consumption will be considerably less than $1,000. The immediate response will be smaller, the more consumers are able to borrow against lifetime resources to cushion the income blow and spread their consumption response over their lifetime. If consumers do not have ready access to credit, for example, their ability to smooth consumption in the face of income fluctuations will be lessened.

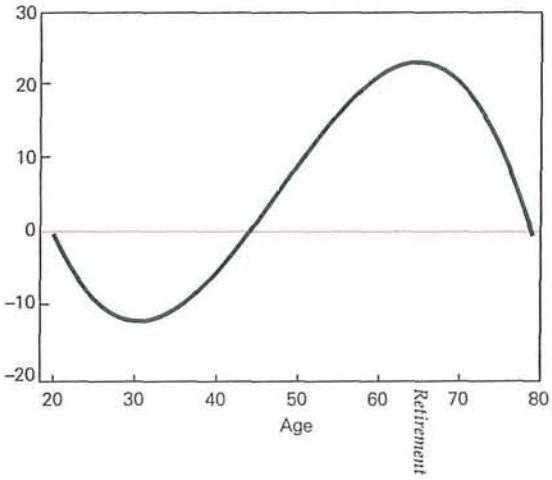
The typical LC/PI profile of consumption and income, Figure 1, shows the young consumer borrowing (accumulating "negative assets") against expected lifetime income to support a level of consumption above current income, the middle-aged consumer saving (paying off debt and eventually accumulating assets) as income exceeds the desired steady rate of consumption, and the older consumer spending from accumulated savings after the earning years.

Figure 1

Typical Consumption/ Income Profile



Accumulated Assets



[1] In fact, asserting that these theories hold over the long run but not the short run weakens the theories considerably. A more accurate statement might be that the data seem to be consistent with consumption behavior that does not violate the consumer's budget constraint in the long run. (See Galí (1991), for example.) The budget restriction constrains consumer behavior far less than the literal life-cycle/permanent-income theories.

[2] The desire to smooth consumption is a direct implication of the utility functions that are assumed to motivate consumers' decisions in most of economic theory. The LC/PI theories develop some of the ramifications of combining the standard utility functions with an explicit lifetime budget constraint.

[3] For simplicity, this description ignores both receipt and leaving of bequests.

II. Empirical Results Bearing on the Theories of Consumption

A large body of empirical work has evolved in the attempt to understand consumer behavior. Keynes's (1936) simple description of consumer behavior posits consumers who spend a fixed fraction of every incremental dollar of income ("the marginal propensity to consume"). Kuznets (1942) first documented the remarkable stability of the saving/income ratio, and in particular that the saving ratio appeared to be *independent* of real income; this stood in sharp contrast to the rigid dependence implied by simple Keynesian consumer behavior. Kuznets's observation implied that consumers may be smoothing consumption and savings in the face of fluctuations in real income, and thus motivated some of the original development of the LC/PI theory by Modigliani and Brumberg (1954), and Modigliani (1957), and the development of the closely related permanent-income theory by Friedman (1957).[4]

More recent work by Hall (1978) develops somewhat stronger implications of the basic LC/PI theory of consumption when it is coupled with a more explicit assumption about how consumers form expectations about their future income prospects. Hall argues that if consumers are reasonably well-informed, then the difference between this quarter's expectation of lifetime resources and last quarter's expectation of lifetime resources will be unforecastable from the viewpoint of last quarter. (After all, if it were forecastable, consumers would have changed last quarter's expectation to reflect this.) If this is true, then the change in consumption from last quarter to the current quarter, which depends only upon consumers' expectations of the lifetime resources available to them, will also be unforecastable from last quarter. A simple way of summarizing this implication is that consumption follows a *random walk*. Denoting current consumption with C_t, this idea may be represented in the simple equation:

$$C_t = C_{t-1} + e_t \qquad (1)$$

where e_t represents information about the expected value of lifetime resources that cannot be forecast from period $t-1$. Current consumption is expected to equal last period's consumption, C_{t-1}, plus the change in consumption due to a revised estimate of lifetime resources that was unforecastable last period (e_t).

The empirical content of this finding is that, if the simple LC/PI model is correct, then nothing that consumers could have known in period $t-1$ would help forecast the change in their consumption between period $t-1$ and period t. Hall shows that this implication holds up quite well for some variables dated $t-1$.[5]

Recent work by Campbell and Mankiw (1989) and others[6] has developed more stringent tests of the LC/PI model. The Campbell and Mankiw approach may be the most straightforward. Rather than looking for evidence that lagged variables might predict current consumption, they directly test the hypothesis that *predictable changes in current income* can predict changes in current consumption. The LC/PI model, augmented with Hall's expectational assumption, says that predictable changes in current income should already be reflected in consumption at the time that they become predictable, not at the time that they are realized. To test this idea, Campbell and Mankiw run the simple regression of changes in current consumption, ΔC_t, on predictable changes in current income, Δy_t^p:

$$\Delta C_t = c_0 + \lambda \Delta y_t^p + e_t. \qquad (2)$$

They find that predictable changes in current income do help explain current changes in consumption; that is, they estimate a significantly positive value for λ in equation (2). They interpret this as evidence that is consistent with the existence of "rule-of-thumb" consumers who consume only out of current, not anticipated, income.[7] Under this interpretation, the coefficient λ in the equation above is the fraction of predictable changes in income, Δy_t^p, accruing to these "rule-of-thumb" consumers. Campbell and Mankiw estimate this fraction to be about one-half.

This result constitutes a strong rejection of the LC/PI model of consumer behavior. It implies that about one-half of all income accrues to consumers

[4] Kuznets's observations also inspired Duesenberry's (1949) "relative income hypothesis," which explains the independence of the saving rate and income by linking current consumption to the most recent peak in income.

[5] Goodfriend (1992) casts doubt on Hall's results by suggesting that if individual consumers receive information about the economy with some delay, and if one examines only aggregate consumer expenditure data, then Hall's test for the validity of the theory may be inappropriate.

[6] See, for example, Flavin (1981), Hayashi (1982), Bean (1986), Deaton (1986), and Campbell (1987).

[7] The "rule-of-thumb" consumers follow the simple rule $C_t = Y_t$. They consume all of their (current) income.

who respond to one-time predictable changes in income only when the changes are realized, and that their response far exceeds the impact of the change in income on the present discounted value of expected lifetime resources. These results lie in direct contradiction to the predictions of the LC/PI theory.

III. Some New (and Preliminary) Results from the Reestimation of the MIT-PENN-SSRC[8] (MPS) Model

The MPS quarterly model of the U.S. economy comprises approximately 120 equations that explicitly describe economic behavior, along with about 170 accounting identities. A neoclassical growth model lies at the heart of its design: in the long run, output is supply-determined, and the economy proceeds along the path of balanced growth. In the short run, output is primarily demand-determined. In a typical equation, the variable of interest depends upon current and lagged values of explanatory variables. For example, total consumption depends upon current and lagged values of income and wealth. The model generally does not explicitly identify the separate contributions of long-run dynamics, short-run dynamics, costs of adjustment, or expectations to the determination of the variable of interest. The estimated lag distributions are assumed to represent the combined contributions of all of these effects.[9]

Respecification of the Model

During the past two years, staff at the Federal Reserve Board have undertaken a respecification of the MPS model. The goal of the project has been to articulate more explicitly, wherever possible, the independent contributions of long- and short-run dynamics, costs of adjustment, and expectations. To distinguish long-run from short-run dynamics, the *cointegration/error-correction* paradigm is used as a guide. This paradigm asserts that trending economic time series may be decomposed into two independent components: a long-run component that essentially captures the trend in the series,[10] and a short-run component that reflects movements about the trend. Furthermore, the cointegration/error-correction paradigm implies that *relationships* among trending economic time series may be decomposed in a similar fashion. See the box for more details on cointegration and error-correction.

Consumption: The Long Run[11]

The distinction between consumption and consumer expenditures is important in this context, particularly for durable goods. Consumption of a durable good begins in the period in which the good is bought, and continues in subsequent periods until the durable good is fully depreciated. The life-cycle and permanent-income theories derive their predictions from the utility that consumers derive from *consuming*, not from spending on consumption goods. Thus, consumption in the MPS model is defined as the sum of expenditures on nondurable goods and services, which are assumed to fully depreciate within the period of expenditure, plus the flow of consumption derived from consumers' stocks of durable goods, including motor vehicles. Consumption so defined generally fluctuates much less than *consumption expenditures*; expenditures for durable goods, in particular, exhibit considerable volatility during the course of a business cycle.

The life-cycle and permanent-income theories derive their predictions from the utility that consumers derive from consuming, not from spending on consumption goods.

In the long run, real, per-capita, aggregate consumption (defined on the flow basis) is assumed to conform with the basic predictions of the life-cycle

[8] The model was originally developed as a joint effort of faculty and staff of the Massachusetts Institute of Technology (MIT), the University of Pennsylvania (PENN), and the Social Science Research Council (SSRC).

[9] For a complete description of the current MPS specification and its properties, see Brayton, Flint and Eileen Mauskopf, "The MPS Quarterly Econometric Model of the U.S. Economy," *Economic Modeling*, July 1985.

[10] To be more precise, the long-run component captures movements in the series that occur at the lowest frequencies. A pure trend contains no recurring or cyclical component, so its frequency of oscillation is zero.

[11] The preliminary consumption specification reported here was developed jointly with David Reifschneider of the Board of Governors of the Federal Reserve System.

Cointegration/Error-Correction

The cointegration/error-correction modeling strategy is described in Engle and Granger (1987). The strategy begins with the recognition that series may be classified according to their *order of integration*. A time series is said to be integrated of order d if its d^{th} difference is stationary.[12] A series that requires first-differencing to obtain stationarity is integrated of order 1 (I(1)); a series that requires no differencing to obtain stationarity is I(0). Many familiar economic time series appear to be I(1): real GDP, nominal interest rates, the rate of inflation. Roughly speaking, series that are integrated of order 1 appear to contain a trend; series that are integrated of order zero appear to be trendless.

A set of time series is *cointegrated* if a linear combination of the time series is purged of its trend or long-run component. Thus, if two trending series are cointegrated, they must share a common trend. Practically speaking, a simple regression equation such as

$$(3) \qquad y_t = x_t\beta + e_t$$

may represent a cointegrating relationship between y_t and x_t if the error in the equation, e_t, contains no long-run or trend component. The error may contain significant short-run information—about business cycle fluctuations, for example—but it must not contain a trend.

At least one of the variables in the cointegrating relationship must move in the short run so as to maintain the long-run relationship. If not, deviations from the long-run relationship would never be corrected, and the long-run relationship could not hold. In the equation above, if y_t is above $x_t\beta$, then eventually either y must fall or x must rise (or both) to maintain the long-run relationship. An *error-correction* equation describes this adjustment process econometrically. The simplest error-correction equation for y_t would be

$$(4) \qquad \Delta y_t = -\gamma(y_{t-1} - x_{t-1}\beta) + u_t$$

which compactly summarizes the notion that when the *cointegrating discrepancy* $y_{t-1} - x_{t-1}\beta$ is positive, y_t must decrease in the short run to close some of the gap in the long-run relationship. The coefficient γ provides a measure of the speed with which y_t closes the discrepancy in the long-run relationship. The larger is γ, the more quickly y_t moves in response to a long-run discrepancy and the more quickly the gap is closed. In practice, the error-correction equation that describes the short-run component of a time series may be a good deal more general, and may include many other (trendless) terms.

hypothesis, as in the current specification. Current consumption depends on expected (real, after-tax, per-capita) lifetime resources, which consist of current stocks of real and financial assets, the expected return to those assets over time, and expected flows of labor income (YLABOR) plus net government transfers (YTRAN).[13] Rather than estimating the expected capitalization rates on asset stocks, the MPS model includes asset stocks and a measure of real, after-tax, per-capita income derived from the stock of assets ("property income," or YPROP). Including property income implicitly captures the expected rates of capitalization that link asset stocks and the expected streams of income derived from the assets.[14] In addition, the specification distinguishes between stock market wealth (WSTK) and non-stock-market wealth (WNSTK), in order to allow for different capitalization rates for the two types of wealth.

The life-cycle hypothesis suggests a demographic interpretation of the magnitude of the effects of each resource category on long-run consumption.

[12] Stationarity in this context refers to the narrow concept of mean-reversion, the tendency of a time series to return to a fixed value over time. Nonstationary time series do not exhibit a tendency to revert towards a fixed mean.

[13] Expected flows of labor income can be thought of equivalently as returns to "human capital," a concept that puts the value of human resources on an equal footing with the value of physical capital.

[14] Because the stock(s) of capital are related to the flows of income by a rate of capitalization, one may legitimately include only two of the flow of income, the stock of capital, and the rate of capitalization. The MPS model includes both stocks and flows, implicitly defining the rates of capitalization.

That is, the coefficient (or sum of coefficients in a distributed lag specification) in the consumption equation for any income source will equal (approximately) the ratio of the years for which the average recipient expects to receive the income stream to the years remaining in her lifetime. For example, suppose the average recipient of net transfer income is expected to receive the current stream of net transfer income for the remainder of her life; then the coefficient on transfer income will approach unity. By contrast, if the average recipient of labor income is 40 years of age with 30 years of remaining lifetime, and if the recipient expects to receive labor income for the next 20 years, then the coefficient on labor income should be about two-thirds. As shown below, these implications are borne out in the estimates of the long-run consumption function.

Ordinary least squares estimation of the regression of total MPS-definition consumption on labor income, net transfer income, and property income, and the two wealth categories from the first quarter of 1960 through the third quarter of 1991, yields the following (cointegrating) relationship:[15]

$$(5)\quad CON_t = .65\ YLABOR_t + .85\ YTRAN_t + .32\ YPROP_t + .05\ WSTK_t + .08\ WNSTK_t.$$

As suggested above, the estimated coefficients on labor, transfer, and property income may be interpreted demographically. The ratio of years for which income will be received to years remaining in the consumer's lifetime for labor income is roughly consistent with an average labor income recipient who is middle-aged and expects a period of retirement that will last one-half the length of his remaining working years. Similarly, the coefficient for transfer income is consistent with an average transfer recipient who expects the transfer to continue for the majority of his remaining lifetime. The approximate sizes of these income coefficients have been a feature of the MPS specification for a number of years.

The coefficients in equation (5), together with estimates of the expected value of lifetime income and current stocks of wealth, determine the value for total consumption that is consistent with the LC/PI theory, denoted by C^*.[16] When consumption exceeds its LC/PI level (C rises above C^*), either (1) consumption expenditures must fall in order to bring consumption back in line with lifetime resources ultimately available to consumers, or (2) lifetime resources must rise.

The MPS model distinguishes among three categories of consumption: nondurable goods and services, consumption services derived from the outstanding stock of motor vehicles, and consumption services derived from holdings of other, non-motor-vehicle durable goods. The long-run movements in the components are captured by equations that explain the share of each component in the total as a function of relative prices and the real rate of interest.[17] Denoting the long-run share of these components as S_i^* (i = nondurables and services, motor vehicles, and other durable goods), the long-run trends of these components of consumption, C_i^*, can be defined as the product of their long-run share and long-run total consumption:

$$(6)\quad C_i^* = S_i^* C^*.$$

Figures 2 and 3 display the actual values of consumption, consumption expenditures, and the LC/PI values (C^*) for total consumption (Figure 2) and its components (Figure 3). Several observations are worthy of note. (1) Consumption—the flow of services derived from the outstanding stock of consumer goods—is (as expected) much smoother than consumption expenditures. In fact, consumption is sig-

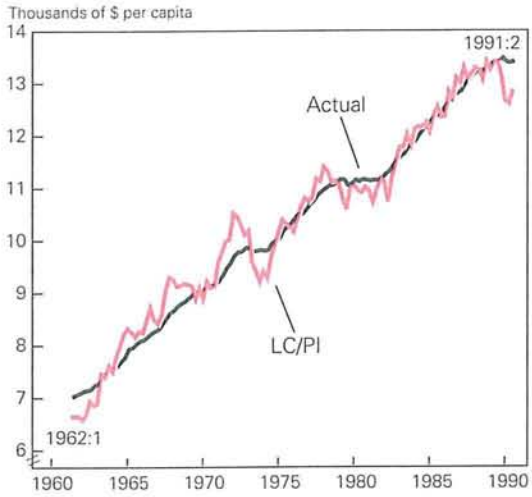
[15] The residual from this equation appears to be trendless, so that this regression constitutes a true cointegrating relationship among trending variables. The augmented Dickey-Fuller test for stationarity takes the value −5.27. Using Engle and Yoo's (1989) table for multivariate higher-order systems, this test value falls well out in the tails of the empirical distribution constructed under the null that the regression contains a unit root. Another way of looking at this long-run "cointegrating" relationship among consumption, income, and wealth is that it prevents an independent trend from arising in the saving rate.

[16] The expected lifetime income terms are computed as follows. First, a vector autoregression is estimated that includes four lags each of labor income, transfer income, property income, the 3-month Treasury bill rate, the rate of inflation in the nonfarm business output deflator, and the detrended log of per capita nonfarm business output. The vector autoregression imposes the restrictions implied by a multivariate cointegration/error-correction analysis (see Johansen and Juselius 1990). The estimated vector autoregression implies that income behaves considerably differently from a pure random walk. This vector autoregression is used to generate expected discounted labor income ("permanent" labor income), expected discounted net transfer income, and expected discounted property income. The discount rate implies a mean lead of about 40 quarters. Expectations are formed in the current period for income in the current and following periods. For computational details in constructing the expected discounted income streams, see Fuhrer and Moore (1992).

[17] In addition to relative consumption goods prices and the real rate of interest, the relative price of gasoline (RPGAS, the price of gasoline relative to the consumption deflator, adjusted for changes in the average miles-per-gallon achieved by the current fleet of motor vehicles) and a time trend appear on the right-hand side of the motor vehicles share equation.

Figure 2

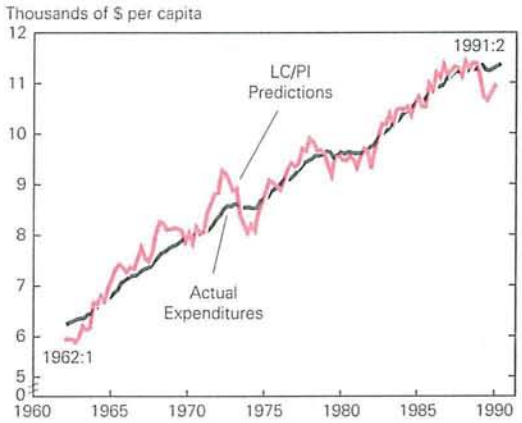
Actual and LC/PI Predictions of Total Consumption, MPS Basis



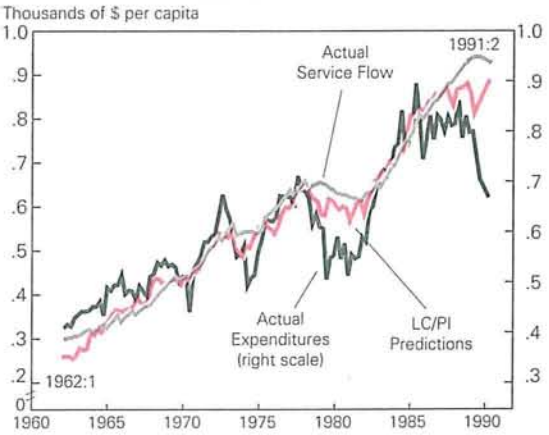
nificantly smoother than the LC/PI predictions of consumption. Consumers do not spend enough in a calendar quarter to significantly alter the outstanding stock of consumer goods, whereas the expected value of lifetime resources (expected income and wealth) can change considerably from quarter to quarter. (2) The timing of the most prominent shortfalls in LC/PI consumption relative to actual consumption corresponds to conventional dating of major recessions: 1974–75, 1980–82, 1990–91; see Figure 2. (3) When LC/PI consumption deviates from actual consumption, expenditures adjust to narrow the gap between long-run sustainable consumption and current consumption. During the 1973–75, 1980–82, and most recent recessions, long-run consumption fell below actual consumption. In response, expenditures, most notably expenditures on durable goods, fell sharply, gradually reducing the growth in the stock of durables, and thus reducing consumption of durables until it was in line with long-run (C_i^*) consumption; see Figure 3. Similarly, during periods of healthy growth such as 1971–72 and 1976–79, LC/PI consumption rose above actual consumption, and durables expenditures—especially expenditures on motor vehicles—surged to close the gap. Overall, nondurables

Figure 3

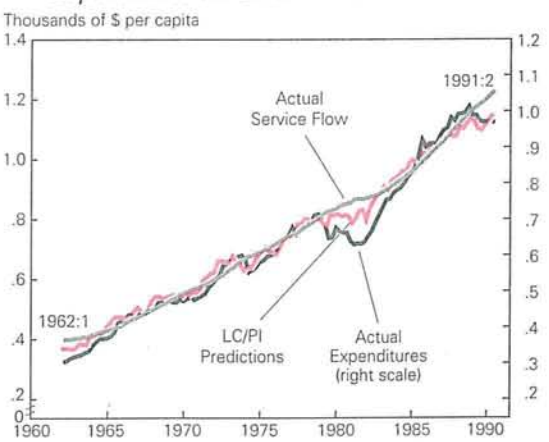
Actual and LC/PI Predictions of Consumption Expenditures on Nondurables and Services



Actual and LC/PI Predictions of Service Flow from Motor Vehicles; Expenditures on Motor Vehicles



Actual and LC/PI Predictions of Service Flow from Other Durable Goods; Expenditures on Other Durable Goods



expenditures appear to respond proportionately less than durable goods expenditures to discrepancies between LC/PI and actual consumption. These two figures summarize much of the short-run consumption dynamics that will be modeled econometrically in the next section.

Consumption: The Short Run

If each consumption component, C_i, were always at its long-run LC/PI value, no explanation of short-run dynamics would be required. Figures 2 and 3 provide evidence to the contrary, showing clear episodes of several quarters' duration during which consumption of all three components deviates from the long-run consumption trend consistent with the trends in income and wealth.

Consumers may deviate from the level of consumption that is consistent with the LC/PI theory because moving immediately to that level may entail serious *costs of adjustment*. These costs of adjustment may include true costs of adjusting the level of consumption (such as changing the value of housing services derived from the housing unit that the consumer occupies); financial costs (such as the potentially high cost of short-term borrowing for consumers who experience a temporary shortfall in income); liquidity constraints (such as those that occur when consumers are turned down for short-term borrowing); or psychic costs of deviating from a "rule-of-thumb" or a habitual consumption pattern. If costs of adjustment are significant, then in the short run consumption will deviate significantly from its LC/PI value.[18]

Consumers may deviate from the level of consumption consistent with the LC/PI theory because moving immediately to that level may entail serious costs of adjustment.

The Campbell and Mankiw results discussed above provide evidence of short-run deviations from the LC/PI model. They interpret the deviations as evidence of rule-of-thumb consumers who spend out of current income only. Implicit in the Campbell and Mankiw interpretation is the existence of consumers who do not follow a rule of thumb, but behave more in the life-cycle mode. (If all consumers followed a rule of thumb, then the coefficient on predictable changes in income would be unity.)

If costs of adjustment (other than the psychic costs of deviating from a rule of thumb) are significant, then life-cycle consumers also will deviate from the LC/PI consumption norm. The presence of significant costs of adjustment for life-cycle consumers implies that today's consumption will be affected by past deviations of consumption from LC/PI consumption. That is, life-cycle consumers who face adjustment costs may alter consumption expenditures today to close the discrepancy between last period's consumption and last period's LC/PI consumption optimum (the "error-correction" term).[19]

The provisional specification of the consumption sector in the MPS quarterly model provides a framework for testing the importance of both costs of adjustment and rule-of-thumb consumer behavior. Disaggregated consumption equations, presented below, distinguish between the response to the lagged discrepancy (error-correction) and the response to predictable changes in current income (rule-of-thumb behavior) as determinants of current consumption growth.

A Provisional MPS Consumption Specification

Simple regression equations attempt to capture the effect on the growth in current consumption expenditures (disaggregated as described above) of (1) consumers' gradual response to last quarter's discrepancy between LC/PI consumption and actual consumption; (2) consumers' response to the predictable change in total income in the current period ($E_{t-1}\Delta Y_t$), as in Campbell and Mankiw; and (3) other short-run determinants of consumer expenditures not explicitly associated with costs of adjustment or rule-of-thumb behavior. Thus, the estimated equations take the general form

$$(7)\quad \Delta C_{it} = a_0 + a_1(C_{t-1} - E_{t-1}C^*_{t-1}) + a_2E_{t-1}\Delta Y_t + a_3Z_t + \varepsilon_t$$

where the first term represents the "normal" constant growth rate of consumption component i; the second term reflects the partial "error-correction" of consumption to last period's LC/PI discrepancy; the

third term captures the response of current consumption to predictable changes in current income, as in Campbell and Mankiw; and the fourth term comprises other determinants of short-run consumption behavior (Z_t), including lagged changes in the civilian unemployment rate, lagged changes in stock market wealth, and the lagged endogenous variable; the last term, ϵ_t, is the residual, the unexplained part of the growth in consumption component i.

The results from estimating equation (7) are displayed in Table 1. For all categories of consumption, it appears that consumers respond consistently and significantly to a discrepancy between last period's LC/PI consumption and actual consumption (the "error-correction" line of Table 1). That is, when consumption last period is well above or below the level of consumption that was consistent with lifetime resources, consumers respond in the current period by altering consumption expenditiures so as to bring consumption partly back in line with lifetime resources.

The speed with which consumers bring consumption back in line with income and wealth fundamentals varies somewhat by consumption component. All of the estimated expenditure responses appear to be relatively slow. The fastest adjustments occur for nondurables and services and for motor vehicles. Although the coefficient for motor vehicles (−0.13) is three times the size of the nondurables and services coefficient (−0.04), the impact of the motor vehicles *expenditure* response on the stock of motor vehicles, and thus on the *flow of consumption*, is about the same as the nondurables and services consumption response.[20] Consumers adjust their consumption of other durable goods quite slowly; the implied coefficient on the flow of consumption is about −0.01. It may not be surprising that consumers adjust nondurables and services consumption expenditures slowly, since relatively inflexible spending categories such as housing services, household operations, medical services, and food consumed at home comprise a sizable fraction of nondurables and services consumption. It is somewhat puzzling, however, that consumption expenditures on motor vehicles respond no faster than nondurables and services, and that consumption of other durables adjusts much more slowly than consumption of motor vehicles. At

Table 1
Estimates of Short-Run Disaggregated Consumption Expenditure Responses (Equation 7)

Nondurable Goods and Services, 1962:I to 1991:II
Dependent variable: Log change in per capita expenditures on nondurable goods and services.

Explanatory Variable	Coefficient	T-statistic
Constant	.0020	3.3***
Error-correction	−.039	−4.3***
$E_{t-1}\Delta Y_t$	.25	6.7***
ΔStock Market Wealth	.015	3.2***
Equation Standard Error	.0034	
R-squared (corrected)	.49	

Durable Goods, 1965:I to 1991:II
Motor Vehicles
Dependent variable: Ratio of motor vehicles expenditures to lagged stock of motor vehicles

Explanatory Variable	Coefficient	T-statistic
Constant	.012	3.4***
Error-correction	−.13	−2.8***
$E_{t-1}\Delta Y_t$	.42	1.9*
Lagged dependent	.32	3.6***
Twice-lagged dependent	.28	3.7***
Change in unemployment rate	−.028	−4.5***
Equation Standard Error	.017	
R-squared (corrected)	.76	

Other Durable Goods
Dependent variable: Ratio of other durables expenditures to lagged stock of durable goods.

Explanatory Variable	Coefficient	T-statistic
Constant	.0053	3.6***
Error-correction	−.039*	−3.4***
$E_{t-1}\Delta Y_t$	.092*	2.1**
Lagged dependent	.84	23.6***
Change in unemployment rate	−.0045	−4.1***
Equation Standard Error	.0034	
R-squared (corrected)	.94	

*Significant at the 10% level or better.
**Significant at the 5% level or better.
***Significant at the 1% level or better.

[18] Peter Tinsley (1992) makes this argument in a recent working paper.

[19] They do not adjust current consumption in anticipation of changes in the *future* course of LC/PI optimal consumption, because any predictable changes in permanent income should have already been incorporated in the current estimate of permanent income.

[20] Remember that expenditures and consumption are equivalent for nondurables and services. The translation between the stock of durable goods and the flow of consumption derived from holding the stock involves both the rate of depreciation of the stock and the real rate of interest. In the MPS model, a dollar of motor vehicles stock yields about thirty cents of consumption service flow per quarter at an annual rate; a dollar of other durables stock yields about twenty-five cents of service flow per quarter.

present, no ready explanation can be offered for these findings.[21]

In addition, the evidence strongly suggests that consumers respond to predictable changes in current income. Consumption of nondurable goods and services responds to predictable changes in current income with a coefficient of about 0.25; the coefficient is estimated with high precision.[22] Motor vehicles consumption also appears to respond strongly to predictable changes in current income, although its coefficient is estimated less precisely. Other durable goods consumption exhibits a weaker, but still precisely estimated, response to predictable changes in current income.

Long-run movements in consumption, income, and wealth are roughly consistent with the LC/PI theories of consumption, but the short-run movements are not.

For many of the costs of adjustment enumerated above, the effect on consumption may be asymmetric with respect to changes in income. For example, liquidity-constrained consumers may be unable to borrow when income falls, but they can surely save when income rises, in order to build up assets in anticipation of future income shortfalls. Some simple tests (not reported here) for the presence of this asymmetric effect revealed no evidence in favor of this hypothesis.[23] This econometric evidence appears roughly consistent with the pattern of expenditures and LC/PI gaps reported in Figures 2 and 3.

The results reported in equation (5) and Table 1 bear interesting implications for the saving rate. Perhaps most importantly, the presence of a stable long-run relationship among consumption, income, and wealth implies a stable saving rate. While the saving rate has fluctuated considerably over the last three decades, equation (5) suggests that these fluctuations are consistent with stable consumption/saving responses to short-run movements in income and wealth and do not result in an unexplained trend in the saving rate.

Overall, these results suggest the following:

- The long-run movements in consumption, income, and wealth are roughly consistent with the life-cycle/permanent-income theories of consumption. Consumption cannot consistently depart from the underlying trends in income and wealth, although consumption clearly does not equal current resources period by period.
- The life-cycle/permanent-income theories of consumption, coupled with Hall's expectations assumption, do not provide a good explanation of the short-run movements in aggregate consumption. As documented in Campbell and Mankiw (1989), many consumers appear to respond to predictable changes in current income when they are realized, rather than when they are predicted. This contradicts the LC/PI notion that consumers immediately revise their consumption plans in light of any news about expected lifetime resources available to them. This violation may arise because consumers follow a "rule of thumb," as suggested by Campbell and Mankiw.
- Consumers who do not follow a "rule of thumb" also appear to deviate from the LC/PI path, perhaps because they face significant adjustment costs, broadly construed. However, because consumers are ultimately tied down by the resources available to them, we expect consumers to (at least gradually) bring consumption back in line with lifetime resources.[24] One can find evidence of short-run adjustment by consumers to bring consumption back in line. For all three components of consumption investigated here, the evidence suggests that consumers consistently alter today's consumption to partially close the gap between last period's consumption and last period's life-cycle/permanent-income consumption.

[21] A complete understanding of the dynamic response of consumption to last period's LC/PI discrepancy requires a full simulation of the MPS model. As a result, the responses described here are only approximate.

[22] This coefficient is about half the size of the response estimated by Campbell and Mankiw.

[23] Asymmetric error-correction was tested by (1) estimating separate coefficients for positive and negative cointegrating discrepancies, and (2) interacting the error-correction term with dummies for positive and negative changes in the unemployment rate or real output. Estimated responses showed insignificant signs of asymmetry for both models.

[24] This is consistent with the results in Galí (1991). In effect, the LC/PI hypothesis is rejected, but the existence of a budget constraint enforces some long-run discipline on consumption behavior.

IV. Policy Implications of the Empirical Results

These findings suggest that, in the short run, consumption may respond quite differently to policy-induced expansions and contractions than the LC/PI theory would predict. Consider the impact on consumption of an expansionary, but temporary, drop in short-term interest rates induced by monetary policy. According to the strict LC/PI theory, consumers essentially annuitize any effect of interest rates on income and on the valuation of wealth, distributing their responses over the remainder of their expected lifetimes. The evidence presented here suggests that many consumers do not spread out the effect of the interest rate change nearly as much as predicted by the LC/PI. Thus, for these consumers, the drop in interest rates would have a larger short-run impact on consumption than the LC/PI theory predicts. Equivalently, smaller changes in interest rates could deliver larger short-run consumption responses. Because the evidence suggests that one-fourth to one-half of all income accrues to such rule-of-thumb consumers, their effect on the aggregate response to policy changes could be substantial.[25]

The evidence presented here also suggests a different response to policies that are expected to have a long-term or permanent impact on the resources available to consumers, such as a tax cut that is perceived as permanent. Unconstrained LC/PI consumers would immediately consume out of the full lifetime impact of such permanent policy changes. The estimates in Table 1 suggest that the consumers who do not follow a rule of thumb do not or cannot adjust their consumption immediately to correspond to their new lifetime resources. Instead, they gradually alter their consumption expenditures to bring consumption in line with the lifetime resources available to them. Consumers who follow a rule of thumb will alter consumption expenditures in each period by the amount of the permanent change in income; this is nearly identical to the predicted life-cycle consumer response. The net effect of both rule-of-thumb and constrained life-cycle consumers under this policy would be a more sluggish response to the permanent policy change than the LC/PI theory would predict.[26]

Overall, the estimates presented here suggest that, in the short run, consumers will respond more vigorously to a temporary policy change than the LC/PI theory predicts. The response of consumption to a long-term or permanent policy change will depend upon the time profile of changes in income that the policy produces, but in many cases the consumption response will be more sluggish than the LC/PI theory predicts.

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[25] The response of life-cycle consumers to a temporary change in income should be small. If they face costs of adjustment, their immediate response will be that much smaller. Thus the response of the rule-of-thumb consumers should dominate the response of life-cyclers for a temporary change in income.

[26] Because the consumption of rule-of-thumb consumers will track their income, their response to a permanent tax cut will depend on the time path of income changes associated with the tax cut. The case described here assumes a one-time cut in taxes that raises income by approximately the same amount in every quarter.

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