

# Permanent Income Hypothesis (Extract I)

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# Introduction

- Distinction is between *ex-ante* and *ex-post* household responses to risk.
- *Ex-ante* responses answer the question:  
“What do people do in the anticipation of shocks to their economic resources?”.
- *Ex-post* responses answer the question:  
“What do people do when they are actually hit by shocks to their economic resources?”.

## The Life Cycle-Permanent Income Hypothesis

- To see how the degree of persistence of income shocks and the nature of income changes affects consumption
- Consider a simple example in which income is the only source of uncertainty of the model.
- Preferences are quadratic, consumers discount the future at rate  $\frac{1-\beta}{\beta}$  and save on a single risk-free asset with deterministic real return  $r$ ,  $\beta(1+r) = 1$  (this precludes saving due to returns outweighing impatience), the horizon is finite (the consumer dies with certainty at age  $A$  and has no bequest motive for saving).

## The Life Cycle-Permanent Income Hypothesis

- $c_{i,a,t}$  is consumption at age  $a$  and time  $t$ ;  $y_{i,a,t}$  is income at age  $a$  and time  $t$
- $\Omega_{i,a,t}$ : information set of agent  $i$ , at age  $a$  in year  $t$ .
- The change in household consumption can be written as

$$\Delta c_{i,a,t} = \pi_a \sum_{j=0}^A \frac{E(y_{i,a+j,t+j} | \Omega_{i,a,t}) - E(y_{i,a+j,t+j} | \Omega_{i,a-1,t-1})}{(1+r)^j} \quad (1)$$

$a$  indexes age and  $t$  time,

- $\pi_a = \frac{r}{1+r} \left[ 1 - \frac{1}{(1+r)^{A-a+1}} \right]^{-1}$ : “annuity” parameter that increases with age and  $\Omega_{i,a,t}$  is the consumer’s information set at age  $a$ .
- Three key issues regarding the response of consumption to changes in the economic resources of the household.

- First, consumption responds to news in the income process, but not to expected changes (heterogeneity vs uncertainty).
- The second key issue emerging from equation (1) is that the life cycle horizon also plays an important role (the term  $\pi_a$ ).

- The last key feature of equation (1) is the persistence of innovations (how they affect the information sets).
- More persistent innovations have a larger impact than short-lived innovations.
- Suppose that income follows an ARMA(1,1) process:

$$y_{i,a,t} = \underbrace{\rho y_{i,a-1,t-1}}_{\text{AR}} + \underbrace{\varepsilon_{i,a,t} + \theta \varepsilon_{i,a-1,t-1}}_{\text{MA1}} \quad (2)$$

- In this case, substituting (2) in (1), the consumption response is given by

$$\begin{aligned}\Delta c_{i,a,t} &= \left( \frac{r}{1+r} \right) \left[ 1 - \frac{1}{(1+r)^{A-a+1}} \right]^{-1} \\ &\quad \left[ 1 + \frac{\rho + \theta}{1+r-\rho} \left( 1 - \left( \frac{\rho}{1+r} \right)^{A-a} \right) \right] \varepsilon_{i,a,t} \\ &= \kappa(r, \rho, \theta, A-a) \varepsilon_{i,a,t}\end{aligned}$$



- Table 1 shows the value of the marginal propensity to consume  $\kappa$  for various combinations of  $\rho$ ,  $\theta$ , and  $A - a$  (setting  $r = 0.02$ ).

**Table 1:** The response of consumption to income shocks under quadratic preferences

$\rho$	$\theta$	$A - a$	$\kappa$
1	-0.2	40	0.81
1	0	10	1
0.99	-0.2	40	0.68
0.95	-0.2	40	0.39
0.8	-0.2	40	0.13
0.95	-0.2	30	0.45
0.95	-0.2	20	0.53
0.95	-0.2	10	0.65
0.95	-0.1	40	0.44
0.95	-0.01	40	0.48
1	0	$\infty$	1
0	-0.2	40	0.03

- A number of facts emerge.
- If the income shock represents an innovation to a random walk process ( $\rho = 1, \theta = 0$ ), consumption responds one-to-one to it regardless of the horizon (the response is attenuated only if shocks end after some period, say  $L < A$ ).
- A decrease in the persistence of the shock lowers the value of  $\kappa$ . When  $\rho = 0.8$  (and  $\theta = -0.2$ ) for example, the value of  $\kappa$  is a modest 0.13.

- A decrease in the persistence of the MA component acts in the same direction (but the magnitude of the response is much attenuated).
- In this case as well, the presence of liquidity constraints may invalidate the sharp prediction of the model.
- For example, more and less persistent shocks may have a similar effect on consumption.
- When the consumer is hit by a short-lived negative shock, she can smooth the consumption response over the entire horizon by borrowing today (and repaying in the future when income reverts to the mean).
- If borrowing is precluded, a short-lived or long-lived shock have similar impacts on consumption.

- The income process (2) considered above is restrictive, because there is a single error component which follows an ARMA(1,1) process.
- A very popular characterization in calibrated macroeconomic models is to assume that income is the sum of a random walk process and a transitory i.i.d. component:

$$y_{i,a,t} = p_{i,a,t} + \varepsilon_{i,a,t} \quad (3)$$

$$p_{i,a,t} = p_{i,a-1,t-1} + \zeta_{i,a,t} \quad (4)$$

- The appeal of this income process is that it is close to the process used in a Friedman's permanent income hypothesis.

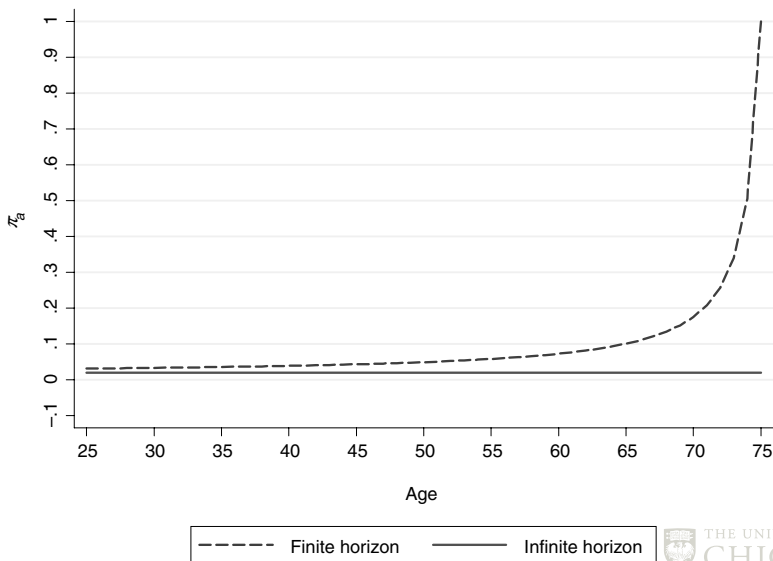
- In this case, the response of consumption to the two types of shocks is:

$$\Delta c_{i,a,t} = \pi_a \varepsilon_{i,a,t} + \zeta_{i,a,t} \quad (5)$$

- Consumption responds one-to-one to permanent shocks but the response of consumption to a transitory shock depends on the time horizon.
- For young consumers (with a long time horizon), the response should be small.
- The response should increase as consumers age.

- Figure 1 plots the value of the response for a consumer who lives until age 75.

**Figure 1:** The response of consumption to a transitory income shock





- Clearly, it is only in the last 10 years of life or so that there is a substantial response of consumption to a transitory shock.
- The graph also plots for the purpose of comparison the expected response in the infinite horizon case.
- An interesting implication of this graph is that a transitory unanticipated stabilization policy is likely to affect substantially only the behavior of older consumers (unless liquidity constraints are important—which may well be the case for younger consumers).

- Note finally that if the permanent component were literally permanent ( $p_{i,a,t} = p_i$ ), it would affect the level of consumption but not its change.
- In the classical version of the LC-PIH the *size* of income changes does not matter.
- One reason why the size of income changes may matter is because of adjustment costs: Consumers tend to smooth consumption and follow the theory when expected income changes are large, but are less likely to do so when the changes are small and the cost of adjusting consumption are not trivial.

- Suppose for example that consumers who want to adjust their consumption upwards in response to an expected income increase need to face the cost of negotiating a loan with a bank.
- This “magnitude hypothesis” has been formally tested by Scholnick (2010), who use a large data set provided by a Canadian bank that includes information on both credit cards spending as well as mortgage payment records.
- As in Stephens (2008) he argues that the final mortgage payment represent an expected shock to disposable income (that is, income net of pre-committed debt service payments).

- Outside the quadratic preference world, uncertainty about future income realizations will also impact consumption.

## Beyond the PIH

- The model with quadratic preferences gives very sharp predictions regarding the impact on consumption of various types of income shocks.
- For example, there is the sharp prediction that permanent shocks are entirely consumed (an MPC of 1).
- Unfortunately, quadratic preferences have well known undesirable features, such as increasing risk aversion with wealth and lack of a precautionary motive for saving.
- Do the prediction of this model survive under more realistic assumptions about preferences?
- The answer is: only qualitatively.

- The problem with more realistic preferences, such as CRRA, is that they deliver no closed form solution for consumption — that is, there is no analytical expression for the “consumption function” and hence the value of the propensity to consume in response to risk (income shocks) is not easily derivable.
- This is also the reason why the literature moved on to estimating Euler equations after Hall (1978).
- The advantage of the Euler equation approach is that one can be silent about the sources of uncertainty faced by the consumer (including crucially the stochastic structure of the income process).