LIFE-CYCLE HYPOTHESIS AND THE INFLUENCE OF FISHER'S INTERTEMPORAL APPROACH

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Intisari

Kehidupan manusia adalah terbatas, seperti halnya dalam menghasilkan pendapatan, manusia dibatasi oleh waktu (usia). Manusia mulai menghasilkan uang pada umur kira-kira usia 15 tahun atau lebih hingga usia 50-an atau 60-an tahun. Itulah salah satu alasan terpenting mengapa seorang individu atau masyarakat secara umum memiliki perilaku konsumsi yang berbeda sepanjang waktu. Tulisan ini akan mengkaji life-cycle hypothesis (LCH) dengan merunutnya dari awal, dan bagaimana hipotesis ini dipengaruhi oleh teori Fisher tentang intertemporal consumption function.

Kata kunci: perilaku konsumsi, LCH, intertemporal consumption function

INTRODUCTION

The existence of human life is limited, as is capability of generating income, even within the limit of his lifetime. Generation of income usually starts when an individual comes to the age of about fifteen, or rather more, until that of fifties or sixties, after which he usually retires. This is one of the most important reasons why individuals or people in general have different consumption behavior between the time when they are incapable of earning income, i.e. in the beginning and the in end of his life, and during the working age.

In the beginning of an individual's life, definitely, he is dependent on his parents since he is unable to get earning yet. Hence, his consumption is in principle comes from their income, whether in a form of direct sustenance or bequest form his parents, or from any other else. When the situation demands him to self-sustain, he has to search for a

job and generate income for this purpose and for preparation after the time he retires. So, according to Fisher,[1] consumption depends on an individual's lifetime income, while income, according to Modigliani,[2] varies systematically throughout his lifetime, so to allow for saving to play its role in determining allocation of income over the whole time of his life. This pattern of income-consumption behavior of the people is interpreted to form the basis of the *life-cycle hypothesis*.

This paper attempts to review this hypothesis by tracing from the beginning of its establishment, as to how such a hypothesis is influenced by the framework of Fisher's theory of intertemporal consumption function. Further evolution of the life-cycle hypothesis (LCH), as of the permanent income hypothesis (PIH), can also be traced from the works of Duesenberry, Friedman, and then vindicated, among others, by Hall.[3]

BASIC NOTION OF INTERTEMPORAL CONSUMPTION

The original work of Fisher's intertemporal consumption makes use of time preference (consumption) and production possibilities, and their relationship with income in terms of general equilibrium framework.[4] Figure 1 provides two basic foundations of neoclassical theory: *First*, time preference that defines the objectives of individuals intertemporal preferences, *second*, production function that defines the constraint, transformation possibilities, from the available individual's income.

Consider a two-period case, where indifference curves describe present and future individual consumption. Its slope illustrating the rate of exchange between units of present consumption, C_0, and that of the future, C_1, can be developed in the way of definition (1):

$$\frac{dC_1}{dC_0} = -(1 + i) \qquad (1)$$

The slope also reflects the *marginal rate of time preference* (MRTP) consumption, which is influenced by

[1] Irving Fisher, *The Theory of Interest as Determined by Impatience to Spend Income and Opportunity to Invest It*, Macmillan, New York, 1930 (reprinted by Augustus M. Kelly Publishers, New ark, 1870).

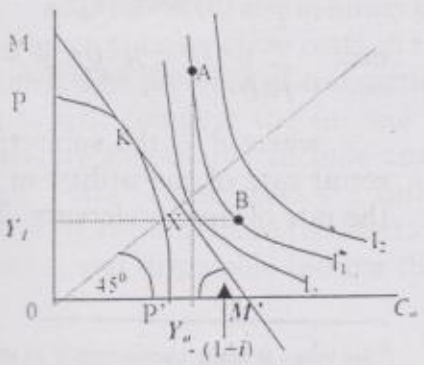
[2] Franco Modigliani, "Life-cycle, Individual Thrift, and the Wealth of Nations," *American Economic Review*, vol. 7, No. 3, June, 1986, pp. 297 1313. This article was presented in Stockholm, Sweden, when he received his Nobel; Prize in Economic Sciences.

[3] See for instance William H. Branson, *Macroeconomic Theory and Policy* (3rd ed.), Harper & Row Publishers, Singapore, 1989, pp. 238-263.

[4] For more complete view, see also Jurg Niehans, "Irving Fisher", a chapter inside *A History of Economic Theory: Classic Contributions, 1720-1980*, John Hopkins University Press, Baltimore, 1990, pp. 267-279.

two factors: available amounts of present and future consumption, and individual income. If an expected future income of an individual is higher than current income, at above 45 degree line (suppose at point A.), he will tend to give up a larger amount of C_1 for a given increment in C_0, than that one at B under the 45 degree line. The 45° line through the origin illustrates the equality amount of present and future consumption. Along the line, the individual still gives up more than one unit of C_1 for an additional unit of C_0, as indicated by the asymmetrical indifference curves in the figure. This exists because people are impatient, but at the same time, want to save in order to get opportunities for investment.[5]

Figure 1
Time Preference and Transformation Possibilities



On the other hand, MM' is the only income constraint that reflects the financial opportunities facing the individual, with the slope of - (1 + i). If the present individual's income is entirely spent for C_0, the situation is represented by point M' = $Y_0 + Y_1/(1 + i)$, he avoids using his income for financial opportunities in the future. Conversely, $M = Y_1 + Y_0 (1 + i)$, represents another extreme for putting all income for future financial opportunities and not to consume today. Along the line MM', the income (or budget) constraint becomes $C_0 + C_1/(1 + i) = Y_0 + Y_1/(1 + i)$, where financial opportunities may be exchanged, so as to form a "market line".

FURTHER CONSIDERATIONS OF THE ANALYSIS

Among the rationale for the hypothesis to be presented is utility maximization of an individual, as a rational economic agent, subject to his budget constraints –i.e., his permanent income, which is treated by Modigliani as *life resources* This income varies over time during the individual's life, or in other words, he allocates his life resources to consumption for satisfying his utility throughout his age.

Hence, there is a relationship, Modigliani claims, between his LCH and Friedman's PIH, despite the

[5] The belief in such that positive time preference always exists in an empirical fact may also be seen from the title of Fisher's book itself.

main difference exists between the two. While simply assuming that life is indefinitely long under which consumption and saving decision is undertaken, the notion of permanent income can take over the position of life resources as suggested by the PIH. The LCH on the other hand, assuming the finite life of the people, realizes systematic variations in income of the people and in consumption occurring over the life cycle, as a result of maturing, retiring and of changes in family size.

Average labor income typically rises with the age, showing a marked hump pattern to reach its peak at the age about 50, falling afterwards to indicate partly the incidence of retirement. The monthly received pension scheme makes the pattern does not go to zero, though it falls sharply after 65. The LCH suggests that not only income does vary but also consumption. Nevertheless, it reflects greatly variations in family size, and is usually assumed to slightly increase. This intertemporal hypothesis rather reflects intergenerational considerations as represented by caring the sustenance for the earlier stage of individual lifetime in the family.

FORMALIZING THE INITIAL MODEL

The standard model of macroconsumption starts with analyzing a single consumer with his utility function U, as a function of his real consumption c, in all of his lifetime T; the instant before his death. The utility function is given as:

$$U = U(C_0, C_1, ..., C_t, ..., C_T) \quad (2)$$

However, the assumption of linearity of the function is carried out, so that individual is assumed to maximize the present value of his consumption, instead of present value of his *utility* of consumption.[6] Since the LCH suggests that individuals' lifetime is finite, the paper also uses notation T, representing the expected lifetime of the individual, rather than infinity (¥), so that it can be written:

$$\max \sum_{t=0}^{T} (1+\delta)^{-t} U(c_t) \quad (3)$$

Or for more convenience, if $b = (1 + d)^{-1}$, equation (3) can be restated as:

$$\max \sum_{t=0}^{T} \beta^t U(c_t), \quad 0 < \beta < 1 \quad (4)$$

where d is the subjective discount rate of the utility, or can be the rate of time preference. The pe-

[6] See William M. Scarth, *Macroeconomics: an Introduction to Advanced Methods*, Harcourt Brace Jovanovich, Toronto, 1988, pp. 93.

riod utility function, $U(c_t)$, is assumed to follow *constant relative risk aversion* (CRRA),[7] indicating sufficient information is available at the time t.

This maximization is subject to his budget constraint that his future assets can not exceed the different between the future values of the current income and of the current consumption, in addition to the future value of the initial (current) assets:

$$A_{t+1} = (A_t + y_t - c_t)(1 + r), A_t < 0 \quad (5)$$

where y_t and c_t are the real income and consumption respectively at time t. A_t represents the initial state of the physical and financial assets or wealth at time t, so that $(A_{t+1} - A_t)$ expresses the yearly accumulation of assets. Explicating the yearly assets accumulation leads to another expression of this constraint:

$$c_t = y^d - (A_{t+1} - A_t) - h(A/y^d) \quad 6)$$

Expression (6) also assumes the existence of transaction costs in the model. The presence of transaction costs will compose the income to separate disposable income from such costs. These costs are influenced by two variables: the assets at time t. and disposable income that is defined to be constant. This is usually used in PIH, as expressed by Scarth.

On the other hand, expression (5) can be simplified by assuming $R_t = (1 + r)$, so that

$$A_{t+1} = R_t(A_t + y_t - c_t), \; A_t \geq 0 \quad (7)$$

In the stochastic dynamic programming, where multiperiod problems require some sorts of reduction to form two-period analysis, instead of Lagrangean function, Bellman's (recursive) equation that introduces the *value function* $V_t(A_t)$ is used. So, the objective function defined in equation (4) gives:

$$V_t(A_t) = \max_{d(t)} U(c_t), + \beta \; V_{t+1}(A_{t+1}) \quad (8)$$

This means that the value function at time t equals the utility of consumption at that time plus the expected future value of the function after one year (or at time t + 1).

Equation (8) implies that the first order condition for maximization of the state function subject to the constraint gives:

$$U'(c_t), = \beta \, V'_{t+1}(A_{t+1}) \quad (9)$$

Along the optimal path, equation (7), (8) and (9) provide the solution for the equality of $U'(c_t) = V'_t(A_t)$, so that the final outcome can be found as:

$$U'(c_t) = \beta \; R_t U'(c_{t+1}) \text{ or}$$
$$U'(c_t) = (1+\delta)^{-1}(1+r)U'(c_{t+1}) \quad (10)$$

[7] See for instance Lei-Lin Chan and Sheng-Cheng Hu, "Financial Liberation and Aggregate Consumption: the Evidence from Taiwan," *Applied Economics*, vol. 29, 1979, pp. 1525-1535.

meaning that the marginal rate of substitution of consumption in two periods of time must be equal to the marginal rate of transformation. If the expected discount rate equals the market interest rate, there will be optimal condition for a random work process, giving $(\beta^{-1} = R_t)$, and

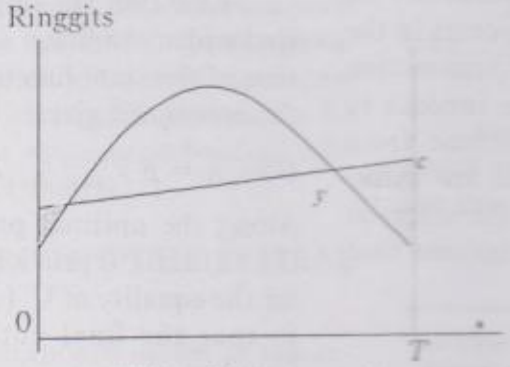
$$U'(c_t) = U'(c_{t+1}) \qquad (11)$$

THE LIFE-CYCLE HYPOTHESIS (LCH)

The assumption that according to LCH an individual nay be expected to maintain a slightly increasing level of consumption throughout his lifetime makes little bit violation to equation (11), because in this case, $\delta < r$, so that $\beta^{-1} < R_t$. This constancy reflects that for a given interest rate, c_t and c_{t+1} are constant proportion of the total resources. His budget constraint hence also follows the assumption that the present value of his consumption during his lifetime does not exceed the present value of his total lifetime resources.

Therefore, a cross-sectional study of LCH undertaking consumption and income level will show that the high level of income groups contain individuals in the middle of lifetime, having relatively low ratio of c/y. In contrast, the low level of income groups will include persons in the beginning as well as in the end of lifetime, with relatively high c/y. Thus, it will illustrate that c/y will go down as income rise, vice versa, so that the marginal propensity to consume falls below the average propensity to consume, MPC < APC; as depicted in Figure 2.

Figure 2
Lifetime Profile of Consumption and Income



Source: William H. Branson, *Macroeconomic Theory and Policy*, p.253

Consumption in each period is constrained by the present value of its related resources. Dellning equations (5) and (6) into a more general term starting from the period of zero, yields:

$$c_o = k \sum_{t=0}^{T} y_t (1+r)^{-t} \quad (12)$$

where l is a fraction of resources an individual wants to consume in period t. Decomposing resources into two: labor income (yL) and property assets or wealth (W), we get:

$$C_o = \lambda \sum_{t=0}^{T} yL_t (1+r)^{-t} + \lambda \sum_{t=0}^{T} W_t (1+r)^{-t} \quad (13)$$

Assuming the initial wealth (net worth) at the beginning of the period equals the asset itself, w_t; and the change of income as a result of periodical changes in labor income, and setting the known current labor income separately from the expected unknown future, we obtain:

$$c_o = \lambda yL_0 + \lambda \sum_{t=1}^{T} yL_t (1+r)^{-t} + \lambda w_i \quad (14)$$

The well-known assumption used in the LCH, which is controversial, is the "proportionality postulate." It follows from the assumption that marginal rates of substitution depend only on consumption ratios.[8] Hence, the remaining lifetime resources are proportionately spread over the whole periods of the lifetime

$$(T\text{-}1)^{-1} \sum_{t=1}^{T} yL_t (1+r)^{-t} = yE_0 \quad \text{or}$$

$$(T\text{-}1)^{-1} yE_0 = \sum_{t=1}^{T} yL_t (1+r)^{-t} \quad (15)$$

This gives:

$$c_o = \lambda yL_0 + \lambda (T\text{-}1) yE_0 + \lambda w_0 \quad (16)$$

Assuming that expected labor income is merely a multiple of the current labor income, so that $yE_0 = q\, yL_0$ where $q > 0$, equation (16) can be rewritten as:

$$c_0 = \lambda yL_0 + \lambda\theta (T-1) yL_0 + \lambda w_0 = \lambda [1 + \theta (T-1)]\, yL_0 + \lambda w_0 \quad (17)$$

or in general form

$$c_t = \lambda [1 + \theta (T-1)]\, yL_t + \lambda w_t \quad (18)$$

Once the coefficient l is empirically known, given the lifetime T, the value of q can easily be determined.

[8] See R. Leighton Thomas, "The Consumption Function, a chapter in David Demery et al., *Macroeconomics*, Longman, London, 1984, Pp. 53-99.

FURTHER EXTENSION OF THE LCH MODEL

The use of LCH and sometimes also combined with PIH is largely coverage, and limitations of this paper do not permit inclusion of such extended works. However, it is necessary to mention some of them. Most of the empirical studies of the LCH depart from simple form of equation (18).

Supposing that $\lambda [1 + \theta (T - 1)] = a_1$, and $\lambda = a_2$ to get:

$$c_t = \alpha_1 yL_t + \alpha_2 w_t \qquad (19)$$

Thomas, enumerating some extension forms of the LCH observes considerable shift from attention to what the so-called "money illusion" as of ignorant of prices changes, to further account of prices movement during 1970. Therefore, modified version of the analysis gives:

$$c_t = \alpha_1 yL_t + \alpha_2 w_t + \alpha_2 P_t \qquad (20)$$

A positive a_3 means that an increase in P_t, will imply the increase consumption, ceteris paribus. For example, observation by Branson and Klevorick (1969) for the U.S. data 1955-1965 provides the evidence that money illusion was significant. Juster and Wachtel (1972) also suggest similar conclusion. There are some works related to inflation, among others by Towned (1976), Deaton (1978) .

Other types of extension models are the role of social security and bequest behavior, saving, etc. There is, among others, a work by Modigliani and Hemming[9] consisting of articles by numerous authors that discusses these two issues based on the life-cycle hypothesis. The straightforward use of the basic LCH model has also been empirically tested for cross-sectional data in the U.K. by Banks and Tanser[10] in observation of savings and wealth.

CONCLUSION

Life-cycle hypothesis has been developed to incorporate intertemporal or rather intergenerational consumption problems and in relation with income. Ando-Modigliani-Bumberg developed this hypothesis at about 1950s, the time when Friedman also developed his permanent income hypothesis, used similar basic foundation.

The basic notion of the hypothesis sterns from the approach of intertemporal as firstly introduced by Fisher. In the LCH model, people are assumed to have the initial income below their consumption, and so do for their end of lifetime. This is due to mainly incapability of getting income and retirement, respectively. However, in the middle of their lifetime, it is proved, their income is higher than consumption.

Recently, the LCH has been extended in various forms including analyses on saving and wealth behaviors, pensions, its relation to inflation and financial regulation, etc. most of which provide some empirical evidence in many countries.

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