THE MODIGLIANI–ADDO–BRUMBERG LIFE-CYCLE MODEL: APPLYING TO UKRAINE'S ECONOMY

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Abstract. *The authors investigate and analyze the possibility of the Modigliani–Ando–Brumberg life-cycle model to describe the relationship among income, consumption, savings, and inheritance of individual households of Ukraine's economy by using the state statistics data of Ukraine. The features and contradictions of the assumption that a person has the desire to stabilize consumption and make it uniform throughout his life to Ukrainian households are tested.*

Key words: *life cycle model, savings, income, debt, retirement, consumption, wealth, inheritance, constant consumption*

Introduction

The consumption of the total population is one of the indicators of the economic growth and development of a country. Therefore, consumption and savings can directly exert an influence on the price level of domestic employment and production.

The meaning of household savings is the desire to secure old age and to pass an inheritance to children or grandchildren, and the accumulation of financial resources to purchase real estate, land, and durable valuables. This aspect is considered in the theory of the life cycle. The Modigliani–Ando–Brumberg theory of the life cycle is based on the microeconomic planning of consumption and savings over a lifetime. However, there is a need for an analysis and study of the theory in a case study, because each nation and state have their own behaviour (consumption, savings, investment). Therefore, the question arises whether it possible to apply the model for the purposes of policy and whether adequate results we get on an example of Ukraine.

Literature review

The features and various aspects of the issues have been addressed in the works of many authors.

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Thus, Christopher Carroll and Summers (Carroll, Summers 1991) analyzed the cross-correlation between savings and growth, according to which the authors admit that the younger generation is growing the economy relatively richer than the older one.

Uncertainty is a problem that Modigliani considered as unsolved. But he has insisted that the strongest effect of uncertainty in the future will create the desire to save in more people; this is the motive which was previously referred to by Keynes, that the younger generation is able to save for the sake of a dual purpose, not only for retirement or for unforeseen costs. Theoretical results of Robert Merton (Merton, 1969) have showed that if the risk is reduced to financial assets, the basic rule of the lifecycle of a customer is true if the consumption is proportional to assets, and provided that the maximization of expected utility maximization is replaced by the utility.

The work on saving for emergencies, partly written by Carroll (Carroll, 1997), where he shows that people with unpredictable future income and are quite reasonable – they would never borrow money as these individuals will not be able to earn enough to repay their debts. If these people expect that their income will increase over time, they will spend within their current income, thereby closing the possibility of "tracking" between consumption and income.

Also, Carroll (Carroll, 1997) and Deaton (Deaton, 1991) have noted that in case of extreme scarcity, consumption is smoothed not throughout the life cycle but for shorter periods such as several years. This phenomenon in economics scholars is often called "high income smoothing".

The work of Pierre-Olivier Gourinchas and Jonathan Parker (Gourinchas, Parker, 2002) has demonstrated that everyone is trying to maximize their expected utility, the utility in the future. The younger generation is more inclined to borrow, but cannot, or are too sensible, to borrow money and therefore limit the size of the consumption of the current income.

During the development of behavioristic economy in the world, it was introduced the concept of "hyperbolic discounting." This concept means that people are waiting too long to set aside money for retirement; this is consistent with a very limited life cycle savings are reflected in the data, which can be an expensive mistake given the power of compound interest. Concept of "hyperbolic discounting" is used by David Laibson (Laibson, 1997), and later in the work of Laibson and Christopher Harris (Harris, Laibson, 2001). Unlike the standard life cycle, people who are "hyperbolic discounters" believe that their consumption varies in different periods of life, regardless of their current position as one would assume before the individual is born, but eventually he changes his views every period depending on where he is now.

Richard Thaler and Shlomo Benartzi (Thaler, Benartzi, 2004) have reviewed the plan called "Save More Tomorrow ™", where people are usually reluctant to save; they have

willingly signed the plan which is the fractional deduction from wages to keep starting "tomorrow" from escalating the further extract fraction of the money by the time until the target rate of savings was achieved. Thaler, David Laibson and his colleagues are actively working on a variety of behavioral effects on savings and think about how to design savings and pension arrangements that simplify the process of saving for people and help them to participate in this process to their advantage.

James Tobin (Tobin, 1957) in his scientific work has noted that economic growth stimulates an increase of savings. Also, he noted that if a person expects that his revenues will grow throughout life, whereas, according to the theory of the life cycle, the individual must consume more than he has cash resources at the beginning of life, and eat, so that the cost of opening and closing life is compensated by savings during the interim period. In an extreme case, if the growth rate is high enough, such a person's behavior may lead to a negative relationship between economic growth and savings.

For versions of the life cycle theory, which assumes that the family will live forever, Modigliani didn't have time for it. This implies that the family (household) seeks to maximize the utility for not only their own lives but also the offspring and future generations. In this behavior, Robert Barro (Barro, 1974) has established the so-called Ricardo equivalence hypothesis that the fiscal surplus and deficits have no impact on national savings, as well as the next generation will provide for the future tax consequences and always be able to change their plans so to offset government actions to restore the national savings to the desired level.

Methods

The aim of the paper is applying the life-cycle Modigliani–Ando–Brumberg model to Ukraine and forming conclusions regarding the hypothesis of consumption and household savings.

Given that the attitudes and habits of people, society and economy are changing each decade, the model of life cycle analysis needs the further improvement to have practical applications for the development and construction of the forecasts on the macro level.

The Modigliani–Ando–Brumberg model of life cycle

The life cycle model of Franco Modigliani, the Nobel Prize winner in 1986 in economics, is developed and presented in a number of articles written in the 50s and early 60s in collaboration with Richard Brumberg and Albert Ando. The Nobel Lecture of Franco Modigliani "Life cycle savings and wealth of the nation" is a review of this fundamental theory (Sachs, 1996).

Comparing the theories of Keynes and Modigliani, J. Keynes believed that consumption is an important factor in the propensity to consume, which means that an increase in the total income of the consumer society is also beginning to grow, but to a lesser extent. The output, prices, and employment are based on consumption and savings; this dependence is manifested via savings and consumption. As a result of a slight increase in the revenue, part of it is removed, and this value decreases the demand for consumer goods and services (Chepinoha, 2011).

The dependence of consumption and income share of savings from the rate of growth of real income is derived by Modigliani and Ando. A significant number of scientists believe that the relationship between income and savings is influenced by various social factors such as education, race, national identity, professional staff, etc., but more specifically describe the mechanism failed. Questions have arisen as to the practice of determining the distribution of an individual's income on consumption and savings, and influencing his decision.

The theory of the Modigliani life cycle means that the distribution of income on consumption and saving is formed on the human desire to distribute their income in the periods of life, to reflect the distribution requirements during these periods, that is, the individual must save to eat in different periods if a loss of income occurs. So, now we use the term "life cycle". Modigliani tried to improve the consumer Keynes function to find a rational basis for macroeconomic behaviour in the actions of individuals, as first described in the Modigliani life cycle model which was intended to explain the pattern formation of the savings of individuals.

According to the theory of life cycle, the human propensity to consume out of income depends on his or her age.

Modigliani and Ando received a number of results that were sufficiently encouraging for the development of the theory of the life cycle. But then it turned out that only part of the provisions of this theory weretrue. The discrepancy is that households save more in adulthood than in younger years. Scientists such as Sh. Danziher, Zh. Haah, Yu. Smolensky, M. Taussih have investigated the propensity to consume and found that older people save more of their income than the younger people. This statement contradicts the theory of the life cycle. In studies of other scientists, such as L. Kotlikofa and L. Sammers, most individuals save in order to leave an inheritance but not to provide for the level of consumption in the old age.

Today, the life cycle model is the basis for many dynamic models used to study the consumption and savings, as well as as a tool to analyze the different interpretations of the concept of the "burden" of debt, which is regarded as the reduction of utility for life (Sachs, 1996).

Description of the model

The Modigliani–Ando–Brumberg model is described by the following equations:

$$A = B_0 + Y_d * n, \quad (1)$$

where A is the wealth for the first period, B_0 – inheritance, Y_d – profit, n – the working period.

$$s = c * (T - n), \quad (2)$$

where s are savings, c is consumption, $(T - n)$ – the period of retirement, T – the average life expectancy.

$$s = n * (Y_d - c) + B_0. \quad (3)$$

Then, from equations 2 and 3, we'll obtain:

$$c * (T - n) = * (Y_d - c) * n + B_0.$$

The futher simplifying yields:

$$c * T = n * Y_d + B_0,$$

$$c = (n * Y_d + B_0) / T,$$

$$c = \frac{B_0}{T} + \left(\frac{n}{T}\right) / Y_d,$$

where $1/T$ – marginal propensity to consume on wealth, n/T – marginal propensity to consume on income.

Let's make the replacement $1/T = \beta$ and $n/T = \alpha$, and we obtain the following expression:

$$c = \beta * B_0 + \alpha * Y_d.$$

Let B_0 be a revenue for the first time (it is inherited, but we assume that B_0 equates to zero).

Results

To make the calculations, it is necessary to find the data for the further processing in Excel and to build a linear regression (consumption depends on income and on inheritance), check the adequacy of the Modigliani–Ando–Brumberg model and the feasibility of its use on data obtained from the State Statistics website. Table 1 reflects the data on average life expectancy at birth in Ukraine (in years), taken from the database on the Head Office of Statistics in the Lviv region.

TABLE 1. **Average life expectancy at birth in Ukraine (years)**

	2002–2003	2003–2004	2004–2005	2005–2006	2006–2007	2007–2008	2008–2009	2009–2010	2011
Both sexes	68.24	68.22	67.96	68.10	68.25	68.27	69.29	70.44	71.02
Male	62.64	62.60	62.23	62.38	62.51	62.51	63.79	65.28	65.98
Female	74.06	74.05	73.97	74.06	74.22	74.28	74.86	75.50	75.88

Notes: for 2011, calculations were carried out in two adjacent years, from 2011 – per calendar year.

Given that the average life expectancy every year gradually increases, except 2003–2004 the data for 2012 can be added, taking into account the increasing average life expectancy for both sexes to 72 years. The required statistics for 2012 are not available, so keeping the trend we make the assumption for this year.

In our research, we assume that the person works for 38 years during his life.

Table 2 presents the analyzed period, annual consumption per household, income per year on average per household, the average life expectancy at birth, and the period of employment. In our research, we assume that the average individual lifetime employment is a period of n years (Table 2).

TABLE 2

Year	c	n	T	Y_d	Retired at
2008	2590.4	34	68.27	2892.8	56
2009	2754.1	37	69.29	3015.3	57
2010	3072.7	38	70.44	3469.1	58
2011	3456	39	71.02	3841.7	59
2012	3812.1	44	72	4121.1	60

Based on the existing data, we proceed to calculations by the formulas above.

Table 3 shows the calculations using formulas 2 and 3.

TABLE 3

Year	s	$S = c^*(T - n)$	$S = n^*(Y_d - C) + B_0$
2008	302.4	88773.008	10281.6
2009	261.2	88929.889	9664.4
2010	396.4	99678.388	15063.2
2011	385.7	110661.12	15042.3
2012	309	106738.8	13596

The value of s was found as the difference between the disposable income Y_d and consumption c.

In Table 4, the following calculations are obtained by using formula 5.

TABLE 4

Year	β	α	$Y_d * n$	$c=\beta * B_0 + \alpha * Y_d$
2008	0.014648	0.498022557	98355.2	1440.679654
2009	0.014432	0.533987588	111566.1	1610.132775
2010	0.014196	0.539466212	131825.8	1871.462237
2011	0.014081	0.549141087	149826.3	2109.635314
2012	0.013889	0.611111111	181328,4	2518.45

Table 5 shows calculations of B_0 possession and use per household.

TABLE 5

Year	$B_0 = c*T - n*Yd$	B_0/(working + in retired)	$C = \beta * B_0 + \alpha * Y_d$
2008	78491.408	2308.570824	2590.4
2009	79265.489	2142.310514	2754.1
2010	84615.188	2226.715474	3072.7
2011	95618.82	2451.764615	3456
2012	93142.8	2116.881818	3812.1

Table 6 shows the estimates of wealth for the first time, and household wealth and consumption over the period of employment.

TABLE 6

Year	$s = n*(Y_d - c) + B_0$	$A = B_0 + Y_d * n$	$A = B_0 + Y_d$
2008	88773.008	176846.608	5201.370824
2009	88929.889	190831.589	5157.610514
2010	99678.388	216440.988	5695.815474
2011	110661.12	245445.12	6293.464615
2012	106738.8	274471.2	6237.981818

Using Eviews 7.0, we have built a linear regression model of consumption dependence on the income and inheritance (B_0). As a result, we obtained regression estimates so that the Student's test statistics are not significant. The result of modeling also indicates that the model is inadequate and has a too large error value.

Conclusions

We can conclude that the model of Modigliani–Ando–Brumberg is not usable for Ukraine's economy. Firstly, the consumption which is indicated on State Statistics is not equal to the consumption that was found using the formula $s = \beta * B_0 + \alpha * Y_d$. Because people consume nonlinear by during their life, in the case of our country they try to hide their profits. Also, it is necessary to take into account the specific conditions of the country and reporting to the State Statistics Committee of Ukraine. Only part of the data are true, which leads to an imbalance between consumption and income and savings, and tracking these processes are extremely complicated. The equation for finding the consumer the does not consider other factors that may affect household consumption; in fact, such a process cannot be described by a linear dependence, because it is nonlinear.

Besides, savings are not equal to each other; they are calculated as $s = Y_d - c$ and are found by formulas (2) and (3). This fact is explained by the fact that the majority of the older generation in Ukraine tends to save and to further undermine that is not taxed and never appears, beginning the formation of the primitive imbalances at the macro level. The adult generation trying to save money by investing in real estate or other items in the future will not lose value due to inflation and minimize their tax revenues. Also, given the fact that most of the income are low, we can make the assumption that people consume almost the entire current income and almost nothing have to save.

Thus, the disadvantage of the life cycle model is that the model focuses on the estimation of the size of wealth, but does not include the return on assets, which constitute wealth, without the optimization of discounted flows. Also, the model does not address the problems associated with mass estimated entities and their profits.

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