

Teaching Time Preference and Human Impatience: The Billionaire Game

Stephen M. Miller*
Department of Economics
The University of Connecticut
Storrs, Connecticut 06269-1063
(860) 486-3853 (telephone)
(860) 486-4463 (fax)
SMILLER@UCONNVM.UCONN.EDU (e-mail)

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Abstract

The Billionaire Game involves students in discussing time preference, or what Fisher (1930) calls human impatience. The game can facilitate the introduction of the material on present value and discounting or discussions on such issues as investment in human capital and the intertemporal consumption-saving decision. Thus, the game can facilitate discussions in a number of economics courses.

* Professor and Head of Economics. The Billionaire Game was initially mentioned in McEachern (1994).

One of my long-time colleagues, Will McEachern, argues quite persuasively that instructors need to incorporate "breaks in the action," times when students can concentrate less intensely and recuperate from the flow of ideas in a lecture. This need for a "commercial break" is all the more necessary in a large lecture class. Thus, I am constantly looking for good methods to break the tension. Of course, the logical place to introduce a break is at a transition from one topic to the next. I have used "The Billionaire Game" for over two decades as such a commercial break.

The Billionaire Game introduces the idea of time preference, or what Fisher (1930) calls human impatience, with minimum effort. Once introduced, several paths of discussion can follow, which makes the game useful in a number of different courses. In the macro principles and the money and banking courses, I introduce the material on present value and discounting with this game. This game, however, can be used in a number of other courses that consider such issues as investment in human capital and the intertemporal consumption-saving decision.

THE BILLIONAIRE GAME

The game builds on a premise of an old television program, *The Millionaire*, a CBS drama that appeared between 1955 and 1960.¹ In that show, an unseen benefactor, John Beresford Tipton, gave individuals a million dollars with only one condition -- the recipient could not reveal the source of the money. The gift was delivered to the (un)lucky recipient by Mr. Tipton's secretary, Michael Anthony. The show proceeded to follow that individual to see how his or her life was affected by this unexpected gift; Mr. Anthony provided a report for Mr. Tipton at the end of the show. I tell the class that Mr. Anthony will deliver to each student a cashier's check for 1 billion dollars at the end of the class hour.²

To receive the check, students agree to the following conditions: (i) each student must surrender all assets that he or she owns, not a big deal to most students; (ii) each student agrees not to generate any income -- earned or unearned -- over the rest of his

or her life;³ (iii) each student agrees to lease or rent all major consumer durables such as automobiles and homes;⁴ (iv) each student freely consumes at any rate he or she so desires, but once the proceeds are exhausted no further money is forthcoming; and (v) each student agrees that any money unexpended when he or she dies reverts to the benefactor. Furthermore, I make the following additional assumptions to keep the game simple: (i) no uncertainty exists in the world and each student knows the precise moment of his or her death, and (ii) the economy will experience no inflation or deflation over the rest of each student's life.⁵ In sum, individual choice reduces to an autarkic equilibrium for each student. No economic exchange occurs with any other person. Only intertemporal exchange exists to alter a student's consumption path, where foregoing consumption now increases consumption at a later date.

I then draw three graphs illustrating different consumption streams (see Figure 1). The above stated assumptions ensure that the areas under the three curves each equals \$1 billion. Each student must decide on one of the three consumption paths. Consumption begins today (time zero) and continues until the "wall of Death" (time D), which is known with certainty. I have conducted this vote on the three consumption paths for over two decades. The results are extremely predictable. Students choose by strong majorities (usually 80 to 90 percent) the Type A consumption path. I identify these students as "live-for-today, for-tomorrow-we-die" consumers. The other votes are scattered across the Type B -- "life-is-so-predictable (-boring)" consumers -- and type C - - "let's-party-tomorrow" consumers -- paths. These results, although I have not kept records, have been fairly stable across the years.

I then observe that this imbalance between Type A and Type C students (consumers) helps to explain why interest rates are positive. That is, to have a balance between borrowing and lending (or saving and dissaving), some Type A consumers must be induced to become Type C consumers and that this is accomplished with a positive interest rate. Of course, such rhetoric plays somewhat fast and loose with the

facts. The game only awards a gift of a billion dollars to be spent over the students' remaining life. It does not directly imply anything about an income stream, which is needed before one can draw accurate conclusions about saving patterns. I return to this issue below.

Students easily recognize that a dollar today is not equivalent to a dollar tomorrow.⁶ If the interest rate is positive, then a dollar today is worth more than a dollar tomorrow. Each income stream needs to be evaluated at the same point in time, generally the present. Students realize that many economic decisions, such as investment in physical or human capital, frequently require the comparison of dollar amounts at different points in time. Thus, the stage has been set for a discussion of time discounting and present value.

TIME PREFERENCE AND HUMAN IMPATIENCE

In *The Theory of Interest: As Determined by Impatience to Spend Income and Opportunity to Invest It*, Fisher (1930) elaborates in great detail on the basic idea that I am trying to illustrate with The Billionaire Game. Fisher refers to individuals' feelings about present and future consumption interchangeably as time preference or human impatience. My experience with The Billionaire Game fully supports this view of humans as impatient to consume today, rather than wait for tomorrow. While Fisher allows for the possibility of miserly behavior -- Type C consumers, he believes that Type A consumers are the norm.

According to Fisher (1930), impatience depends crucially on income -- its size, its time path, and its uncertainty. Individuals possess sets of willingness curves (i.e., indifference curves) between present and future consumption. The marginal rate of substitution of the willingness curves at each point in the present and future consumption space gives the local value for human impatience or time preference. In today's vernacular, the marginal rate of substitution gives the internal rate of discount (see equation (1) below and the related discussion). The marginal rate of substitution of

the willingness curves changes as total income changes, as the distribution of income between the present and future changes, or as the uncertainty of future income changes.

Let me illustrate these last observations. The movement from extremely low income levels (see point A in Figure 2) to extremely high levels (see point B) probably associates with a steeper trade-off (i.e., a higher internal rate of discount or impatience) between present and future consumption when the individual is poor to a nearly one-to-one trade-off (i.e., a nearly zero rate of discount or impatience) when the individual is wealthy. Similar stories emerge for the distribution of income between the present and the future (see points C and D in Figure 2) as well as for the uncertainty of future income.

HUMAN CAPITAL THEORY

With a brief classroom presentation of The Billionaire Game (no more than 10 minutes depending on your propensity to spin a story), several paths can be followed for more in-depth economic analysis. For example, the game makes an excellent opening in courses, such as labor economics, where issues of human capital investment are discussed. After completing the vote, you can ask Type A students the following questions: "Why are you attending college and sitting in my class?" "If you prefer present to future consumption, why are you not out earning income so that you can consume today?" "Why are you sacrificing present consumption to attend college?" The responses to such questions will be wide and varied.

Some responses will allow you to pursue issues related to investment in human capital; others will not. For example, statements that "my parents sent me to school" or "I couldn't find a job, so I decided to go to college" need to be followed with additional questions to focus the discussion of opportunity cost and the anticipated future benefits from improved job market skills.

Once students see that the future income generated from the additional education may exceed their income absent that education, then you are able to move into issues of comparing these two different income streams using present value tools.

MULTIPERIOD CONSUMPTION DECISIONS

Another avenue of investigation, probably best suited for intermediate or graduate level macroeconomics, involves multiperiod consumption decisions -- the two-period model being the simplest. Divide the continuous time period from 0 to D into two discrete periods. Essentially divide the three consumption profiles in half -- young and old, or present and future. Type A consumers still consume more today than tomorrow and Type C consumers the reverse.

Two-period consumption decisions received considerable discussion in Fisher (1930). The Billionaire Game determines whether students have a positive (Type A) or negative (Type C) time preference. Time preference or human impatience associates with an internal rate of discount that can compare present and future consumption. This internal discount rate is positive (Type A) or negative (Type C) depending on the students' time preference.

A simple approach to modeling the utility of students over time is to use the internal rate of discount (r) to discount the utility of future consumption back to the present (see McCafferty, 1990, pp. 16-17). Thus, in the two-period case, we have the following representation:

$$U = U(C_0) + U(C_1)/(1 + r), \quad (1)$$

where C_0 and C_1 are present (young) and future (old) consumption, and U is the utility function over consumption.

The Billionaire Game structure imposes a zero interest rate between the periods, since students substitute present for future consumption on a dollar-to-dollar basis. Figure 3 shows the budget line. Type A consumers (point A in Figure 3) prefer present to future consumption; Type C consumers (point C) prefer future to present

consumption. At both points A and C, the (not-shown) willingness (i.e., indifference) curves are tangent to the budget line forcing r to be zero, a necessary equilibrium condition according to Fisher (1930).⁷ At point B, where present consumption equals future consumption, however, the willingness curves indicate a positive discount or impatience rate for Type A consumers and a negative discount or impatience rate for Type C consumers. In other words, Type A consumers, based solely on their willingness curves, exhibit relatively more impatient than Type C consumers. Equilibrium requires each type to choose a consumption pattern over the two periods so that the internal rate of discount or impatience equals the market interest rate, which in this special case artificially equals zero.

Positive Interest Rate and Saving Behavior

A similar story emerges for a positive market interest rate (i). Now, we need to specify the individual's income over the two periods. The simplest assumption imposes equal incomes between the two periods (i.e., \$500 million, if we continue with The Billionaire Game scenario) for the individual. With a zero interest rate, the slope of the budget line equals minus one. With a positive interest rate, the budget line rotates through point B such that increased consumption opportunities emerge for Type C consumers while reduced opportunities may emerge for Type A consumers. On the new budget line, Type A consumers move to a point such as A'. At this point, individuals consume more than their first period income, which is accomplished by borrowing.⁸ Type C consumers move to a point such as C', where they consume less than first period income. We assume for simplicity that the borrowing rate equals the lending rate. Thus, the budget line for a positive interest rate does not contain a kink at B.

The movement of Type A consumers from A to A' or the movement of Type C consumers from C to C' involves both a substitution and an income effect. Such discussions can provide grist for the microeconomics mill. Whether or not consumption

decreases or increases for Type A or Type C consumers depends on the relative sizes of the income and substitution effects.

Type B consumers provide a special case absent an income effect. Since Type B consumers initially consume their income each period along the zero interest rate budget line, the introduction of a positive interest rate causes Type B consumers to experience only a substitution effect. Thus, we unambiguously know that Type B consumers reduce their consumption below first period income. These consumers become savers (investors), partly because they are paid interest to forego some present consumption.

OVERLAPPING GENERATIONS MODELS

Why money plays such a critical role in macroeconomic models is an important, but frequently overlooked, question. Principles of macroeconomics and money and banking courses usually enumerate and discuss the functions or uses of money -- medium of exchange and store of value functions. These discussions, however, generally expand at great length on the use of money as a medium of exchange to facilitate the contemporaneous exchange of goods and services. Money exchange dominates barter exchange, for example, in the fewer number of prices that must exist. Precious little time, in my view, focuses on the role of money in facilitating the exchange of goods and services over time. With this latter focus, the medium of exchange and store of value functions merge into one

The overlapping generations model allows us to consider these issues in an extremely simple framework. Such modeling has received considerable interest in recent years, although much of the work traces its roots to the classic paper by Samuelson (1958). While Samuelson's specification incorporated three phases of an individual's life, most modeling today now incorporates only two phases -- young and old.

Returning to the basic Billionaire Game, the game assumes a zero interest rate and provides each consumer with an endowment from which each consumer finances consumption over the rest of his or her life. Now assume, however, that this endowment is perishable, *not money*, and that each individual lives for two periods. At any point in time, two generations exist -- the young and old. The young generation lives to become the old generation next period; the current old generation dies. To keep things simple, assume that the number of individuals in each generation is the same. Finally, assume that in each generation the young, and only the young, receive a perishable endowment that must finance consumption over the two periods of that young person's life. In other words, the old generation does not receive any additional endowment when they are old; they must finance their consumption out of the endowment received when they were young.

Any portion of the endowment that is not consumed in the first period perishes and is not available for consumption in the second period. How then can the young generation finance its consumption needs when it is the old generation? The problem is the classic lack of double coincidence of wants; here, however, the double coincidence is over time, rather than at a point in time.⁹ The current young generation wants to consume in the next period. The current young generation can offer current consumption only to the current old generation. To consume next period, the current young generation must rely on the future young generation. In sum, the current young generation needs to contract with the current old and the future young generations. Since the future young generation does not now exist, such contracts are not feasible.

Money offers a solution to this intertemporal exchange problem. If money exists, the current young generation can exchange with the current old generation some of their endowment for the old generation's money. Since money is a store of value, the current young generation can hold the money until the next period. In the next period, the current young generation, which is now the old generation, can exchange their

money for a portion of the new young generation's endowment. Of course, for this scenario to work, the new young generation must willingly accept money in exchange for a portion of their endowment. That is, money must be a medium of exchange (or is it store of value?) over time.

Finally, if the distribution of Type A, Type B, and Type C consumers does not change from one generation to the next and if consumption patterns are identical for all individuals within a consumer type, then all exchange can occur at a zero interest rate. As one, but not the only, solution, Type A consumers exchange only with Type A consumers, Type B with B, and Type C with C. In this case, exchange will clear without a need for a positive interest rate. The reason: Although there is an imbalance between time preferences of individuals at a point in time, there is no such imbalance for this scenario over time.

CONCLUSION

The Billionaire Game provides a simple method to illustrate a number of important topics in economics. The game takes minimal time to set up and execute. I have enumerated some of the possible uses of the game. Let your imagination wander; you can probably create other interesting applications. Let me know of your successful innovations.

ENDNOTES

1. One attempt at a revival led to a not-to-successful television movie in 1978.
2. The course of inflation since the late 1950s makes a million dollars seem a bit too small to finance consumption spending over the rest of one's life. With 50 years of life remaining, a million dollars translates into \$20,000 per year. A billion dollars generates \$20 million per year, a nicer sum to contemplate. Thus, Michael Anthony now doles out billion dollar checks.
3. This means no work, no investing to earn interest, dividends, or profit, and so on. The basic idea contained in the assumption ensures that the student can transform present

consumption into future consumption, and vice versa, on a dollar-to-dollar basis. The interest rate is artificially set at zero.

4. This assumption links expenditure to actual consumption and prohibits purchase of durables at time t to consume over time t to $t+n$.

5. Alternatively, I could assume that the students' holding of money is hedged against inflation. That is, Mr. Anthony, or his authorized successor, will deposit on a regular basis additional money to keep the real value of the unspent portion constant.

6. Remember, however, that the game structure implies a zero interest rate. That is, I attempt to focus on individual time preference, easier said than done.

7. Remember that the Billionaire Game imposes a no-exchange, autarkic equilibrium. Each student equates the marginal utility of youthful consumption to the marginal utility of old-age consumption, each of which equal the marginal utility of money from the standard Lagrangian maximization.

8. Type A consumers may move to A'' , if the willingness curves exhibit the necessary curvature. This is why I state that the opportunities for Type A consumers may fall -- A'' represents a consumption choice unavailable at a zero interest rate. That is, some Type A consumers may consume enough more in the future and less today to mimic Type C consumers, but with a positive interest rate.

9. A recent text by Champ and Freeman (1994) discusses many of these issues, and more. Our discussion mirrors some of the material in their Chapter 1. Note also that the structure of the model rules out borrowing and lending between members of the same generation, since no one receives an endowment when they are old.

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FIGURE 1:

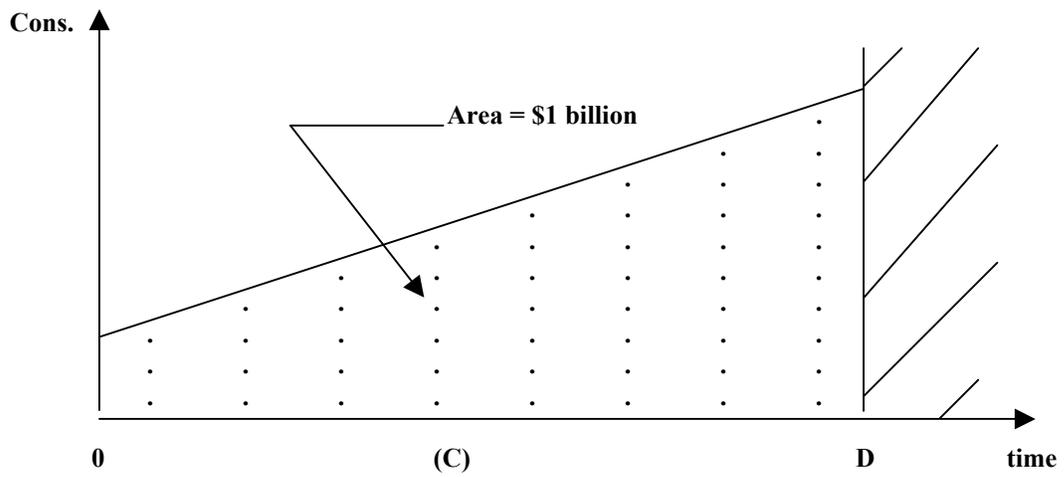
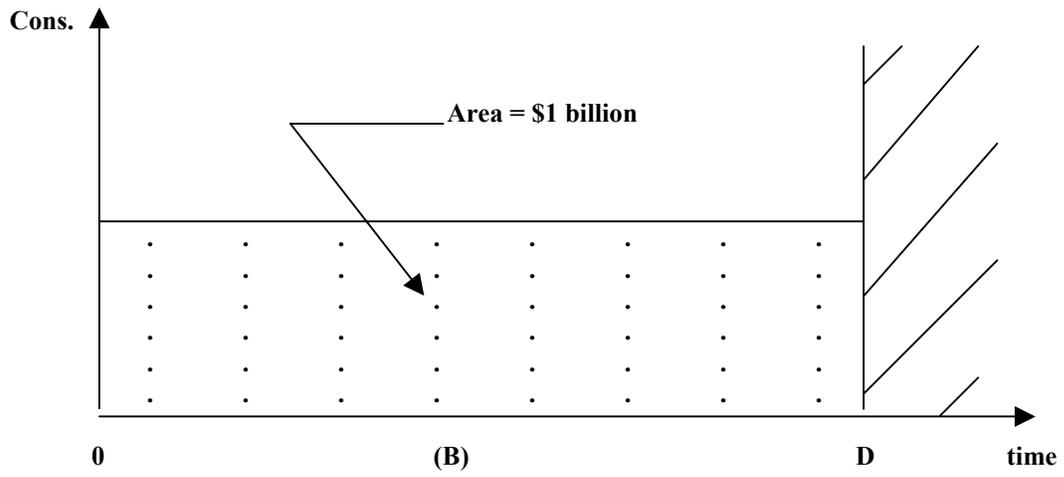
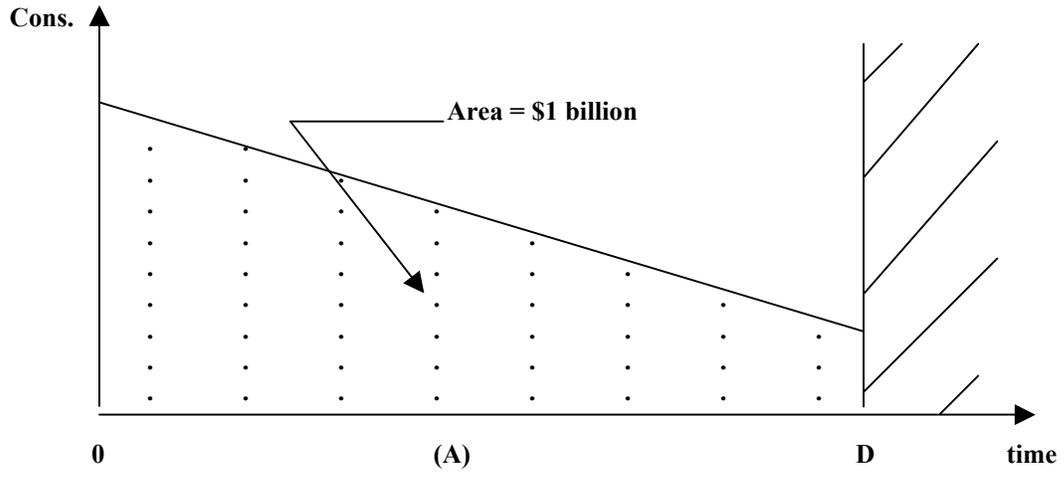


FIGURE 2

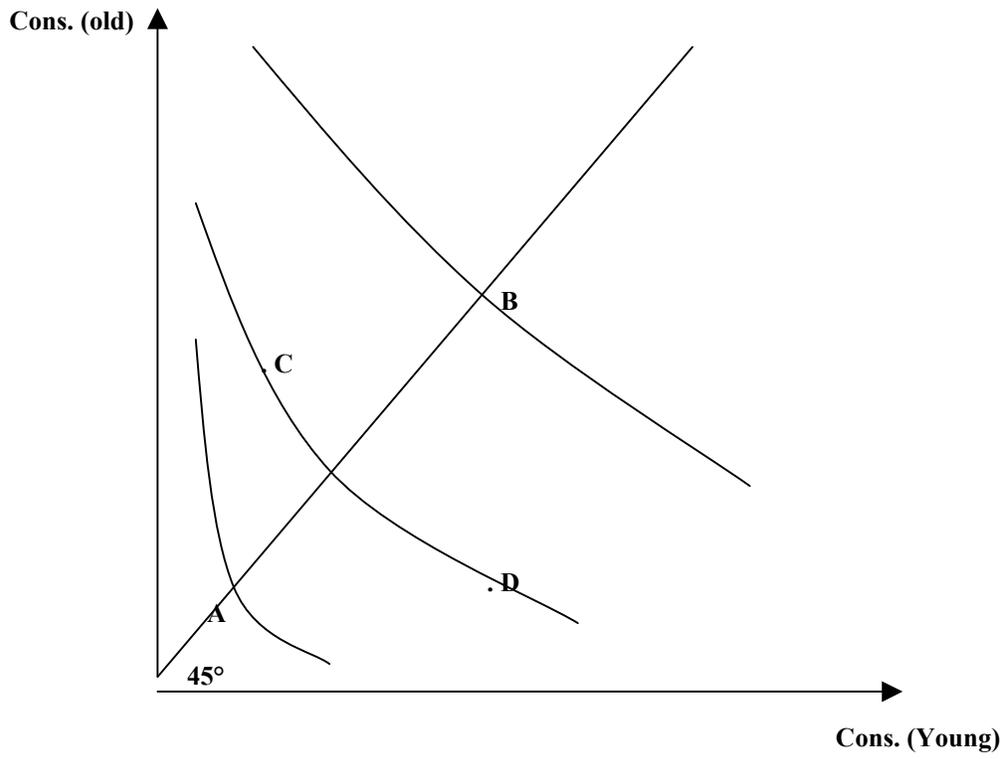


FIGURE 3

