THE IMPORTANCE OF EMPHASIZING THE INTERTEMPORAL CONSUMPTION MODEL IN INTERMEDIATE MICROECONOMICS

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Abstract

We show that emphasizing the intertemporal consumption (IC) model in intermediate microeconomics can help connect the content to intermediate macroeconomics, econometrics, and finance. This also helps the instructor relate modern macroeconomic theory to topics discussed, typically incorrectly, in the media.

Key Words: Intertemporal Consumption Model; Microeconomics Teaching; Macroeconomics Teaching

JEL Classification: A22, D90

Introduction

Regardless of one's views on modern macroeconomics, few would dispute that the subject as is now taught in graduate schools is consistent with microeconomic theory. Indeed, one could argue that the hallmark of all modern economics is the primacy of the *forward-looking* utility maximizing individual. Decades ago the impact of this approach overhauled the finance curriculum. While graduate macroeconomics programs have long reflected micro-foundations, it has taken considerably longer for that impact to be felt in undergraduate macroeconomics content. However, with the advent of Barro (2000), Mankiw (2013), Williamson (2013), Jones (2014), and many others, undergraduate macroeconomics is now much more consistent with that taught in graduate schools.

In this paper, we argue it is time for intermediate microeconomic textbook authors to support this change and put more emphasis on the one model that explicitly models the forward-looking part of macroeconomics, finance, and econometrics: the *intertemporal consumption (IC) model*. In other areas, intermediate-level microeconomic text authors have done a good job of incorporating changes in graduate school curriculums. Insights from game theory are now often incorporated throughout the text versus the traditional treatment of including an optional separate chapter. However, nearly all textbooks still present indifference curve analysis in terms of a choice of goods at a single point in time. Yet many of the new insights in macroeconomics involve rational choice *across* time, and for finance, it is always choice across time.[2]

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[2] Our argument implies that intermediate microeconomic theory should be a pre-requisite for intermediate macroeconomic theory. This reflects the development of economic theory from the days when microeconomics and macroeconomics were not as consistent as they are today. We thank a referee for raising this important point.

To be clear, many textbooks, although far from all, cover the intertemporal consumption model. However, most introduce the model in later chapters, often combined with subjects such as risk or other "optional" topics. Wetzstein's comprehensive *Microeconomic Economic Theory: Concepts and Connections* (2013) doesn't introduce the IC model until page 792 in Chapter 19. In the excellent mathematical approach to intermediate microeconomics, Mathis and Koscianski's (2002) *Microeconomic Theory: An Integrated Approach*, the model isn't introduced until page 586 as part of Chapter 22, the third from the last chapter in the text. Also in the third to last chapter is Landsburg's (2014) treatment in *Price Theory and Applications 9th Ed.* Bernheim and Whinston (2008) move the model up to Chapter 10, while Perloff (2008) *Microeconomics: Theory and Applications with Calculus* doesn't discuss the IC model at all nor does the popular Pindyck and Rubinfeld (2009). The model is also completely absent from the recently released and highly rigorous *Intermediate Microeconomics: A Tool-Building Approach* written by Samiran Banejee (2015). It is also not found in most Managerial Economics textbooks (e.g. Wilkerson, 2005).

Two textbooks that have given the model prominence are Varian (2014), *Intermediate Microeconomics A Modern Approach*, and Browning & Zupan (2004) (formerly Browning & Browning) *Microeconomic Theory and Applications*.[3] The former dedicates a chapter to intertemporal consumption while the latter includes it in the applications chapter immediately following the introduction of indifference curve analysis.

We argue that, because of its importance in so many economic fields and topics, the IC model should be a core topic of all intermediate microeconomics courses. Further, it should be presented and emphasized when indifference curve analysis is introduced. Given that so many students who take intermediate microeconomics are finance majors, to ignore this model misses an opportunity to directly relate economic theory to core models in finance.[4]

Adding the IC model to a standard intermediate microeconomics text is a relatively trivial addition, both in terms of content and level of difficulty, as it is a rather straightforward extension of the two-good same period model. The strength of the argument is how it enhances an intermediate macroeconomic class and how many topics it helps students understand once they are familiar with the model. We provide those examples below after we lay out the standard IC model.

Intertemporal Consumption Model[5]

As mentioned, once students are introduced to indifference curve analysis with consumers maximizing utility across goods at a point in time, it is a relatively simple to extend the utility maximization approach to choice *across time*. With the simplifying assumptions of a two-period world (allowing graphical depiction) and the ability to borrow or lend at the same rate (allowing for a linear budget constraint), the analogy of a choice of goods at a point in time is complete. The model can easily be extended to include an endowment, different interest rates, and more time periods.[6] None of these augmentations is essential for deriving several important core concepts.

Suppose an individual maximizes utility, $U(C_1, C_2)$, with C_1 being consumption in the first period and C_2 being consumption in the second and last period. Incomes in both periods, Y_1 and Y_2, are known, as is the interest rate, i. Figure 1 shows that the slope of the budget constraint, $-(1+i)$, is the relative price of C_1 and C_2 (analogous to P_x/P_y in the two-good model). The

[3] The authors thank a referee for the Varian reference.

[4] For an example of how it can be applied to finance see Norman, Schlaudraff, White, and Wills (2012).

[5] For a more complete derivation of the model see Norman, Schlaudraff, White, and Wills (2012).

[6] The range of interest rates can be extended to negative rates, relating the model to current monetary policies. The authors thank a referee for this point.

optimal consumption in each year, given income and the interest rate, is C_1^* and C_2^*. From this point, one could perform the typical comparative-statics exercises common in any intermediate microeconomics course.

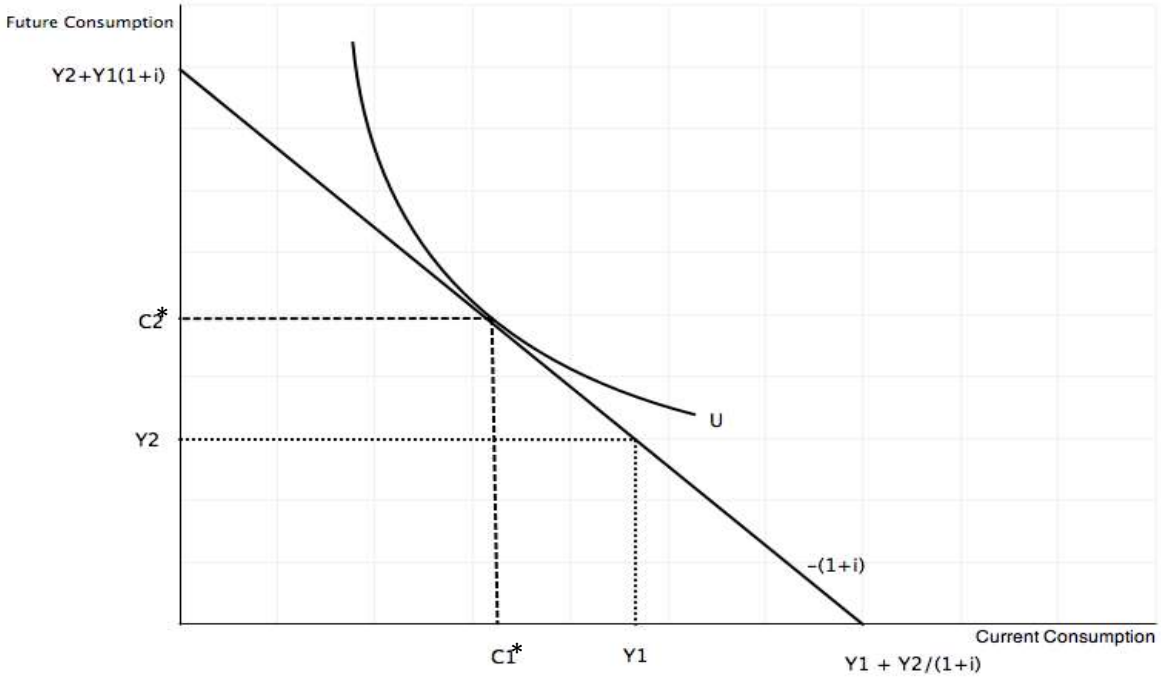

Figure 1: Intertemporal Consumption Model

Relevance to Intermediate Macroeconomics

A challenge for all economics' instructors is to make the course they teach relevant to the real world. This is particularly true for those teaching modern intermediate macroeconomics where economics fallacies are common in the popular press and the subject itself is often criticized for being too abstract and unrealistic.[7] This is particularly true in finance.[8] As such, it is important that the core of modern macroeconomic theory be grounded in concepts that students already understand. William Becker (2000) writes that "The primary goal of undergraduate courses in economics is to enable students to think like economists … But even college-educated high school teachers of economics have beliefs about economics that are more highly correlated with those of journalists than with those of economists…" A truly successful course is one that offers students the preparation they need to identify errors in economic analysis in the popular press.

We argue that the more familiar a student is with the IC model the more intuitive and relevant modern macroeconomics becomes. Many core macroeconomic concepts such as the consumption function, the permanent income hypothesis, Ricardian Equivalence, and the Euler Equation, can be quickly and intuitively derived using the IC model. By doing so, the model puts these concepts within the familiar and powerful constrained utility maximizing framework developed in intermediate microeconomics.

[7] See Romer (2016), *Trouble with Macroeconomics*, https://paulromer.net/the-trouble-with-macro/

[8] The popular finance writer James Grant describes macroeconomics as "ideology disguised with differential calculus" (http://www.powerlineblog.com/archives/2016/09/economic-macroaggression.php)

To demonstrate the core idea of a consumption function, we use the basic IC setup. Suppose an individual has the following intertemporal utility function, $U = C_1 C_2^{\beta}$, with $\beta < 1$. When presented in a lecture it could be pointed out that β depicts Fisher's impatience hypothesis. The equation for the budget line is easily derived as $C_2 = Y_2 + (Y_1 - C_1)(1 + i)$. The constrained optimization point is the simultaneous solution of the tangency condition with the budget constraint.[9] The tangency condition is

$$\frac{MU_1}{MU_2} = \frac{C_2}{\beta C_1} = 1 + i. \qquad (1)$$

Solving for C_2 and substituting into the budget constraint implies that

$$C_1^* = \left(\frac{1}{1+\beta}\right)\left(Y_1 + \frac{Y_2}{1+i}\right) \qquad (2)$$

is the optimal consumption in period one.

As can be seen from equation (2), optimal consumption is a function of current income, future income, and the interest rate (plus the extent to which you prefer current consumption over future consumption, β). Since optimal savings is simply

$$S_1^* = Y_1 - C_1^*, \qquad (3)$$

this implies that optimal saving, at any given point in time, is a function of current and future income plus interest rates. As such, a specific savings rate cannot be reported as being "too little" or "too much" when compared to some other time period, as is the common practice in the media. This also lays the foundations for the role of expectations (of future income) in determining current consumption and provides a key insight on why central bank officials often focus on interest rates to affect behavior today.

The second important macroeconomic concept that can easily be understood from equation (2) is the permanent income hypothesis. By the time students are taking intermediate macroeconomics they have likely been exposed to the concept of present value at least once. As such, the second term, $Y_1 + \frac{Y_2}{1+i}$, will be instantly recognizable as the present value of lifetime income. As Jones (2014, pg. 448) articulates, this makes the concept of permanent income precise and in terms of something a typical student understands.

A third concept, Ricardian Equivalence, becomes a much more plausible and powerful concept when derived within the optimizing intertemporal consumption framework. The typical introduction of the concept in which increases in deficit financed government spending (or tax reduction) will not have any effect on current consumption, sounds wildly implausible. Few students believe that individuals will increase savings to offset future tax increases. However, when put into the two period optimizing model, the ineffectiveness of such policies is obvious as the budget constraint does not shift.[10] As such, it lays out the necessary conditions for these policies to be effective.

The fourth concept that immediately falls out of this model, and one that lays the foundations for more advanced macroeconomics, is the *Euler Equation*. From equation (1), rearranging the components of the optimal choice gives:

$$\frac{C_2}{C_1} = \beta(1 + i). \qquad (4)$$

The growth rate in consumption is related to one's degree of impatience and interest rates. As clearly discussed by Jones (2014, pg. 446), this explains why interest rates and an economy's

[9] This can be solved either through substitution or standard LaGrangian techniques.

[10] Any increase in income, T, in the current period must reduce income in the future period by (1+*i*)T. As such, the intertemporal budget line does not change.

growth rates are similar. While the Euler Equation implications are beyond the scope of this paper, this demonstrates how many macroeconomic concepts can be developed both intuitively and rigorously from the IC model.

Conclusion

Including the IC model in intermediate microeconomics offers many benefits at a very low cost. First, by linking the material to the content of a wide range of future courses, it demonstrates the internal consistency of economic theory. Secondly, it helps motivate many important concepts of modern macroeconomic theory such as the development of the consumption function, the permanent income hypothesis, Ricardian Equivalence, and the Euler Equation. Third, it can be used as the basis for applied examples that can help students identify errors in the macroeconomic analysis made by the popular media. Fourth, it directly demonstrates how modern finance is based on economic theory.

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