

Preface: *Economics with Calculus*

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How should one approach the study of economics? There is no one answer to this question because the appropriate learning style depends in large measure upon the reader's prior training and interests. Those blessed with a working knowledge of calculus are prepared to absorb the basic analytical framework of economics by a much easier route than those who lack this background.

Each year approximately 90,000 high school students achieve a 4 or a 5 score on the Advanced Placement Calculus Examination (AB or BC). Countless more complete their first year of calculus in college before enrolling in the introductory economics course. My experience from teaching a calculus based introductory course is that students blessed with this background can learn economics more easily and with more enjoyment by making use of their specialized training. The author of a prominent introductory economics text has commented that "to mathematically sophisticated students the introductory [textbook] models look naïve and simplistic; these students are discouraged from going into economics because it is too simple."¹ Students with a working knowledge of calculus will find this text provides an exciting challenge. Far from being dumbed down, this book is designed to help the reader smarten up.

Some economics textbooks claim they enable the student to learn economics without tears. Some even claim they can provide a useful introduction to economics without either graphs or equations! This book presents an honest introduction to economics that can be covered in one semester, not by thinning the soup, but by assuming that the reader has a working knowledge of the calculus. I strive to make the argument as simple as possible, but no simpler. We do not use the calculus to complicate the analysis but to simplify the presentation.

The standard introductory economics textbook presents economic theory in translation — it is a translation of concepts developed with mathematical tools into non-threatening English. In order to avoid talking calculus to the uninitiated, the standard introductory textbook introduces such basic concepts as "marginal revenue," "marginal cost," and "marginal utility" without telling the reader that they are first derivatives. The end of chapter problems in the standard textbook are designed for the numerically challenged. The exercises in this text challenge students to put their quantitative skills to work. Students with a strong mathematics background find that it is easier to learn the basic principles of economics using the calculus rather than reading economics in translation.

Scope: There is a danger in the introductory course that one will try to do too much. There is the task of allocating scarce time to diverse pedagogical objectives. The task is complicated, because for many students the introductory course may be the only economics course they will ever take. Therefore, this book is not just hardcore economics — readers must be exposed to the breadth of concepts they have to know in order to function effectively as economic citizens. A student who invests a semester or two in the study of economics should acquire the background necessary for understanding articles in the newspaper's financial section and for segregating enlightened insight from economic nonsense on the editorial page. Because many students find that the introductory course turns out to be only the beginning, one of the responsibilities of the introductory text is to provide students planning to major in economics with a good overview of the discipline and an understanding of the types of intellectual demands imposed upon the student of

¹ David Colander, "Telling better stories in introductory macro," *American Economic Review*, May, 2000.

economics. This text is designed to help students who will be continuing master the basic analytic tools they will be expected to bring with them when they enter more advanced courses.

I also hope that this volume will be an interesting independent read for anyone who majored in science or engineering in college but now wishes to pursue the study of economics. It should be of interest to anyone with a quantitative background who wishes to study economics in preparation for a career shift into the worlds of business or finance. It may also interest anyone with a quantitative bent who enjoys reading about economics and business developments in the popular press but wants to take a deeper and more structured look at how economists analyze how the system works.

Mathematical Prerequisites: In developing these materials I have given a high priority to not requiring more mathematics than is covered in the standard high school Advanced Placement Calculus course (AB or BC). I do not assume that the reader has studied probability or statistics. Because Lagrangian multipliers are not covered in the AP Calculus, I solve problems of constrained maximization by substituting the constraint into the objective function; but Lagrangians are covered in an appendix for any reader who has a stronger mathematical background than is assumed in this text. Partial differentiation, the one indispensable calculus topic that is not covered in the standard Calculus Advanced Placement Course, is carefully and patiently introduced to the student during the discussion of demand functions in Chapter 3. When developing models of economic growth I have found that many of my students find e^{rt} intimidating; therefore, we work in discrete time and write $(1+r)^t$.

I have found that students who have earned a 4 or a 5 on the Calculus AP course (AB or BC) do not find the mathematics employed in this text too much of a stretch.² Students with a lower score should consider studying more math before attempting a course based on this text or else take a conventional introductory economics course. The level of mathematics in this text may seem pedestrian to upper division students in the sciences who have a stronger mathematical background than this text presumes. It is obviously *not* the type of mathematics that economists use in serious research these days. But after completing the overview of economics provided by this text, the mathematically sophisticated reader will have the economics background required to read more advanced economics texts focusing on whatever areas of economics may be of particular interest.

Organization: In deciding how to organize the material in this text I kept several principles in mind.

- First, I place micro before macro in order that the students will have a foundation in micro that can be drawn upon in developing macroeconomic concepts.
- Second, I carefully pace the use of mathematical concepts so as to enable rusty students to gradually recall the details of their calculus course. Thus, chapter 2 refreshes the student's memory of how to use the calculus to solve maximization problems and contains the simplest possible example of constrained maximization. Once our students have flexed their calculus muscles on economic problems the pace of the analysis can accelerate.
- Third, I try to move from the simple to the complex. For example, I discuss monopoly before competitive markets because it is easier. Again, I do not begin the discussion of macroeconomics with growth theory, however logical that might be, because students find it easier to start worrying about fiscal and monetary policy issues before moving on to the complexities of growth theory in Chapter 12.

² If their calculus is rusty, they may wish to consult Stephen Silver's review:
<http://www.citadel.edu/faculty/silver/calculus.pdf>

- Fourth, I decided not to segregate international trade topics to a chapter near the end of the book. This decision was motivated in part by my fear that this chapter might be skipped over in the end of semester rush. But the primary reason is that international trade permeates practically every aspect of economics and provides wonderful examples for illustrating the applicability of economic theory to important policy issues. So the theory of comparative advantage is discussed when the production transformation curve is introduced in chapter 2. In chapter 3 on supply and demand the student is introduced to the topics of foreign exchange rates, tariffs and quotas. In almost every chapter, the student encounters trade issues.

There is room for flexibility for those who would prefer to sequence the topics in a different order. For example, one can start the study of macroeconomics with Chapter 12 on growth and then drop back, perhaps selectively, to read about economic indicators and monetary and fiscal policy.

Classroom alternatives – pick and choose: This book obviously presents more material than most instructors will want to use, particularly in a one semester course covering both micro and macroeconomics. Some parts are essential. Other sections may be judiciously sampled in accordance with the interests of the students and the objectives of the instructor. Here are some alternative strategies for using this book in the classroom:

1. I have found it possible to cover in one semester most but not all the material in this book with a group of highly motivated students with strong mathematical skills but no prior coursework in economics. I have supplemented the text with a paperback book of real-world readings from the financial press, newspapers and popular magazines.³ An instructor teaching such a course will probably want to make a point of covering the following barebones core sections of the text plus other sections that would be of particular interest in the light of current economic developments or special concerns of the students.

The Micro Core: Ch 1, Ch2, Ch 3.1-3.6, Ch 4.1-4.3.1, Ch 5.1, 5.2, 5.4 , 5.5.1, 5.5.2, 5.6, Ch 6.1-6.3, 6.6, Ch 7.1-7.2.1.

The Macro Core: Ch 1.5.1-1.5.4, Ch 8, Ch 9.1-9.3, 9.5, Ch 10.1-10.4, and Ch 12.1, 12.4, 12.5.1-12.5.4.

2. In a yearlong micro-macro principles sequence there is ample time to cover the Micro and Macro Cores plus Ch 10.5 (aggregate demand and supply), 10.6 (Monetarists versus the Keynesians), Ch. 11 (expectations, uncertainty and inflation), Ch 12.2 (Malthusian population dynamics), 12.3 (classical growth), Ch. 12.4 (growth accounting), Ch 12.6 (population trends), 12.7 (exhaustible resources), 12.8 (over fishing).

For greater depth in a two-semester first course, this text may be read alongside a conventional introductory economics textbook. Read the conventional text for institutional details, but turn to this book whenever the text starts to develop the theory. Alternatively, one can progress chapter by chapter through this text, but look for real world applications on the internet or in the *Economic Report of the*

³ *Economic: Annual Editions*, ed: Don Cole, McGraw Hill-Dushkin. The web now provides a wonderful source for current event materials. This approach is articulated by Professors Shyamala Raman at Saint Joseph College, Jean Shackelford at Bucknell University and Kim Sosin at the University of Nebraska Omaha in their “just-in-time syllabus” home page: <http://ecedweb.unomaha.edu/jits.htm>

President, the New York Times, the Wall Street Journal, The Economist, or an appropriate compendium of supplemental readings.

3. I have used the book as a supplement to a traditional non-calculus (delta) intermediate microeconomics text, assigning chapters 1 through 7 plus chapter 11.2 on market dynamics and speculation, 11.4 on rational expectations, 12.7 on exhaustible resources and 12.8 on over-fishing.
4. Students enrolled in a standard intermediate macro course may supplement their readings in a conventional nonmathematical text with Ch 1.5.1-1.5.4, Ch 8-10, Ch 11.3-11.5 and Ch 12.1-12.6.

Controversy: Economics is controversy, among professional economists no less than in Washington and in the financial press. There is no shortage of controversy in microeconomics. Thus MIT economist Franklin M. Fisher served as the key witness for the prosecution at the Microsoft antitrust trial while his MIT colleague Richard Schmalensee was the chief economist for the defense. The disagreement among macroeconomists is extreme, having at times reached the point where the discipline was all too accurately described as being in a state of chaos. At the 1997 American Economic Association convention, several prominent macro-economists responded to the question of whether there was a common core to their discipline. Most thought there was a core to macroeconomics, but they could not agree on what it was. One participant at the session commented that there is a core of practical macroeconomics, but went on say “This believable core model falls well short of perfection, leaves many questions unanswered and is subject to substantial stochastic errors.”⁴ It is likely that *any* macroeconomics text will be judged to be in serious error by at least 2/3rds of the profession.

There is a temptation in the textbook, no less than in the classroom, to present economics as revealed truth. Or we may confuse our students by laboriously partitioning the discipline into “classical,” “neo-classical,” “new-classical”, “monetarist,” “post-Keynesian,” and “neo-Keynesian” schools of thought. This text discusses how macroeconomic thought evolved in reaction to unanticipated historical developments. I present the multiplier, the IS-LM apparatus, and short-run and long-run aggregate demand and supply functions. I develop the concept of rational expectations, the Lucas supply function, a modified Solow growth model subject to diminishing returns to scale, and real business cycle theory.

Exercises: The exercises at the end of the chapter are designed to help readers test and strengthen their understanding of analytical materials. Symbols distinguish two types of questions:

- * Indicates questions that elaborate on the analysis of the text, often by considering different applications of the techniques or asking the students to work with slightly more complicated problems. Sometimes they involve extensive independent projects, such as the question at the end of Chapter 1.
- # Distinguishes questions that are more demanding mathematically than the material in the text.

⁴ Alan S. Blinder, “Is there a core of practical macroeconomics that we should all believe?” *American Economic Review*, May, 1997

Counter Culture: This is *not* a traditional introductory economics text. It is a slim volume and does not claim to cover all the material in traditional introductory textbooks, which often run to more than 1,000 pages and weigh in at over 4 ½ pounds. It does not come with a CD Rom presenting videos of the author. It's produced in black and white rather than gaudy color. It's just a book. Readers with comments, suggestions and complaints are invited to Email the author: mlovell@wesleyan.edu, Subject: Econ Principles.

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