

**Instructor's Manual**  
**for Modeling Monetary Economies**  
**Fourth Edition**

Bruce Champ

Scott Freeman

Joseph Haslag  
University of Missouri-Columbia

Sumitrra Ganguli  
University of Missouri-Columbia  
May 2015

## Tips for Instructors

This book has evolved over two decades of teaching money and banking and monetary economics to undergraduates. Although it is slimmer than most textbooks, its emphasis on explicit models will take more time per page than the standard. An instructor will find it a full semester's course.

## Book Organization

The book is organized into three parts of increasing complexity. The first examines money in isolation. Here we take up the questions of the demand for fiat money, a comparison of fiat and commodity monies, inflation, and exchange rates. In the second part, we add capital, to study money's interaction with other assets, and banking, the intermediation of these assets into substitutes for fiat money. In the third section we look at money's effects on saving, investment, and output through its effect on nonmonetary government debt.

Because the models grow in complexity, building on the same basic framework, we recommend that the topics be taken up in the order presented. There is no need, however, to take up each topic presented. Chapters 2, 4, 5, 9, 10, 11, 13, and 17 and the appendices are the endpoints of a line of analysis. Each may be dropped without major consequence to the teaching of later chapters. This is not to say that these topics are of lesser importance or that they themselves do not depend on material from earlier chapters. However, we find that most instructors are unable to cover the entire book in a single semester, especially when teaching the course for the first time. These instructors should choose among the chapters above when looking for material to leave out. Alternatively, an instructor using this book as a supplementary text may drop either all of Part II (except for Chapter 6) or all of Part III.

## Level of Book

This book is written for undergraduates. Its mathematical requirements are no more advanced than the understanding of basic graphs and

algebra. Calculus is not required. (Those who want to teach using calculus can find a simple exposition of this approach in the appendix to Chapter 1.) While the book may also prove useful as a primer for graduate students in monetary theory, the main text is pitched at the undergraduate level. This pitch has held us back from a few demanding topics, such as nonstationary equilibria, but we hope the reader will be satisfied by the large number of topics that we have been able to present in simple, clear models within a single basic framework. Material that is difficult but within the grasp of advanced undergraduates is set apart in appendices and thus easily skipped or inserted. The appendices also contain nonmonetary extensions, like the models covering credit or Social Security, that some instructors may wish to use but were not essential to the exposition of the main topics.

## References

The references display the most tension between the needs of undergraduates and the technical base in which this approach originated. Whenever possible we reference related material written for undergraduates or general audiences. Asterisks mark these references in the list. We also reference the works from which our models and data have been drawn. Finally, when undergraduate-level references are not available we have inserted references to a few academic articles and surveys to offer graduate and advanced undergraduate students some places to start with more advanced work. These are not intended as a full survey of the advanced literature.

## Choices of Topics

The choice of topics to be covered was also difficult. We make no claim to encyclopedic coverage of every topic or opinion related to monetary economics. We limited coverage to the topics most directly linked to money, covering banking (but not finance in general) and government debt (but not macroeconomics in general). We insisted on ideas consistent with fully rational people operating in explicitly specified environments---models of unexplained sticky prices or people with irrational expectations are readily available elsewhere. To promote the

unity and consistency of our approach across topics, we also selected topics tractably teachable in the basic framework of the overlapping generations model. Finally, we offer what we best know and understand. Where this leaves gaps, we hope that individual instructors can build on our foundations to fill them.

## Suggestions for Teaching

We offer some other teaching suggestions, chapter by chapter:

### Chapter 1:

In this chapter, the aim is to develop a model of the economy in which trade makes people better off. A model description has four main parts: (i) there is a description of the physical environment, which consists of things like how long does the economy last, who lives there, how long each person lives, what goods are present, and what meetings occur between people; (ii) there is a description of how people get goods, such as things they are endowed with over their lifetime or the ways in which they can produce things; (iii) we need to know what kinds of goods people like and be able to compare different bundles of goods; and (iv) we need a way to combine the different actions that people want to take so that the quantity supplied is equal to quantity demanded. With all four pieces together, we have a model economy.

### Chapter 2: A Simple Model of Money

Students need repetition and practice to learn the technical material in early chapters. Since they use these tools throughout the book, this material will be worth a careful presentation even if progress seems slow to the teacher. This is why the book covers separately the nearly redundant cases of constant and growing population. One way to make this seem less repetitious is to ask the students to do the growing population case as a homework assignment, then go over it in class. Students often confuse the budget and feasible sets because both use

many of the same variables and in this chapter, they turn out to be identical. Take care to differentiate the two by distinguishing their origins.

The appendix using calculus is a minimal exposition of how calculus can be used to solved the models. It is not required for any material taught in the book but is inserted for those teachers who wish to teach using calculus.

### Chapter 3: Barter and Commodity Money

This chapter deals with barter and commodity money exchange and may be skipped. It might also be covered after Chapter 4 or 5 if you find the barter model too distracting from the standard overlapping generations model of Chapters 2, 4 and 5. Also, one might teach one of the two topics without teaching the other, although we found that the topics go well together.

### Chapter 4: Inflation

This is the key chapter of the book, of great importance for future chapters. Present it carefully, assigning exercises and going over them in class. Students often seem to understand this material until they are asked to do it themselves.

### Chapter 5: International Monetary Systems

Another endpoint chapter, all or part of which can be skipped or moved. These international topics are taught earlier than usual because only the basic model is used. The material on speculative attacks can be tricky, but we find that students have great interest in this topic.

### Chapter 6: Price Surprises

Students may find this material difficult. we have added it to the second edition nevertheless because of the revolutionary effect of Lucas model on macroeconomic thought. Related ideas involving rational expectations and policy advice are covered in Chapters 10 and 17 so this chapter may be skipped if the students find it too difficult. The emphasis on methodology makes this chapter better suited to advanced students.

## Chapter 7: Capital

This chapter contains all the theory of finance needed for subsequent chapters. It is not intended as a self-contained finance course. To cover the material in the second part of the book we needed only one asset as an alternative to fiat money. We chose capital because of its direct link to output. Many instructors and students, however, enjoy a more thorough treatment of private debt. The appendix is for them.

## Chapter 8: Liquidity and Financial Intermediation

The material in this chapter is important for the next three chapters but the appendix stands alone as a foray into a more sophisticated model of banking as intermediation. The material in this chapter is important for the next three chapters but the appendix stands alone as a foray into a more sophisticated model of banking as intermediation.

## Chapter 9: Central Banking and the Money Supply

Attention paid to the monetary aggregates here will be rewarded in Chapter 10. if desired, the section on central bank lending can be skipped.

## Chapter 10: Money Stock Fluctuations

The money/output link studied in this chapter involves a long train of argument (see Figure 1-.4). Students nevertheless master the material when taught each step of the argument before studying it all together. We feel it is an important chapter, the cumulation of Chapters 7 and 8 but it is not required for later chapters. The appendix, which is separated from the main body of the chapter because its topic is different, may serve as a useful review and consolidation of material taught in Chapter 8.

#### Chapter 11: Fully Backed Central Bank Money

Although the math is not difficult, this can be a puzzling topic for students because economic behavior in this case is distinctly different from that of the fiat money economies of other chapters. The section on currency boards presumes a familiarity with Chapter 5.

#### Chapter 12: The Payments System

This new chapter stands alone and so may be skipped if desired. The value of the chapter is its illustration of a nontrivial role for central banking, public or private. The island structure may take some exposition time, but the essential market, that for reserves, is easy to present.

#### Chapter 13: Bank Risk

This chapter stands apart building mostly on the banking models of Chapter 8. It could be taught directly after that chapter. It is not required for later chapters.

#### Chapter 14: Liquidity Risk and Bank Panics

This new chapter builds on the concepts developed in Chapter 13. The primary step is to add monetary factors into a banking model, reflecting the facts on the role that currency plays in bank panics. It can be taught in addition to or substituted for the material in Chapter 13. It is not required for later chapters.

## Chapter 15: Deficits and the National Debt

Chapters 15--18 stand together as a group on the national debt. as such, many instructors have used this group as a supplement in nonmonetary macroeconomics courses. They require elements of Chapters 2, 4, and 6 as a background.

## Chapter 16: Savings and Investment

This chapter introduces the formal modeling of saving and investment used in Part III. It is worth taking slowly because it is essential for understanding the complicated effects of government debt studied in Chapters 17 and 18. The model of saving and investment invites the study of a number of issues (like social security) that are interesting but are not essential elements of monetary economics. To maintain the book's focus, these nonmonetary issues are introduced only in exercises and the appendix from which the instructor may pick and choose. The appendix does not require calculus but would benefit more than most topics from its use.

## Chapter 17: The Effect of the National Debt on Capital and Savings

Instructors short of time or leery of more abstract topics may wish to skip the section on fiat money and the crowding out of capital. The appendix about infinitely lived agents also cannot be taught quickly and should not be taught if a large block of time is not available.



## Chapter 18: The Temptation of Inflation

The chain of reasoning that links unexpected inflation to its real effects involves a number of advanced concepts. The instructor should make sure that students understand the effects and time inconsistency of a default on the national debt before teaching that an unexpected inflation works like a default. the concepts of rational expectations and the Lucas critique can be studied in the context of this chapter as a substitute for or complement to the Lucas model of Chapter 6.

# Chapter 1

## Trade in a Model with no Frictions

**Exercise 1.1** (a) Equation 1.1 (Total amount of the consumption good in) $_t = N_t y_1 + N_{t-1} y_2$

- Equation 1.2 (Total consumption by the young) $_t = N_t c_{1,t}$
- Equation 1.3 (Total consumption by the old) $_t = N_{t-1} c_{2,t}$
- Equation 1.4 Feasibility constraint:

$$N_t c_{1,t} + N_{t-1} c_{2,t} \leq N_t y_1 + N_{t-1} y_2$$

With a constant population, we have,

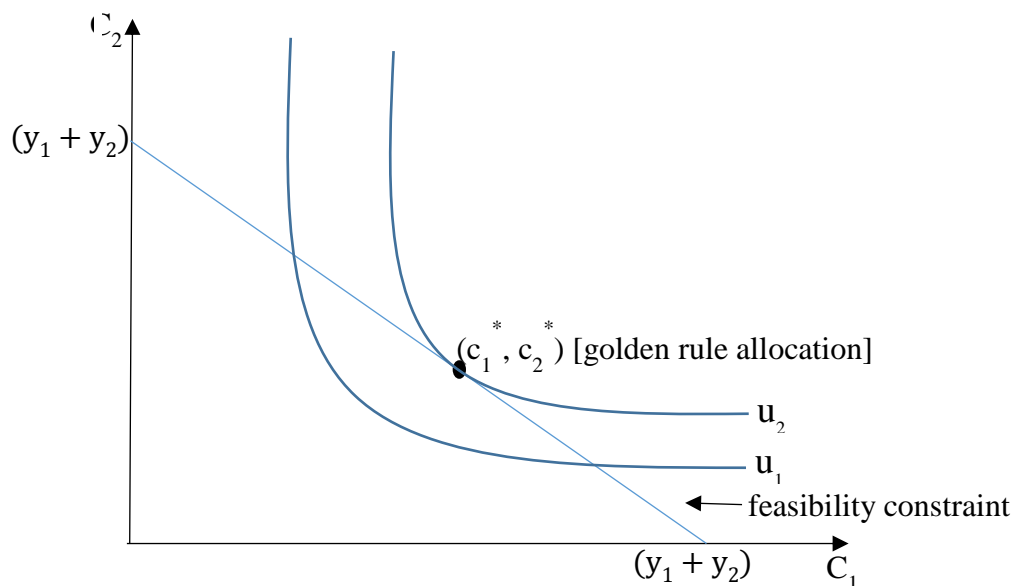
$$N c_{1,t} + N c_{2,t} \leq N y_1 + N y_2$$

Dividing throughout by N, we have

- Equation 1.5  $c_{1,t} + c_{2,t} \leq y_1 + y_2$
- Equation 1.6 Assuming a stationary allocation, the per capita constraint becomes

$$c_1 + c_2 \leq y_1 + y_2.$$

- (b)  $(c_1^*, c_2^*) \rightarrow$  Golden Rule Allocation: allocation that maximizes the utility of future generations.



**Exercise 1.2**

- Bundle A:  $c_1 = 6, c_2 = 12$
- Bundle B:  $c_1 = 4, c_2 = 10$
- $c_1^A > c_1^B$  &  $c_2^A > c_2^B \Rightarrow$  Bundle A is strictly preferred to Bundle B by assumption #3 of “More is preferred to less”

**Exercise 1.3** (*Supply of transfers by the young*) $_t = N_t(y_t - c_{1,t})$ 

Since the young consume half their endowment in every period, ie  $c_{1,t} = \frac{1}{2}y_t$ , we can rewrite the above equation as:

$$(\text{Supply of transfers by the young})_t = N_t \left( y_t - \frac{1}{2}y_t \right) = N_t \frac{y_t}{2}$$

$$(\text{Demand for transfers by the old})_t = N_{t-1}x_t\phi_{t-1}$$

In equilibrium, we have,

$$N_{t-1}x_t\phi_{t-1} = N_t \frac{y_t}{2}$$

$$\Rightarrow x_t = \frac{1}{\phi_{t-1}} \frac{N_t}{N_{t-1}} \frac{y_t}{2}$$

Using,  $N_t = 1.1N_{t-1}$  and  $\phi_{t-1} = y_t - c_{1,t-1} = y_t - \frac{y_{t-1}}{2} = y_t - \frac{1}{2} \frac{y_t}{1.05} = \frac{0.55}{1.05}y_t$ , we have,

$$x_t = \frac{1.05}{0.55y_t} \frac{1.1N_{t-1}}{N_{t-1}} \frac{y_t}{2} = 1.05$$

**Exercise 1.4**

<u>Economy A</u>	<u>Economy B</u>
$y_1 = 20, y_2 = 0$	$y_1 = 20, y_2 = 0$

$$c_1, c_2 = 10, 10$$

$$c_1, c_2 = 8, 12$$

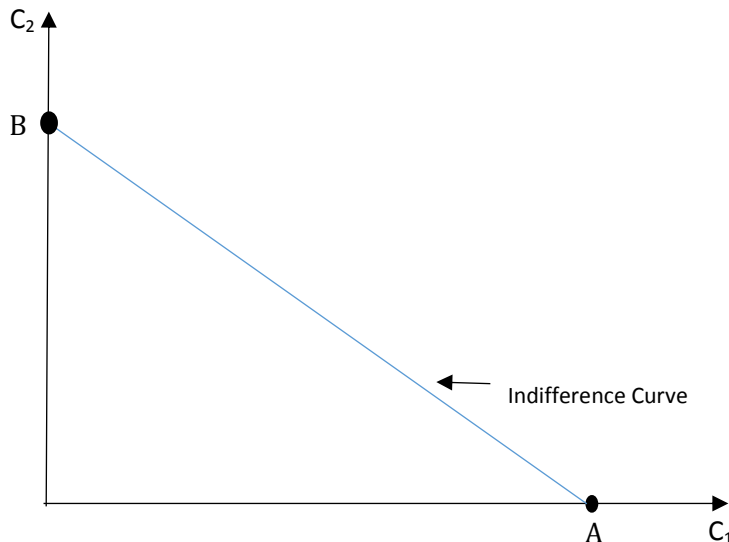
- (a) Since these choices maximize “lifetime welfare” → it maximizes the utility of the current and future generations (Golden Rule Allocation) at the cost of the initial old’s welfare. With a constant level of population and a stationary allocation, the feasibility set for both economies is the same,

$$c_1 + c_2 \leq 20$$

However, as the preferences of the individuals are different, it implies that we are going to be on two different sets of indifference curves for each of the two economies. As such this situation is Pareto incomparable.

- (b) These choices maximize “lifetime welfare” [Golden Rule Allocation] ⇒ it maximises the utility of current and future generations and not the utility of the initial old. If the utility of the initial old was to be maximized, we would end up with a corner solution, implying that people consume nothing when young and that would not maximise the utility of the future generations.

**Exercise 1.5** (a) Constant marginal utility → Indifference Curves are linear



$$(b) \frac{Mu_1}{Mu_2} = \frac{dc_2}{dc_1} \Rightarrow \frac{dc_2}{dc_1} = \frac{Mu_1}{Mu_2}$$

If  $Mu_1 > Mu_2 \rightarrow |slope| > 1$ , we end up with a corner solution at A. Individuals only consume in the first period of their lives

(c) If  $Mu_1 < Mu_2 \rightarrow |slope| < 1$ , we end up with a corner solution at B. Individuals only consume in the second period of their lives.

## Chapter 2

### A Simple Model of Money

**Example 2.1** The answer is summarized in the following table

Period	Young Alive	Old Alive	Total Population
1	120	100	220
2	144	120	264

Calculating from the table, we can see that the total population also grows at a net rate of 20% [= (264-220)/220]. In general, we can prove that the total population grows at the rate  $n$ :

$$\begin{aligned}
 (\text{Total Population})_t &= N_t + N_{t-1} \\
 &= nN_{t-1} + nN_{t-2} \\
 &= (N_{t-1} + N_{t-2}) \\
 &= n(\text{Total Population})_{t-1}
 \end{aligned}$$

**Exercise 2.1** (a) Feasible set:  $100c_{1,t} + 100c_{2,t} \leq 100y = 100(20) \Rightarrow c_{1,t} + c_{2,t} \leq 20$

The graph is easy. The horizontal and vertical intercepts equal 20. Note that until you know more about the preferences, you cannot find exact values for  $c_1$  and  $c_2$  but you can draw a general graph. An example with properly drawn indifference curves is Figure 2A.

(b) First period:  $c_{1,t} + v_t m_t \leq y$

Second Period:  $c_{2,t+1} \leq v_{t+1} m_t$

Lifetime:  $c_{1,t} + \left[ \frac{v_t}{v_{t+1}} \right] c_{2,t+1} \leq y \Rightarrow c_{1,t} + \left[ \frac{v_t}{v_{t+1}} \right] c_{2,t+1} \leq 20$

(c) The money market clearing condition is:

$$v_t M_t = N_t(y - c_{1,t}) \Rightarrow 400v_t = 100(y - c_{1,t}) \Rightarrow v_t = \frac{100(y - c_{1,t})}{400}$$

You could substitute for  $y$  here, but this form is good enough for our purposes.

We want to find  $\left\lceil \frac{v_{t+1}}{v_t} \right\rceil$ .