Macroeconomics

A NEOCLASSICAL INTRODUCTION

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treatment of liquidity preference by bringing in many matters now routinely covered, such as real vs. nominal interest rates, Fisher's law, the payment of interest on demand deposits, the dynamic form of the Quantity Theory, inflation as a tax, and the budgetary impact of open market operations. So too for our section on household consumption (chaps. 4–6), with its emphasis on consumption functions derived from structured Fisherian models of intertemporal resource allocation (notably the Modigliani-Brumberg life-cycle model).

To be sure, we would make further changes if we were preparing a new edition rather than a reprinting of the old. The '70s, after all, were a period of great construction as well as destruction in macroeconomic theory. It is clear now, for example, that if macrotheory is to be presented from its microfoundations, consideration must be given to the work-leisure choice as well as to the consumption-saving decision we emphasized. The basics of the work-leisure choice have long been familiar to economists (though much new material has been developed on human capital and on the economics of the household with important implications for macrotheory). Indeed, our computer simulation model had—and has—an endogenous labor supply function constructed in the same spirit as our consumption and money demand functions. For fear of putting too many balls into the air at once, however, we treated labor supply as exogenous in the text. For similar reasons, we decided against explicit treatment of the bequest motive in the text and the simulation model. This topic, which has come to figure so heavily in recent discussions of deficit financing, was relegated to an appendix to the chapter on the burden of a national debt.

A strong case can also be made for quickly dropping our assumption of a closed economy, as soon as the basic model has been presented. Even in our one-commodity world, it would be easy to connect economies to analyze some kinds of international capital flows of current concern as well as to introduce the monetary theory of exchange rates and interest rate differentials. The role of comparative advantage as the basis for international trade and exchange which is the focus of "real" international economics cannot be discussed, of course, in such single commodity models. Multiple commodity models, however, quickly become very complex. Our judgment then, as now, was that this complexity would be incompatible with a "broad brush" macroview of how an economy works and was best deferred to more specialized advanced courses.

Other concerns underlay the relatively brief allotment of space we made to issues of short-term labor market dynamics. In the early '70s, the short-run analysis of labor markets was in a state of flux which still persists despite the explosion of research in labor economics on contracting, both optimal and implicit, imperfect information theory, incentives, search, efficiency wages and the like. We tried to give some flavor of this newer line of research in our chapter 16 on the microfoundations of unemployment. But for the macrotheory of short-run unemployment in chapter 17, our treatment was closer to the older standard Keynesian formulation. We did manage to introduce an expectation-augmented Phillips curve, however; and we did warn of the stagflation nightmares it portended for policymakers.

We had hoped originally to do more with rational expectations than just our frequent references at critical points to Lincoln's law. We found, however, that a thoroughgoing treatment would have required more background in formal statistics than we could then reasonably expect from most students. Hence we settled instead on a mixture of certainty models with occasional unanticipated "surprises" which led to adjustment paths that we tried to make sure were at least not grossly inconsistent with rational expectations. Adjustment paths that would be in no way inconsistent with rational expectations paths might conceivably have been brought in without explicit use of stochastic terms by models with iterative convergence to the perfect-foresight adjustment path after each shock. Models of that kind are now routinely used in simulations of major tax regime changes. Computational limits ruled that out in the 1970s, and probably still do, despite the emormous recent increases in computational power.

These increases, however, and especially the widespread availability of personal computers, make access to a "hands-on" model of the kind underlying the text now much easier. A version suitable for IBM-compatible personal computers has been prepared and is available at a nominal charge from the authors.

Preface

THIS BOOK is offered as an alternative to the standard approach to teaching macroeconomics. That approach, all too often, leaves students with the impression that an economy, left to its own devices, settles into an equilibrium with substantial amounts of unemployment. Stagnation can be avoided if the government stimulates private spending or, more reliably, if it acts as the spender of last resort. Care must be taken not to overdo it, however. For then effective demand will exceed full employment supply and cause inflation. Macroeconomics, in sum, comes through essentially as a course in economic therapy stressing how the government can keep an inherently dysfunctional economy alive by a nicely timed sequence of transfusions and bleedings.

We believe that the course in macroeconomics should emphasize rather that a market economy left to its own devices will settle into a full employment equilibrium. External shocks, of a variety of kinds, will dislodge it from equilibrium from time to time, but the economy's internal defenses will speedily return it to equilibrium barring new shocks or actively destabilizing policies by the government. In special circumstances, government policies may speed the return to full employment equilibrium, but the scope for such policies is limited and temporary. Once the public catches on, fiscal and monetary stimuli lose their potency, though, not always, alas, their unpleasant long-run side effects.

Changing the emphasis dictates a corresponding change in the order of topics and the space allotted as compared with the

standard texts. We begin with the neoclassical growth model that is usually relegated to the end of the standard course, if it is covered at all. The neoclassical model developed in Section One describes the full-employment equilibrium path of a growing economy with flexible wages and interest rates and serves as the backdrop for all subsequent discussion. The model is then extended successively in four subsequent sections entitled: Consumption and Saving (Two), Government Finance (Three), Money and the Price Level (Four), and Unemployment (Five). Some idea of the coverage can be gained from the brief overviews provided at the start of each of these major sections as well as the short annotated bibliography at its end.

Despite our use of the neoclassical model as the organizing principle, this book is and is intended to be a text in macroeconomics and not in growth theory, as both those terms are understood. We make no attempt to deepen the analysis of the simple growth model by incorporating such refinements as embodied technical change and vintage capital, nonneutral technical change, production functions other than the Cobb-Douglas or multi-sector models. We provide no discussion of the determinants of technological change or population growth, nor do we take up such esoterica as the reswitching problem, turnpike theorems or Von Neumann growth models. Instead, we work throughout with the simple one-commodity, two-factor model of moving, full-employment equilibrium in a closed economy, merely widening it, as it were, to bring it to bear on the particular class of problems that have come to be called macroeconomics—the effects of tax and debt financing, money and the price level, and unemployment.

The emphasis on growth does not mean that our concern is only with the long run. The short-run responses of the system and the immediate effects of government policies receive a considerable share of the attention throughout. Our heavy reliance on the Modigliani-Brumberg life-cycle model of consumption is in part an attempt to provide some of the detail about short-run behavior that gets suppressed in the basic neoclassical model. The same is true of our treatment of recently developed "search" theories of unemployment. But we have not attempted to provide a complete catalog of the adjustment lags often associated with discussions of short-run behavior.

We have managed to treat most of the standard topics in macro-

economics (including even some of the rudiments of national income accounting) within this widened neoclassical framework, but we have not always treated them in the standard way or with the standard vocabulary of macroeconomics. In particular, we have found no need in telling the story to bring in the marginal efficiency of investment, liquidity preference (though we do discuss the famous liquidity trap), the speculative demand for money, the interaction of the multiplier and the accelerator, the relative income hypothesis, built-in flexibility, or even effective demand; and we have given only passing reference to many other concepts such as the IS-LM apparatus (for which we have what we believe to be a more versatile substitute), permanent income, and the velocity of money. Our hope was that by pruning away unnecessary concepts and by treating macroeconomics as an extension of microeconomics the central core of the subject would come through more easily to the students for whom this book is intended—essentially undergraduate and MBA students taking a one-quarter or one-semester course in intermediate macroeconomics.

Although the neoclassical growth model is usually regarded as an advanced topic—which is perhaps one reason why it has so far had little effect on the teaching of macroeconomics—we have taken pains to present the model and its extensions in ways accessible to those with only very limited mathematical preparation. We make no use of the calculus, for example, except in certain appendixes which can be safely skipped without loss of continuity. We try to substitute explicit functional forms for implicit functional representation wherever possible (with due warnings about their special properties). And, instead of merely listing the system of simultaneous equations and relying on implicit differentiation for tracing out the interactions, we have developed a computer model of an imaginary economy built up from the underlying micro components described in the text. Simulation experiments based on the model are described in some detail at two critical points (Chapters 6 and 12). Knowledge of computer programming is not essential for following those experiments.

Insofar as possible, we have tried to set the basic parameters of the experimental models to produce numbers for the capital/labor ratio, the capital/output ratio, the saving/income ratio, the real rate of interest, the share of wages in national income, and so on

that are of the same order of magnitude and yield the same "stylized facts" as those found in modern economies. We have, however, made no attempt to fit the models or their components to empirical data nor, with a few exceptions, to relate the experiments to particular real-world episodes or events. In the belief that the law of comparative advantage holds for textbooks of economics we have chosen to specialize this book to the task of expounding the neoclassical theory of macroeconomics in as clear and coherent a way as we could. In our classes, we do, of course, try to flesh out the bare bones of the theory by issuing a supplementary packet of assorted empirical readings, polemics, and "current events" material. And we would imagine that most instructors would want to do the same.

Any text by authors currently at the University of Chicago will inevitably be labeled (and in some quarters dismissed) as "monetarist." The basis of distinction between the "monetarists" and the "fiscalists" has never been entirely clear to us, but if an operational definition of monetarism is work that has been strongly influenced by the writings of Milton Friedman, then ours is certainly in that class. In fairness to him, however, we should emphasize that his contribution has been that of a capital input through his writings and not a labor input. We have not had the chance to discuss the material with him and none of our sins should be laid at his door.

The *cognoscenti* will also detect the strong influence of that rapidly growing body of work in the field of finance under the heading of the "efficient markets hypothesis." We have tried to purge basic macroeconomics of all results that would seem to leave opportunities for individuals to earn above-normal returns from mechanical trading rules or chart-reading (including charts of the money supply or of the National Bureau's leading indicators). We regret that we have not been as successful in this purging as we had hoped, but at least we have tried. Our colleague, Fischer Black, has been particularly helpful in keeping our attention focused on this class of problems and in suggesting ways out of the difficulties when we stumbled into them.

Michael McPherson and Charles R. Nelson gave us a detailed critical reading of the entire manuscript and we have incorporated many of their suggestions in the final version. Robert Clower, Lloyd Reynolds, B. F. Roberts, and Joseph Stiglitz, who

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Preface, 1986

WE BEGAN this book in 1970 because we could no longer bring much enthusiasm or conviction to teaching macroeconomics along the then standard Keynesian lines. The largely ad hoc Keynesian consumption, investment and money demand macrofunctions were often in conflict with the better-motivated treatments of those same subjects that our students were seeing in their courses in price theory, labor economics, and finance. The Keynesian policy emphasis on 1930s style unemployment was becoming increasingly irrelevant to students coming of age in the booming 1960s. And even the academic true believers were finding a model built mainly for depressions hard to adapt to the growing concerns over inflation. Rather than try to patch up a creaking model, we proposed to start afresh.

As it turned out, our dissatisfaction with the Keynesian macromodel came to be shared widely throughout the profession by the end of the decade. The Keynesian hegemony was shattered in the 1970s.

Our then radically different approach to teaching macroeconomics is now much closer to the standard. The general theme described in our original preface—that macroeconomics should focus first on the determinants of aggregate supply under conditions of product and resource market equilibrium—is widely accepted these days, although our emphasis on neoclassical growth theory as a way of modeling the basic, full-employment economy may still strike some as idiosyncratic. In the section on public finance (chaps. 7 and 8) our focus on the allocative effects of tax and spending policies, rather than on their demand effects, anticipated much of the "supply side" thrust of public policy discussions in recent years. Our section on money (chaps. 9–15) went beyond the usual 1960s Keynesian

also read the manuscript, were extremely perceptive in their comments and we greatly appreciate their advice.

A number of our colleagues have read and commented on individual chapters. In particular, we wish to thank Paul Breck, Walter Fackler, John P. Gould, Katherine D. Miller, and Jeremy Siegel. J. Phillip Cooper provided invaluable help in the early stages of devising the solution algorithm for the computer model of Chapters 6 and 12, and Gary Curtis did much of the programming for those models and for the conversational-mode version that we have used in our courses. Of course, we assume responsibility for any remaining errors.

A special word of thanks also to Mrs. Julius Schuster who did her usual outstanding job of shepherding the manuscript through the preparation stage, to Steven Manaster who prepared the index and to Mrs. Lowell Nelson who assisted in the proofreading.

February 1974

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section one

The neoclassical theory of economic growth and production

MACROECONOMIC THEORY is abstract in its approach to economic questions, as indeed is economic theory generally. One cannot walk along a street and point to a "unit of capital" or to an "effective labor unit," to name two terms used throughout this book. But abstraction does not mean irrelevance; the issues to which macroeconomics addresses itself, such as the determinants of the standard of living, the effects of government monetary and fiscal policies, and the causes of unemployment, to name only a few, are real and important. The emphasis on abstraction represents rather a belief that much can be learned about important economic problems by stripping them of institutional detail and clutter, which often serve merely to confuse the main issues.

Chapter 1 takes up an early application of macroeconomic analysis to important social and economic issues, the Malthusian analysis of the relationship between population growth and the standard of living. Although the discussion has been restated in modern terms, this restatement primarily reflects changing tastes for exposition. The basic model is that of Malthus. This chapter shows how abstract models can be applied to various policy questions.

Despite its impressive historical background, most economists today regard the Malthusian model as of limited importance, partly because Malthus made too little allowance for technological change and partly because he overlooked the role of

capital as a means of production. Chapter 2, therefore, turns to developing the more general model which is the basis of this book. This model, called the *neoclassical model,* emphasizes the role of capital accumulation and technological improvement in determining the standard of living. The development is continued in Chapter 3, which shows how wages and capital rental rates are determined in a neoclassical economy and how both are affected by technological change.

1

An introduction to macroeconomic reasoning: The Malthusian model

ALTHOUGH the phrase "war on poverty" dates from the middle 1960s, the concern of economists with the causes and cures of mass poverty is by no means so recent. In fact, from its very beginnings with the writings of Adam Smith, Thomas Malthus, David Ricardo and other "classical" economists of the late 18th and early 19th centuries, economics has focused on the forces governing the average standard of living and its growth or decay over time. The steps that a wise government might take to increase that average standard of living or to accelerate its rise have been a major preoccupation throughout.

A good case in point is the controversy over the Poor Laws in England in the late 18th and early 19th centuries. Like some more recent welfare programs in the United States, the English Poor Law of 1601 provided direct grants to the local poor to be financed by local property taxes. As distress rose throughout Great Britain in the wake of the Napoleonic wars, proposals were made to have these local grants and income supplements taken over by the central government and extended on a national scale. Proposals were also made for what today in many countries would be called "family allowances," or in the United States AFDC programs (aid to families with dependent children), with the motivation partly humanitarian and partly to encourage the production of future soldiery. Malthus believed these proposals, however well-intentioned, to be completely unsound and counter-

productive; and his justly celebrated essay on *The Principle of Population, As It Affects the Future Improvement of Society* was his attempt to explain why.

THE MALTHUSIAN MODEL

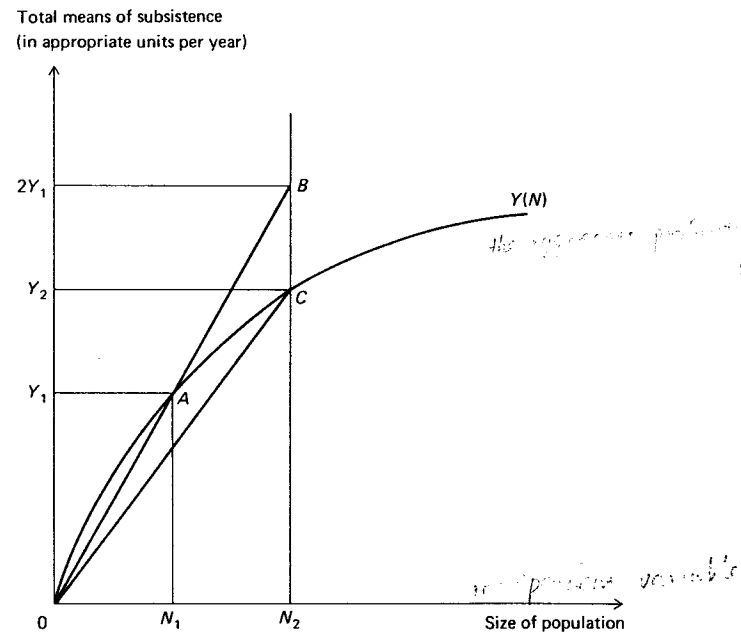
To make his point, Malthus constructed what economists would today call a *macroeconomic model.* In keeping with the standard practice of his day, of course, he presented his model entirely in discursive, verbal fashion, supplemented with occasional illustrative numerical examples, rather than as the explicit system of equations that the term model usually connotes today. But that is a matter of style rather than substance, and the main lines of his argument translate readily into the more convenient and compact modern way of presentation. As we shall see, economists no longer accept Malthus's analysis of the limits to economic growth. Nevertheless, his model has left an indelible mark on all subsequent modeling of economic growth; and its essential structure so typifies the macroeconomic approach that it remains the logical place to begin any study of modern macroeconomic theory.

The aggregate production function

Central to the Malthusian model is an *aggregate production function* of the kind pictured in Figure 1–1. The vertical axis measures what Malthus would call the total "means of subsistence" available to a particular country, measured in bushels or pounds or some other appropriate units. The horizontal axis measures the size of the country's population. The curve labeled $Y(N)$ is the aggregate production function and shows the maximum amount of means of subsistence that can be produced by any specified population, given the amount of arable land and other natural resources in the economy, and given the current state of the technological arts. Thus, when the population consists of N_1 individuals, the maximum total output for the economy is Y_1 units of subsistence per year.

What is critical about $Y(N)$ to Malthus's argument is not the actual numerical value of Y that goes with any given value of N, but the qualitative property of the direction of its curvature. As drawn, the curvature of $Y(N)$ reflects Malthus's assumption that

FIGURE 1–1
The Malthusian aggregate production function



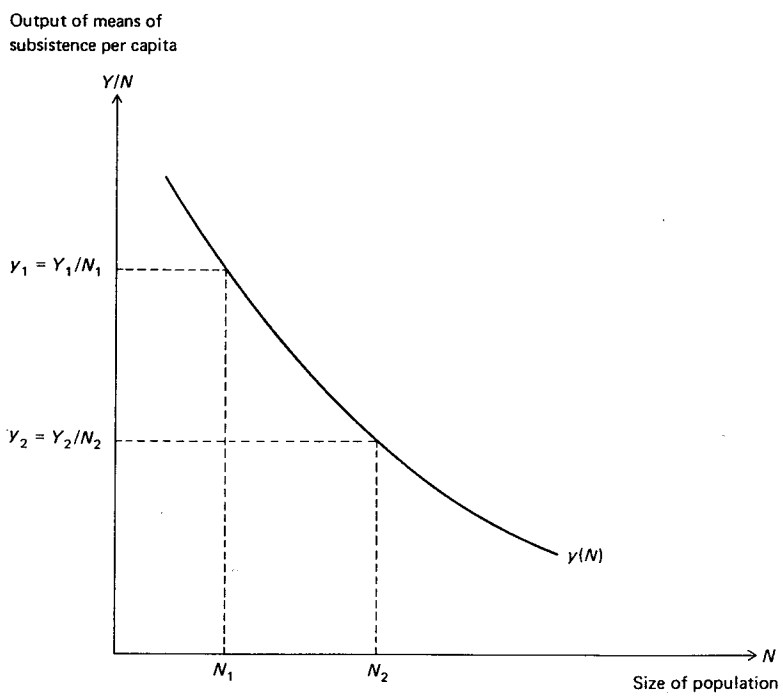
the production process in an economy with a fixed stock of arable land would be characterized by *diminishing average returns* to labor inputs. When the population is N_1, the total output will be Y_1, implying an average output per capita of Y_1/N_1, or equivalently, of AN_1/ON_1, the slope of the line OA. Let the population double to $N_2 = 2N_1$. If output per capita remained unchanged, Y would rise to a total of $2Y_1$ bushels per year. $Y(N)$ tells us, however, that output will only rise to Y_2 bushels, leading to a fall in the average output per capita (i.e., to a fall in the slope of the line through the origin from AN_1/ON_1 to CN_2/ON_2). The relation between average output per capita and total population implied by the aggregate production function $Y(N)$ is graphed in Figure 1–2 as the curve $y(N)$, where y equals output per capita. (Obviously, $y(N) = Y(N) \div N$.)[1]

[1] Here, and throughout, we shall adopt the convention of using capital letters to indicate aggregate quantities and lowercase letters to represent per capita variables. Thus, Y represents total output and y output per capita.

The Malthusian population growth function

The function $Y(N)$ of Figure 1–1 shows the relation between the means of subsistence and population with population as the independent variable. More population leads to more output, though at a diminishing average rate. Malthus argued, however, that another relation between Y and N also existed, in which the roles of the two variables were reversed. The means of subsistence became the independent variable and the size of the population the dependent one.

FIGURE 1–2
Average output per capita in relation to population size



The relation between standard of living and size of population assumed by Malthus for this second function is shown in Figure 1–3A. The vertical axis now measures the rate of growth of the population in percent per year denoted by $n = \Delta N/N$, and the horizontal axis measures the average standard of living, y. As

before, Malthus's argument hinges on qualitative properties of the function relating the two, rather than on the precise numerical values involved. What is critical is that the curve cuts the horizontal axis in only one place, that it cuts from below and that it has a positive but finite slope at the crossing point.

The forces that act on population to produce these properties are summarized in Figure 1–3B which shows birth and death rates per year in any given population as a function of the standard of living. The curve representing birth rates $b(y)$ is drawn to reflect the belief of Malthus and his contemporaries that birth rates were relatively insensitive to economic conditions. They were assumed to be governed mainly by what was quaintly referred to as the "passion between the sexes," which was taken as one of nature's constants, plus such deep-rooted and slowly changing customs as the normal age for marriage. Death rates, however, were regarded as much more directly related to the standard of living. At low average standards of living, such as y_L, famine, pestilence and related natural disasters take a heavy toll of the undernourished and weakened population. The death rate function $d(y)$ in Figure 1–3B lies above the birth rate $b(y)$ at that point, implying that the net change in population, shown in Figure 1–3A, is actually negative. Population is declining. At higher values of the standard of living, death rates are successively lower,

FIGURE 1–3A
Rate of population growth and the average standard of living

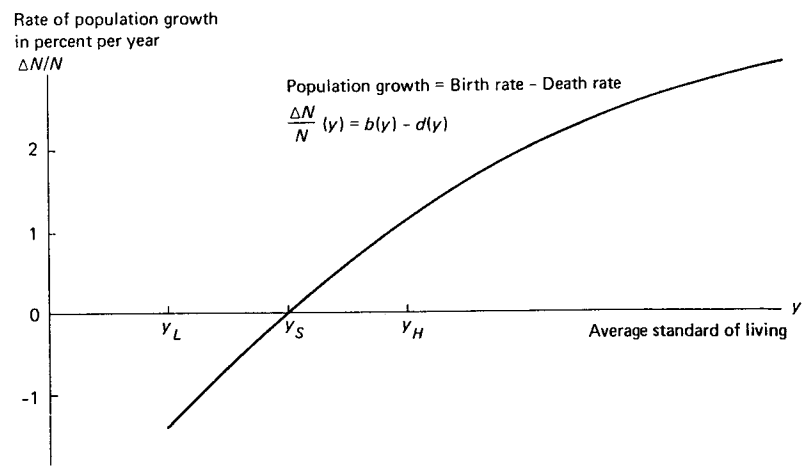
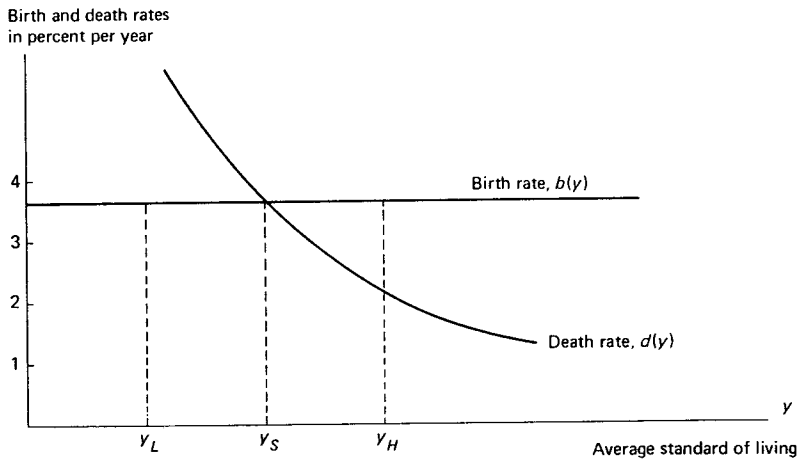


FIGURE 1–3B
Birth rates, death rates and the average standard of living



and at high levels such as y_H, death rates are less than birth rates. Population is increasing.

The curve $n(y)$, representing the net population growth rate, $b(y) - d(y)$, has been drawn to be asymptotic to the particular growth rate of 2.8 percent per year in recognition of Malthus's famous dictum that population, if unchecked, might double every 25 years. Growth rates of this magnitude have in fact been observed in some Latin American and Asian countries, but, as noted earlier, the force of the argument does not depend on the numerical magnitudes used.

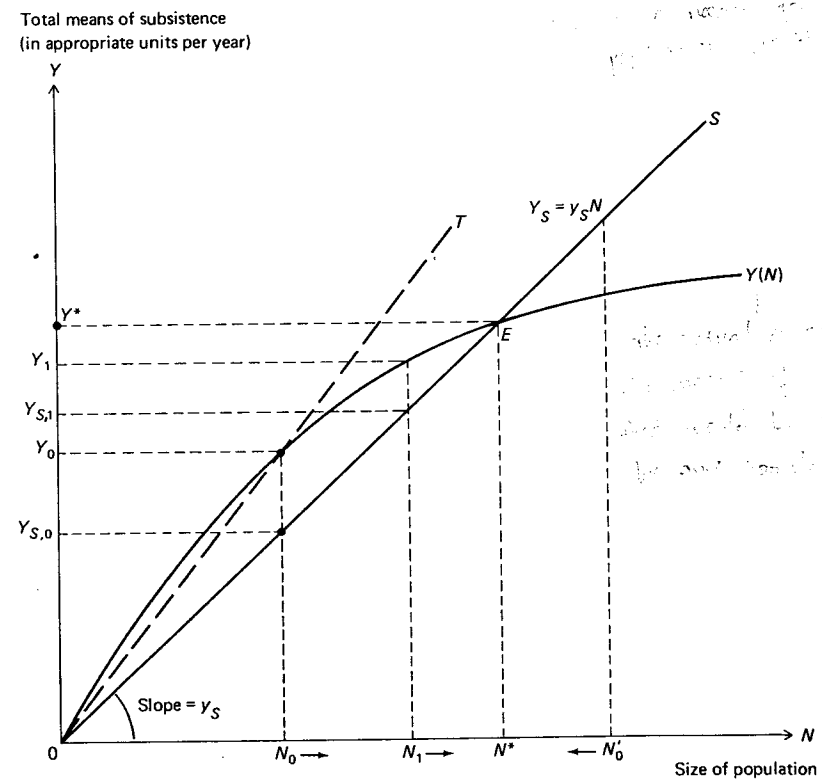
Somewhere between y_L and y_H is a standard of living, y_S, in which the birth and death processes are just in balance. The standard of living is high enough to stave off starvation and to maintain the population at its then given size, but not high enough to permit further growth.

THE EQUILIBRIUM POPULATION SIZE AND STANDARD OF LIVING

Figure 1–4 portrays the interaction between the two Malthusian functions connecting population and the standard of living—the production function in which population enters as "hands," and the population growth function in which population enters as "mouths." The key to the evolution of the system is in the line OS which has been drawn with slope equal to the level y_S of Figure 1–3A. The line thus measures the total amount of means of subsistence per year needed to maintain any given population. If, for example, the population of a country were at size N_0, then the total amount of food and other means of subsistence necessary to keep population at this same size N_0 would be precisely $Y_{S,0} = y_S \cdot N_0$.

While the line OS (which is just the relation $Y_S = y_S \cdot N$) shows the minimum total amount of subsistence needed for zero population growth (ZPG, for short) for any size of population, the *actual* amount of the means of subsistence that would be produced by any population is given by the production function

FIGURE 1–4
The equilibrium solution of the Malthusian model



$Y(N)$. Thus when population is N_0, total output of means of subsistence is Y_0, which is greater than the level needed for ZPG. The average standard of living is Y_0/N_0, the slope of the line OT, which is clearly greater than (Y_0/N_0), the slope of the line OS. But by virtue of the mechanism summarized in Figures 1–3A and 1–3B, this excess of the actual standard of living over the critical value y_s implies an increase in population. Hence, N moves along the horizontal axis of Figure 1–4, away from the initial value N_0 in the direction indicated by the arrow. After some time has passed, population may have reached some higher value such as N_1. At that value for N, total subsistence requirements are now at the higher level $Y_{S,1}$. Actual total output has increased, thanks to the larger labor force, but less than proportionately. The margin of the means of subsistence per capita over the ZPG standard of living is smaller than before, but still positive. Again population grows, and keeps on growing in this fashion until a population of N^* is reached. At that size the actual average standard of living produced is just enough to maintain the population, and no further growth takes place.

Note that the same *final* value for population would have been reached no matter what its initial value. If the population had initially been N'_0, for example, to the right of N^*, then the movement of N would have been from right to left. At N'_0, actual output of means of subsistence is less than needed for ZPG. Starvation and disease cut population back, and that dreary process must continue until N^* is reached.

A point such as E, where the two functions cross and toward which the N values and Y values tend to return if displaced, is said to define the *equilibrium* values of the variables of the system. That word, here and throughout, is intended strictly as a technical term to indicate that the various contending forces are in a state of balance, and not to convey any notion of well-being, or goals toward which to strive. In fact, the equilibrium in the Malthusian model, as should be clear from the discussion of its mechanisms, is a wretched one indeed. The equilibrium standard of living is Y^*/N^*, just the bare ZPG standard of living level. This is a bleak enough prognosis of mankind's future to have earned Malthus the sobriquet of the "gloomy parson" even if he had pushed it no further. But when he and his successors went on to use his model to analyze various policy proposals for improving the

condition of the poor, economics quickly earned the sobriquet bestowed on it by Thomas Carlyle of the "dismal science."

THE POLICY PRESCRIPTIONS OF THE MALTHUSIAN MODEL

Consider, for example, a proposal to improve the condition of the poor by better public health services such as, say, purer water supplies. To the extent that the purer water reduced the incidence of such water-borne diseases as typhoid fever, cholera, or dysentery, no one would deny that, in the immediate short run at least, such a program would serve to prevent much personal pain and tragedy. But a Malthusian would point out that a general lowering of the death rate has longer-run consequences as well. In terms of Figure 1–5A, the program amounts to shifting the death-rate curve from its original position to the new position indicated by the dotted curve. This shift in turn implies a corresponding shift of the population growth function in Figure 1–5B and, most critically, a shift to the left of the ZPG standard of living from the original level y_s to a new lower level, y_{s_1}. With less subsistence now required to maintain the population at any

FIGURE 1–5A
Effects of a public health program on the death rate

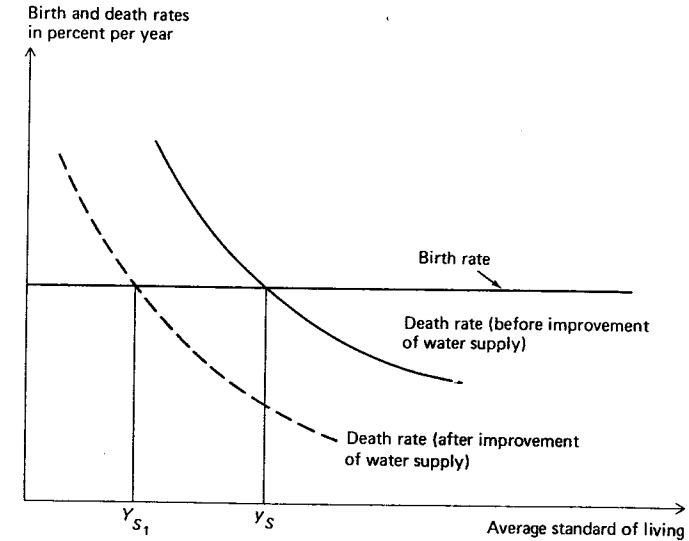
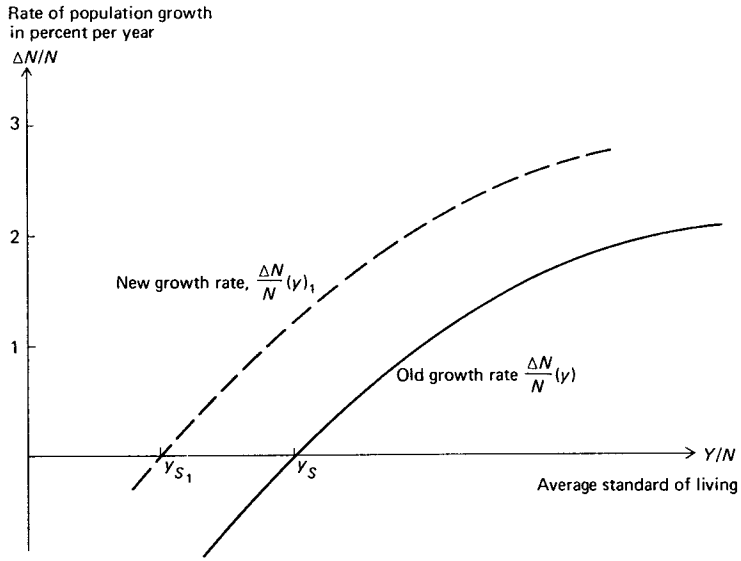


FIGURE 1–5B
Effects of lowering the death rate on the rate of population growth

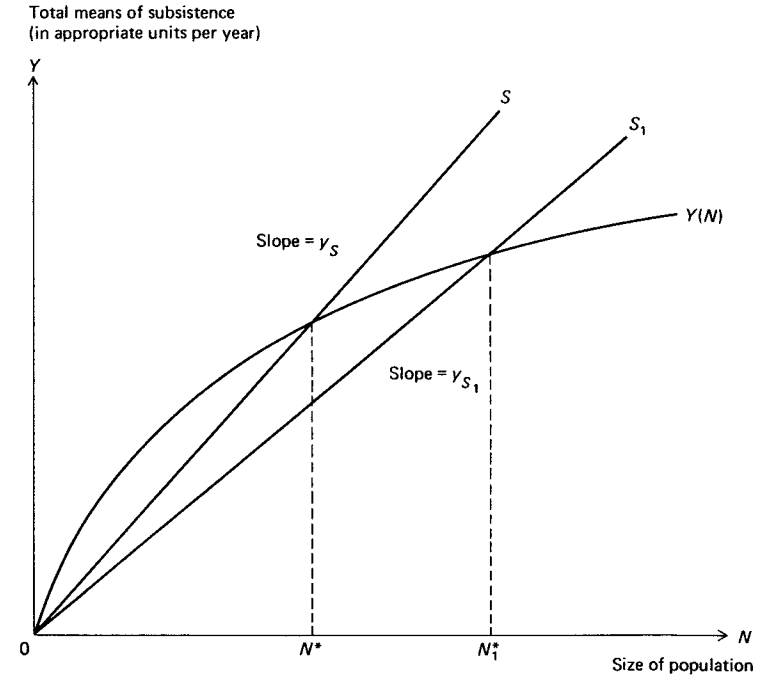


given size, the ZPG line in Figure 1–6 shifts downward from OS to OS_1. Population now begins to increase from its equilibrium value at N^* and the process continues until a new equilibrium is reached at N_1^*. Thus all that the public health program has accomplished has been to increase the total number of the poor. The standard of living, moreover, is actually lower and the conditions of life even more wretched than before the well-meaning but too short-sighted venture in health improvement was undertaken.

The effects of income redistribution in a Malthusian world

It was not lost on Malthus's contemporaries that not all members of society seemed to be suffering equally from the cruel mechanisms of his model. Side by side with grinding poverty for the masses was enormous opulence for a favored few, especially among the nobility and the landholding class generally. Observers in the late 18th century believed that the gap between rich and poor was not only wide, but steadily widening. Small wonder then that the air was filled with proposals for the redis-

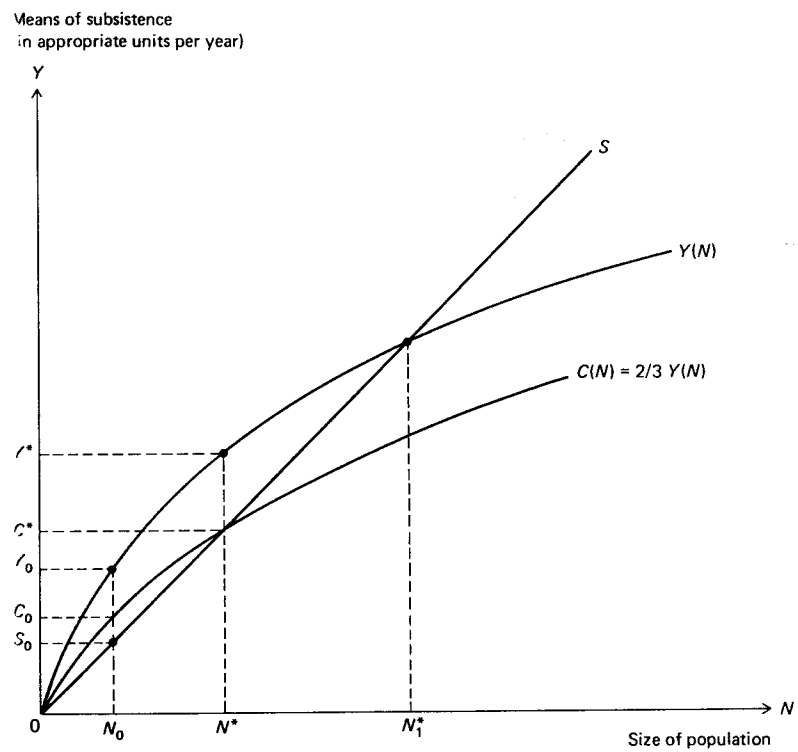
FIGURE 1–6
Effects of an increase in the rate of population growth on the equilibrium size of population and standard of living



tribution of wealth from rich to poor, ranging from such relatively mild schemes as reforming the Poor Law to drastic calls to "expropriate the expropriators" along the lines of the then recent French Revolution.

The Malthusian model, with a slight extension, could be brought to bear on proposals of this kind as well. Figure 1–7 presents the extended version of the model. Below the production function $Y(N)$ is another curve $C(N)$ showing that part of the total production of means of subsistence that would be made available to the "laboring classes" under the workings of unfettered competition. Precisely how that share would be determined in a free market economy will be deferred to a later chapter. For the moment, the important point is simply that a distribution mechanism of some determinate kind is in operation and that it gives the poor less than the total output being produced. For

FIGURE 1–7
Effects of a revolution on the equilibrium size of population and standard of living



simplicity, the share of the workers has been set at two thirds of $Y(N)$ with the remaining third accruing to the landowners. Note that as N increases, the average output available per member of the working force declines (i.e., $C(N)/N$ falls with increasing N). At the same time, the *absolute* size of the share accruing to the landowners rises (because they are still getting one third of a larger absolute total output). Hence if their numbers, which are small relative to N in any event, do not increase as fast as those of the laboring poor—a proposition that Malthus and his contemporaries accepted—the per capita income of the landed will actually increase. Thus as population increases from N_0 to N^*, the rich get richer and the poor get poorer.

Suppose now that in the interest of social justice steps are taken

to transfer output from the rich to the poor. For simplicity, suppose that the landowning class is wiped out completely so that labor's share rises from two thirds $Y(N)$ to 100 percent of $Y(N)$. Initially, such a redistribution clearly results in a substantial betterment in the condition of the working classes. The standard of living per worker rises from C^*/N^* per person to Y^*/N^*. Travellers would bring back glowing accounts of the success of the revolution in raising the standard of living of the common people. To a Malthusian, however, such tributes are premature. The initial improvement will simply lead to a more rapid rate of increase of population. Eventually the economy will return to a steady-state equilibrium at N_1^* where the standard of living is once again at the prerevolutionary level. Nothing lasting has been accomplished—except to extend the misery of a minimum subsistence existence to a larger number of people.

Was there then to be no escape from this cycle of misery for mankind? The best hope that Malthus could hold out was that population growth might some day come to be held in check through the exercise of "moral restraint" on the part of those in the procreative age groups. (By moral restraint he meant voluntary abstinence from procreation, not the sort of mechanical birth control or sterilization programs that present-day Malthusians tend to stress. Malthus, after all, was an ordained Anglican priest!) How such reductions in birth rates might affect the evolution of the economic system and the standard of living in an otherwise Malthusian model is the subject of some of the exercises at the end of this chapter.

WHERE DOES THE MALTHUSIAN MODEL STAND TODAY?

Although modern macroeconomics, as we shall see, uses an apparatus very similar in outward appearance to the Malthusian model just studied—which is, of course, precisely one of the reasons for starting with the Malthusian model—no leading present-day economist would claim to be a Malthusian as that term is currently understood. The Malthusians of today are found mainly among the biologists or ecologists. Nor is this interest on the part of the biologists entirely surprising, since Malthus's essay had a profound effect on his countryman, Charles Darwin.

What has led economists to reject Malthus's model as a description of the way an economy works is not merely that it is "too simple" or that the assumptions underlying it are "unrealistic." The accepted major theories in economics or any other field of scientific inquiry are always based on a drastic pruning away of surface "realistic" detail. There is no other way to get at the really crucial essentials.

What has led economists to reject Malthus's model is rather that they have developed a better model that explains more of the observed facts of economic evolution. Just as in astronomy the Ptolemaic, earth-centered model of the solar system was displaced by the Copernican, sun-centered model, so in economics has the Malthusian model been displaced by what has come to be called the *neoclassical model of economic growth.*

The neoclassical model accounts for two general classes of facts better than does the simple Malthusian model: those relating to differences in the standard of living of different countries today, and those concerning the evolution of the standard of living of particular countries over time. As to the former—or *cross-sectional* differences, as they would be called in economist's jargon—the Malthusian model predicts that high densities of population will be associated with low standards of living. (Remember that the population in Figure 1–4 was assumed to be put to work on a given total acreage of land, so that as N increases, so does population per acre). Certainly one can readily point to countries today in which these two properties do coexist. The Malthusian model may have been supplanted by a better one, but no one would claim that it is totally lacking in explanatory power. But one can also readily point to countries (such as Holland, Belgium, Switzerland or Japan) with higher than average densities of population and higher than average standards of living. In the other direction, cases abound in which an extremely low standard of living is found even without an exceptionally high population density. Mainland China, for example, has more than three times as much total land per capita and more than twice as much cultivated land per capita as Great Britain or Germany.

The Malthusian model also had a very gloomy prognosis, as we saw, for the evolution of the standard of living over time unless mankind somehow learned to curb its procreative instincts. Yet in the 170 years since Malthus's essay, the population of an even then seemingly crowded Britain has increased about fourfold. The increase in the average standard of living over the same interval is harder to quantify, partly because the component items in the standard of living have changed so drastically, and partly because we still have few reliable ways of measuring changes in those components of the standard of living (in the broad sense) that are provided outside the market economy. But such direct and indirect evidence as we have about rates of economic growth in Great Britain would suggest an improvement in the average standard of living of fivefold at the very least since 1798, and almost certainly more. (The basis for believing that a fivefold increase in the average standard of living is likely to err on the low side will become clearer in the chapters to come.) Nor has the experience of Great Britain been unique in this respect. Many countries in all parts of the world have grown as fast as Great Britain over the last 170 years, and not a few considerably faster.

To a convinced neo-Malthusian, these past examples of rapidly rising living standards despite substantial rates of population growth would be regarded as merely temporary deviations from the fundamental downward trend (just as the revolution pictured in Figure 1–7 led to a temporary rise in the standard of living). To economists, however, such an alibi for the failures of prediction of the Malthusian model would not be acceptable. It is not simply that they regard 170 years as a bit too long to be considered a temporary departure from trend in human affairs. It is rather that, as noted earlier, they can account for the discrepancies by specific processes not allowed for in the simple Malthusian version (which processes, incidentally, also hold out very different and far less gloomy prospects for further improvement in worldwide living standards over the foreseeable future even in the face of continuing worldwide population growth). The processes are those of *capital accumulation* and *technological improvement.* Britain may have less land in cultivation per capita than China, but it has considerably more railroads, refineries, factories and machines. Furthermore, the machines available to British workers today are many times more effective than those used by their counterparts in Malthus's day.

How these processes work to increase a society's productive

power and how they interact with population growth to determine the standard of living and its evolution is what the modern neoclassical model seeks to explain. The development of that model and its major implications is the task of the next two chapters.

PROBLEMS FOR CHAPTER 1

1. What effect would a lowering of the birth rate have on the equilibrium standard of living in the Malthusian model?
2. At the time Malthus wrote, the amount of land under cultivation around the world was increasing; indeed, there was land in England not under cultivation. Yet Malthus believed that bringing this land under cultivation could at best only temporarily stave off the dilemma. Using Figures 1–3 and 1–4, show the effects of a one-shot increase in the amount of land under cultivation—for example, by building a dam, and irrigating a desert—on the standard of living, and on population growth and population size both in the short run and in the long run.
3. One factor not included in the Malthusian model is technological innovation, an increase in the amount of output that can be obtained from any given inputs of land and labor. Using Figures 1–3 and 1–4, show the effects of a once-for-all "Green Revolution" doubling output per acre on the standard of living and on population growth and population size both in the short run and in the long run.
4. A final factor overlooked in this chapter is the role of capital equipment. Again, using Figures 1–3 and 1–4, show the effects of a single increase in the number of tractors on the standard of living and population growth and population size both in the short run and in the long.

2

The neoclassical model of economic growth

THE TERM "NEOCLASSICAL" is used in economics in a variety of different, though related, ways. It sometimes refers to a particular school of late 19th and early 20th century economists, mainly British, but including also the French economist Léon Walras and the Swedish economist Knut Wicksell. More generally, it has come to be applied to models that take full employment of all resources to be the natural state of an economy when its prices and wage rates are flexible. That is the principal sense in which we shall be using the term throughout the book. A particular case of a neoclassical model is the neoclassical growth model discussed in this chapter—a model whose precise formulation dates from the 1950s in the work of the American economist Robert Solow and the Australian economist Trevor Swan.

CAPITAL AS A FACTOR OF PRODUCTION

THE neoclassical growth model, like the Malthusian model from which it is descended, takes human labor as one of two inputs or factors of production in the aggregate production function. The second factor of production, however, is no longer land but *capital,* defined as productive resources whose supply can be increased by production. Thus capital differs from labor whose supply is presumably governed to a considerable extent by biological and social mechanisms rather than by strict economic cal-