

THE CAMBRIDGE COMPANION TO

THE ROMAN
ECONOMY



Edited by

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- 100 Nicolet 1988b: 224–40, with discussion. Cf. id. 2000: 163–87; Capogrossi Colognesi 2009: 300.
- 101 As Cassius Dio, Tacitus, and Suetonius testify (cf. Nicolet 1988b: 233–4), as well as the lovable verse by Horace (*Ep.* 1.1.57–8: “You have sense, you have morals, eloquence and honour, but there are six or seven thousand short of the four hundred; you will be in the crowd”, trad. H. Rushton Fairclough).
- 102 Nicolet 1988b: 239.
- 103 The cataloguing of the *ager* reflected its status: *publicus, privatus, occupatorius, censorius, quaestorius, vectigalis, tributarius, stipendiarius*, etc.
- 104 The definition of *latifundium* is controversial even today; it was not so much the size that mattered as the waste of land.
- 105 Morley 2007a: 92. Cf. Halstead 2002: 68.
- 106 *Georg.* 4.133; cf. Whittaker 1985: 49.
- 107 Here also the bibliography is endless; from Fink 1945 to Gelderen and Skinner 2002.
- 108 Nevertheless, if Augustus extended the census and the land registry to the provinces, he intended to assess and systematically impose taxes; this lends credibility to Agrippa’s speech (and Maecenas’s, cf. Dio 52.6, 27–29).
- 109 Vivenza 1998b: 318–20.
- 110 Which may, in part, have been calculated: Kehoe 1989: 584–5.
- 111 This expression is owed to Schiavone 1996: 203.
- 112 This is not the place to enter the discussion on whether economic growth occurred during the Empire; cf. the contributions by Bruce Hitchner (Hitchner 2005) and Richard Saller (Saller 2002 in Manning and Morris 2005 (eds.), and the comment by Avner Greif.

3: THE CONTRIBUTION OF ECONOMICS

Peter Temin

Economics is about the allocation of resources. In the modern industrialized world, most goods and services are allocated through transactions, which in turn are mostly purchases and taxes. Goods are largely the outputs of early modern economies, while services – particularly labor services – are more typically the inputs. To understand how an economy works, we need to consider how inputs are directed to provide the outputs that people desire. There also are economic analyses of marriages and families, seeing marriage itself, fertility choice, and the raising of children as decisions that affect the allocation of resources. Ancient economies clearly differed from modern ones, but the principles of economics still hold true, and economics can bring clarity to the analysis of how resources were allocated in the ancient world.

I make this case in several steps. First, I describe the concepts of a market and of institutional economics. Second, I separate supply and demand and discuss the nature of economic incentives and equilibrium to show that economics may be useful even in the absence of market activity. Third, I introduce the concept of comparative advantage to explain trade. Fourth, I discuss possible economic growth as well as catastrophes like plagues. Fifth, I turn to money and prices. Sixth, I discuss the nature of information that can be used to test hypotheses about all these topics. The last two topics are discussed on this volume’s web site.¹

MARKETS

All economies larger than Robinson Crusoe’s have to allocate resources among people. Even Robinson Crusoe had to allocate his time; adding other people makes the problems far more complex. Families need to decide who will work and in what activities. They need to decide how to divide the fruits of this labor among family members. Even if they

do not consciously make choices – or even regard these decisions as choices – family decisions have consequences for both production and consumption. Larger groups have the same kinds of decisions to make, and the relations between people in tribes or states or other groupings affect the process by which they make these decisions as well as their outcomes.

Polanyi asserted that the main forms of integration in the human economy are reciprocity, redistribution, and exchange.² Reciprocity, as the term suggests, is a system in which people aim toward a rough balance between the goods and services they receive and that they give to others. The reciprocal obligations are determined by social obligations and tradition, and they change only slowly. Participants typically see themselves as following traditions or custom rather than as making choices. Redistribution is a system in which goods are collected in one hand and distributed by virtue of custom, law, or ad hoc central decision. This system is present in units as small as households, where it is known as householding, as well as in the taxation levied by modern states. The essential characteristic is that a central authority collects and distributes goods and services. Exchange is the familiar economic transaction where people voluntarily exchange goods for each other or for money.

This tripartite schema corresponds also to a division of individual behavior. People even today rely on a mixture of behavioral modes, choosing which one to use as a result of internal and external forces.³ These forces can be represented on two dimensions. One dimension measures internal forces along an index of personal autonomy. The other dimension indexes the rapidity of change in the external environment. When people are less autonomous and change is slow, they typically utilize customary behavior. When change is rapid and personal autonomy is neither very high nor very low, then people use command behavior. When personal autonomy is high and the pace of change is moderate, people employ instrumental behavior, that is, they have explicit goals in mind and choose actions that advance their plans. These different modes of behavior correspond to the three types of organization used in economic life. Customary behavior generally is used for reciprocity. Command behavior is typical of redistribution. And instrumental behavior is used in market exchange.

There consequently are two types of tests we can use to discriminate between the various kinds of organizations. Prices are used in market exchanges. (They may be used in reciprocity, although they will not vary in response to economic conditions in that context.) In

addition, people behave instrumentally in market exchanges, not customarily or by command; these two modes of behavior are typical of reciprocity and redistribution. Neither prices nor behavior are seen clearly in the historical record of ancient Rome, but the formulation of tests using varied fragments of information allows discrimination between alternative categories.

Markets are an important means of allocating resources, and they were prominent in the ancient world; it will ease later discussions to clarify what a market is. The problem is that there is a popular definition and an economic definition, sowing confusion in historical discussions. The popular definition of a market is a place at which trade is conducted. The *Oxford English Dictionary* notes that the Roman forum was designated as a market in medieval writing. Markets now include fish markets, farmers' markets and supermarkets for food. In the modern world, most trade is directed via stores – distinguished from markets by having uniform, posted prices. Department stores arose in the mid-nineteenth century, and the initial function of prices was to let the store know how much the customer had paid and therefore the amount to be returned, not to inform the customer how much he or she would have to pay.

The stock market is located in a specific place on Wall Street, even though news of stock-market activity is all around us. It is considered to be a paragon of markets by economists because stock prices change the way competitive prices are expected to behave. Current prices embody all information about the stock to date. Future prices depend on future information and cannot be predicted. The best prediction of tomorrow's stock's price therefore is today's price. In mathematical terms, stock prices move as a random walk, that is, tomorrow's price is today's price plus a random (with today's knowledge) movement. I have shown that agricultural prices in Hellenistic Babylon moved as a random walk, that is, that they behaved like modern market prices.⁴

Now think of selling a house. We speak of putting our house on the market, but there is no place to take a house – and of course no way to take it even if there were such a place. The market in this case is a virtual or disembodied market. It is defined by the nature of the goods or services being sold rather than by where they are sold. This is the key to the economic use of the term which focuses on the items being sold rather than the method of selling them.

People who anticipate buying or selling a house want to think about its price. To find a suitable range of prices, they look at the sale prices of other, similar houses. But what makes another house similar

to this one? It might be location, the prime characteristic of all real estate, so that only local sales are relevant. Local sales might be those on the same street, in the same neighborhood, the same city, or the same country. It might be houses of the same size, or of the same age, or with the same kind of garden. It might even be houses of approximately the same putative value.

This highly ambiguous description is a key to how economists use the term, market. All houses are in some sense in the same market, but some are closer substitutes for the house being sold than others. Economists argue roughly that houses are in the same market if the price of one affects the price of the other. This is the general idea, but the statement is not quite accurate. On one hand, the price of any single house cannot affect the price of any other in a perfectly competitive market, because there are so many similar houses in this kind of market that the sale of any one house has no effect on the market as a whole. On the other, the price of nearby apartments might affect the price of houses. We do not have to be very precise here; we stay with the idea of a market consisting of goods and services that compete with each other. The boundaries of such a market are unclear, and setting them provides employment for economists, but not for ancient historians.

The term 'market economy' adds another level of complexity to the discussion. When Hopkins described Rome as a slave society, he did not mean that everyone was a slave.⁵ Similarly, not every resource in a market economy is allocated through a market. In both cases, the terms indicate that slaves and markets were important, even dominant, institutions. In twentieth-century America – arguably the purest market economy in history – economists have estimated that one-third of economic activity in the United States today takes place within households, that is, in householding.⁶ The proportion was even higher in the ancient world, but I argue that the economy of the early Roman Empire was a market economy because of the importance and prevalence of market activity.⁷

It is necessary here to distinguish between personal and anonymous exchanges. The former is negotiated between a buyer and seller, possibly with a broker to facilitate the transaction. Most house purchases and sales are of this type. Anonymous exchanges involve stated or posted prices that are available to any customers that come by. When we discuss the price of wheat in ancient Rome, we are referring to anonymous exchanges. Only if wheat had been sold in a bazaar for a different price to each purchaser would it be classified as personal exchange.

The consideration of societies can be made sharper by use of the New Institutional Economics (NIE). This body of thought grows out of a belated recognition by economists that institutions affect economic activity – and are in turn affected by economic pressures. Douglass North won a Nobel Prize for making this point over and over again.⁸ A paragraph in the earlier of these books says that Rome fell when it could not longer maintain property rights. This paragraph illustrates a weakness of the NIE. No ancient historian can take such a paragraph seriously. Was a decline in property rights a cause or an effect of the "decline of the Roman Empire"? How do you define or measure either of these concepts to find out?

We should not throw the baby out with the bathwater. The New Institutional Economics is useful to ancient historians in two ways. It helps focus attention on the institutions that govern activities in the ancient world, and it has given rise to some basic hypotheses that may be useful to explore when considering ancient institutions. For example, property rights have been found to promote economic growth by more systematic studies than North's. Acemoglu, Johnson and Robinson made this assertion for modern colonies.⁹ They argued that colonies differed initially by the healthiness of European colonists. Where the Europeans survived, they brought with them European institutions. Where Europeans died frequently from new (to them) diseases, colonial leaders instituted what are called extractive institutions that did not guarantee private property, condoned bound service of various types, and enriched a small elite at the extent of the general population. Acemoglu, Johnson and Robinson found that the effects of these initial conditions, indexed by European mortality, explain a substantial amount of income differences in former colonies today. This paper spawned an enormous literature, both because of its ideas and as a new indicator of institutions that avoided the chicken-and-egg problem in North's paragraph. (Economists speak of this chicken-and-egg problem as the identification problem, that is, the problem of identifying which is chicken and which is egg.)

Another aid to economic activity is education (see below, Chapter 4). Like property rights, it often is hard to determine whether education is a cause or effect of economic growth and prosperity. The same goes for governments that keep corruption at a minimum and for the protection of intellectual rights, that is, the application of property rights to new discoveries. While all of these institutional factors raise similar identification problems, it is useful to set them out separately in order to see what kinds of institutions dominated ancient

societies. For example, chapters in Part VII of the *Cambridge Economic History of the Greco-Roman World* describe regions of the Roman Empire, distinguishing them by their initial institutional background and making progress toward solving the identification problem.¹⁰ The western provinces contained few cities before the Roman conquest, and their economies were redirected after integration into the Empire. The eastern Mediterranean provinces by contrast built on previous urban patterns, and Roman Egypt developed from its previous well-developed organization and its peculiar geography.

SUPPLY AND DEMAND

Economists divide their field into microeconomics (the study of individual markets) and macroeconomics (the study of economies as a whole). One of the foundations of microeconomic analysis is the separation of supply and demand. Both terms refer to schedules or curves relating the quantity supplied or demanded as a function of the relevant price. We have evidence of prices in the ancient world, and many of them appeared to vary as a result of changes in supply and demand. Some prices were fixed by administrative fiat of some sort, and some people were not aware of prices. I will discuss how to deal with the former; the latter can be dealt with by interpreting prices as an incentive to buy or sell. Economists speak of prices as shorthand for factors that provide incentives to supply or consume. University professors, for example, perform academic and administrative services for their departments and universities even when there are no explicit prices. The incentives to do so are informal, signifying reciprocity and customary behavior. Nevertheless, if the burden of doing these jobs gets large, professors will do less. If the rewards for these activities increase – say by enhancing chances for promotion or getting a better office – they will do more. This kind of enhanced price is harder to observe than a market price, but it functions in the same way.

We distinguish between supply and demand because it often is the case that different people are behind them. This was true particularly in Roman cities, where food was brought from farms located in the countryside and sometimes far away. It was true within cities when craftsmen made clothing or oil lamps for others to utilize. Robinson Crusoe was both supplier and demander, of course, but it even makes sense to distinguish him as producer (determining supply) and consumer (determining demand). The distinction helps to clarify the role

of different forces affecting the allocation of resources even in such a simple economy.

The quantity demanded generally increases when the price falls. At lower prices, people can consume more; their money (in whatever form it takes) goes farther. In addition, people often want more when the price is lower; they may shift between goods to use more of the cheapest goods and leave some money left over for other things. If prices get much lower, then people may even think of new uses for a commodity. For example, the price of cotton fell dramatically in the Industrial Revolution, leading people to think of putting cotton sheets on the beds and cotton curtains on their windows.

These factors will differ in intensity for different goods, and economists use the concept of price elasticity to describe the extent to which the quantity demanded rises when the price declines. Unitary elasticity is defined to be when the proportional increase in the quantity demanded just equals the proportional decline in the price. Total expenditure stays the same. When the quantity demanded changes less than this, the demand curve is inelastic; when it changes more, demand is elastic. Demand is infinitely elastic if it is so elastic that even a very small change in price will lead to dramatic – even infinite – changes in the quantity demanded. In that case, the very high elasticity of demand keeps the price from varying. That is true in competitive markets, where the actions of any single person have no effect on the price. If the demand for houses, to return to the earlier example, is infinitely elastic, then the decision of any one person to put his or her house on the market will not have any effect on the price.

The quantity supplied generally increases when the price rises. As the price for a product increases, producers make and sell more. They can afford to use more inputs to produce their product, and they may enjoy greater return from the sale. The reasoning implicitly assumes that there are two inputs needed for production. Following a long tradition of classical economists, call them labor and land. If land is fixed, then increasing the number of workers will result in diminishing returns from each worker as more and more of them are added. It is diminishing returns that make the supply curve slope upward.

Supply and demand curves are shown in Figure 3.1. Economists normally draw the quantity on the horizontal x-axis and price on the vertical y-axis, and I have followed that convention here. Since the demand curve slopes down and the supply curve slopes up, they generally cross. This is shown in the figure as happening at Q^* and P^* . Let us ask what happens if the price is above P^* . The quantity of this

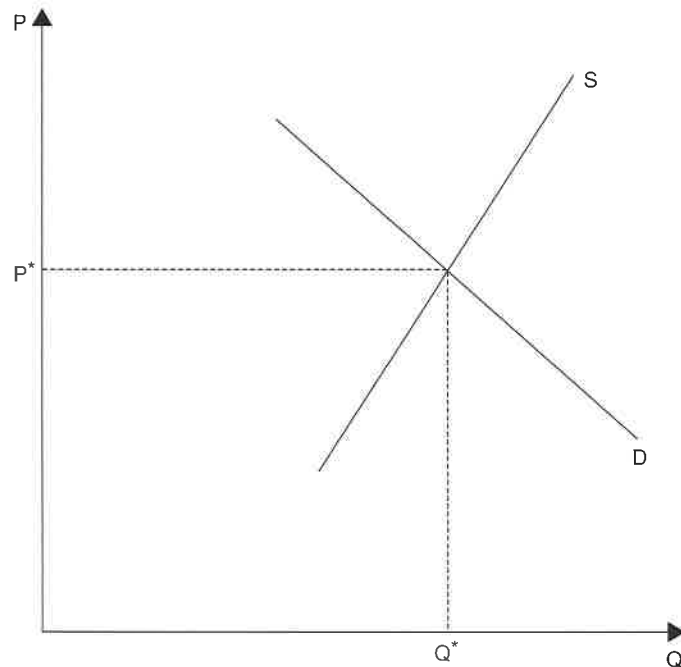


FIGURE 3.1 Supply and demand

good that producers want to sell is larger than Q^* , while the quantity that people want to buy is less than Q^* . Some of the goods produced will remain unsold, and producers will reduce their price to get rid of them. The price therefore will fall if it is above P^* . Similarly, if the price is below P^* , people will want to buy more of the good than producers want to sell. Producers will see that they can sell almost as much as before – each individual producer may expect to sell as much as before – if they raise the price. It will rise as long as the price is below P^* . Only when the price equals P^* will it stay at that level. We therefore speak of P^* and Q^* as the equilibrium level of this market.

Why do economists use this framework? The first reason is to understand *changes* in prices or quantities. For example, the production of wheat increased in Roman times. Looking at Figure 3.1, we see that the quantity is not likely to differ much from Q^* while the supply and demand curves stay the same. If the quantity of wheat produced rose substantially, we then can ask why it rose. We can ask if the supply curve, the demand curve, or both curves shifted to move Q^* to a new, higher level. Archaeological debates about innovations in agriculture focus on the supply curve, while thinking about feeding the city of

Rome is concentrated on demand. Thinking about supply and demand enables us to integrate these disparate analyses.

For example, a recent comparison of the supply and demand for wine and wheat in Republican Italy argued that there was not enough demand to support many large estates. It concluded that these markets were essentially competitive, earning limited profits for even large landowners and implying that, “We must remove the aristocracy’s formation of large, commercial estates from the central role they have long played in reconstructions of the social and economic developments in the middle and late Republic.”¹¹

The forces of supply and demand operate even in reciprocity and redistribution. There are no explicit prices in these cases, but examples abound. The Roman senate gradually changed in the second century *ci* from a group of Italian senators to a group from the provinces.¹² The separation of supply and demand leads us to ask if this was due to conditions of supply (the scarcity of rich Italians) or instead to demand (a desire to have a wider representation in the Senate). Hopkins famously tried to estimate the GDP of the Roman Empire to show that the tax burden was light.¹³ He clearly was motivated by the presumption that rising taxation would have led to disaffection from the empire, that is, that it would have been harder to maintain the tax rate as its burden increased.

A second reason to use this supply and demand framework is to describe the way in which people made decisions. While the demand for Roman wheat might have risen, each Sicilian or Egyptian farmer would only have known what price – or tax rate – he faced. We have several surviving comments about the prevailing price of wheat, some in normal times and more in unusual ones. The presence of these prices indicates that both farmers and consumers knew what the price was. We have no way of knowing how widespread this information was, but the quotations suggest strongly that this was general information. It makes sense therefore to see farmers as facing a competitive market in which their output was too small to affect the price. They then made their choices on the basis of what they saw as a fixed market price, just as farmers do today. We can use the tools of a competitive market to analyze the behavior of Roman farmers, even though we do not presume that they – or many more recent farmers – consciously saw themselves in what we now call a competitive market.

A third reason is to examine administrative decisions to see if they were effective or not. For example, wheat was given away in early imperial Rome under the *annona* for free or a very low price. This price

almost certainly was below P^* , the price that would have prevailed if the wheat was bought on some kind of free market. In that case, following the analysis of equilibrium, we expect that there should be pressure from consumers for more free distribution than the authorities planned to give away. The program expanded over time, and this analysis provides one reason why it did.

Two extreme cases are often spoken of by economists. The first one is the infinitely elastic demand curve. As noted already, this is a characteristic of a competitive market, where there are many producers all trying to sell their products in the same market. Transport and transaction costs in the ancient world kept many producers from competing head-to-head with others, but the abstraction gives us a benchmark against which to evaluate what we observe. Given that there were lots of farmers, vineyards, olive presses, makers of oil lamps, etc., the assumption of a competitive market can be very useful.

The second extreme case is when supply is completely inelastic, that is, the supply curve is vertical. A vertical supply curve says that the amount supplied is independent of the price. Paying a high amount or almost nothing will not affect how much is supplied. The most prominent example of this condition is agricultural land. When the Antonine and Justinianic Plagues struck the ancient world, they decreased the number of farmers, but they had no effect on the quantity of farmland. With fewer farmers seeking to work on the same amount of land, the price of land fell. Since the fall did not affect the quantity of land, we speak of this price as a rent, that is, a price that does not affect the allocation of resources. The more inelastically a good is supplied, the more its price resembles rent.

Rent seeking in the NIE consists of activities designed to capture economic rents. They do not encourage productive activity, but rather contest the returns to inelastically supplied goods and services. A thief, for example, does not produce anything; he steals things. In other words, he changes the ownership of existing resources, which is known as rent seeking. If we undertake activities like locking our houses or hiring body guards to deter thieves or assassins, that also is rent seeking. These preventive activities redirect activities that could be productive into unproductive pursuits; locks and guards are only used if thieves try to steal our possessions or others want to harm us. The existence of rent seeking causes the costs of purchasing to exceed the return from selling it; this discrepancy gives rise to what we call transaction costs, which include both rent seeking and anything else – like transport or information costs – that introduce a gap between the selling and buying price.

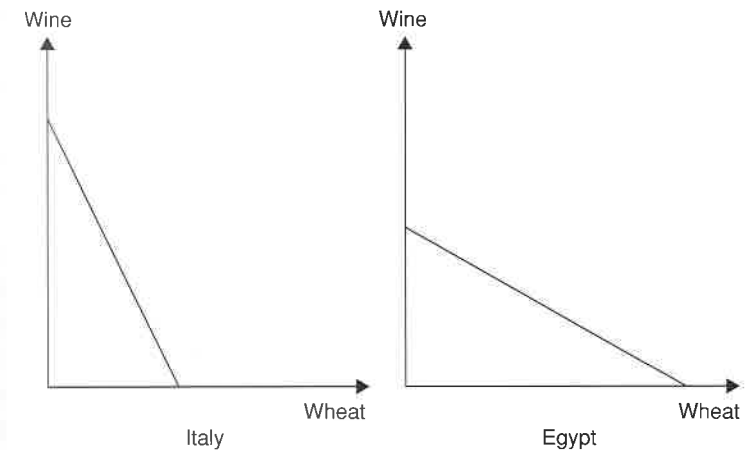


FIGURE 3.2 Production possibility curve

COMPARATIVE ADVANTAGE

David Ricardo presented the theory of comparative advantage 200 years ago; it has lasted as one of the most convincing arguments in economics, showing how trade can benefit both partners. It is a simple theory, but it requires a little background to be understood.

Every country has what economists call a production possibility frontier, or PPF. The PPF shows how much of any one good or service can be produced, given how much of the other goods and services are being made. This relationship is best seen in two dimensions, assuming that a country makes only two products. Let us call them wine and wheat. If we put wine on the vertical axis and wheat on the horizontal axis, we can draw a country's PPF. It will touch each axis where the country devotes all of its resources to the production of either wine or wheat, that is, if it specializes in one or the other. The PPF connects these two points. Ricardo assumed it ran in a straight line, assuming that the amount of wheat that needed to be given up to produce an extra unit of wine was not affected by the amount of wheat and wine being produced. He assumed there was a single input to production – call it labor – which was easily switched between the production of various goods. There was no second input like land and no diminishing returns.

This relationship is shown in Figure 3.2. I show in this figure a PPF for each of two countries or regions that might trade with each other. The curves differ from one country to the other, even though

both embody the same linear assumption. They differ in their slope. (The other possible difference – in height – will be discussed later.) One region, which we will call Italy, can make more wine more efficiently in terms of foregone wheat than the other region, which we will call Egypt. Egypt is well suited to growing wheat and needs to transfer a lot of resources from growing wheat to increase its wine production. The PPF for Italy therefore is steeper than the PPF for Egypt.

Consider the PPF for Italy. Where the PPF hits the vertical y-axis it shows how much wine would be produced in Italy if all the labor in Italy was used to produce wine. Where the Italian PPF hits the horizontal x-axis, it shows how much wheat would be produced if all the labor was used to produce wheat. If Italian agriculture was not completely specialized in wine or wheat, then total Italian production is shown by a point on the PPF between these extreme positions. The slope of the PPF shows the (constant) amount of one product that has to be foregone to produce more of the other. The ratio of the prices of the two goods is the *inverse* of this slope. Since Italy can make so much wine if it chooses to specialize in wine production, wine is cheap in Italy. The same reasoning applies to Egypt, where the PPF is flatter because Egypt is more suited to growing wheat. Wine therefore is more expensive in Egypt than in Italy because wine is scarcer – as represented by the flatter PPF.

It is the difference in the steepness of the PPF between the two countries that allows them to have comparative advantage and gains from trade. I have drawn the curves about the same level, but nothing rests on that. Assume for a minute that Italy is more efficient at producing both wine and wheat than Egypt. If the two PPF curves have different steepness, it still will be worthwhile to trade. For example, consider a lawyer who is the best lawyer in town and also the best typist. She has an absolute advantage over her secretary, even though the secretary has a comparative advantage in typing. The secretary can do a lot of typing for each unit of law services he omits, even though he does less legal work and typing than the lawyer in any time period. It makes sense for the lawyer to specialize in doing law and delegate her typing to her secretary, even though she is better at both. Despite the lawyer's absolute advantage in both activities, she still can gain by exploiting her *comparative* advantage in legal services.

Return to Figure 3.2. If there is a market, then the price of wine in terms of wheat will be higher in Egypt than in Italy, since the PPF is flatter. If farmers cannot sell wheat on any kind of market, they will make the choice of product by comparing the relative outputs they

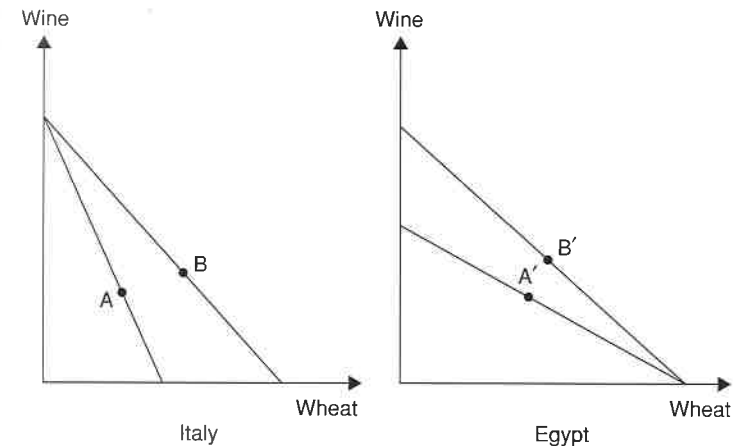


FIGURE 3.3 Effects of trade

can get from their limited resources. We can express this choice as expressing what economists call the “opportunity cost” of producing wheat or wine. That is the amount of the product *not* grown in order to produce the one that is grown. The opportunity cost functions exactly the way the price does in a market, and I use price as a generic term to include both market prices and opportunity costs. Egyptian farmers would like to produce wine due to its high price; the flat PPF shows that they cannot do so with Egyptian resources.

Now assume that trade is introduced between Italy and Egypt. Wine is more expensive in wheat units in Egypt because the opportunity cost of producing wine is larger than in Italy. Egyptians then will want to export wheat to get wine, which is relatively cheaper in Italy. Italians face exactly the opposite incentives. Wine can be produced easily in Italy, and the Italians will be happy to import wheat, which is harder to grow (relative to wine). Trade will make both countries or regions better off.

The benefits are shown in Figure 3.3. The price of wine was higher in Egypt before trade, and the price of wheat was higher in Italy. Once trade is allowed, both countries will have the same price ratio (in the absence of transport costs), which will be in between the initial price ratios in Italy and Egypt. The price of wine will fall in Egypt, allowing people there to get more wine for a given opportunity cost in wheat. Italy will use its resources to produce wine, getting its wheat by importing it. The initial consumption might have been at a point like A on the Italian PPF. With trade, Italy can now consume at point

B, above the PPF and unobtainable without trade. Similarly, Egypt will use its resources to produce wheat and increase its consumption of wine and wheat from A' to B'. The price of wheat in terms of wine will fall in Italy, and rise in Egypt. The price of wheat in terms of wine, or of wine in terms of wheat, will be the same in both countries.

Adam Smith wrote that the division of labor was limited by the extent of the market. Trade extends the market between countries or regions and thereby promotes the division of labor. This is one way in which the extension of trade increases the earnings of workers. Of course, if different regions or countries have resources unique to that locale, trade also allows these resources to be used for the benefit of the whole trading area.

Three extensions of this basic theory should be mentioned. First, what will be the new, common price of wine in terms of wheat? We know only that it must be between the original prices in Italy and Egypt, and the theory explained here does not contain enough detail to demonstrate where in this range it will lie. The position depends on the volume and elasticity of supply and demand for the two goods in the two countries or regions. In particular, large countries or regions that have large supplies and demands have much more effect on the eventual price than small countries. (This is where the height of the PPF is important.) When Britain was brought into the Roman trade network, it got many more gains from trade than the rest of the Roman world. Interregional trade benefits both regions, but taxes may offset some of the gains. For example, much of the wheat sent to Rome from Egypt was tribute. We clarify the effects of this tribute by dividing it into two parts. Trade improved access to all products in both Rome and Egypt. Tribute transferred some – or perhaps all – of this gain from Egypt to Rome.

Second, Ricardo drew the PPF as a straight line, but economists now generally draw it curving above a straight line. A convex PPF describes an economy in which there are diminishing returns to the production of wine and wheat. Here we consider two inputs to production, land and labor. If land cannot be transferred easily between different crops, there will be diminishing returns to labor in each activity. (This is the assumption that makes supply curves slope upward.) As the economy moves away from specialization in, say, wheat, it produces the first unit of wine by sacrificing only a tiny bit of wheat. In a position away from the axes where the economy is producing both wine and wheat, the economy has to give up a larger amount of wheat to free enough resources to make more wine. The gains from trade are

the same as before with this complication, assuming that the internal price ratio of the goods differed initially in the two countries. The difference is that while countries will concentrate in the production of goods where they have a comparative advantage, they generally will continue to produce some of the other good as well. They will only specialize completely as shown in Figure 3.3 if the cost structures in the two countries are very different.

Third, the model as stated assumes that there are no transport costs when trade is allowed. That is why the price lines with trade in Figure 3.3 have the same slope in both graphs, indicating that the relative prices of wine and wheat were the same in Italy and Egypt. In antiquity, transport costs often were quite high, both because of the cost of transporting goods and because of administrative costs like duties and verification. If there are significant transport costs, the price ratios in the two countries will not approach equality. Instead, they will remain apart by the cost of the transport. If this wedge is large enough, it may preclude trade even if the costs of production in the two countries are different.

Transaction costs never completely eliminate trade. Very rare and expensive goods can be traded profitably even if transaction costs are high. Before the Pax Romana, jewelry and royal objects were traded around the known world. But high transaction costs prevented trade in cheaper goods, like wheat. Only when costs were low did trade extend to bulk commodities and the articles of common usage. This kind of trade flourished in the early Roman Empire, but it had existed earlier across the Mediterranean Sea. Two Phoenician ships sank in deep water during the eighth century BCE, each carrying 400 amphoras of wine. Their documentation has been lost, and we do not know why they were sailing, but it makes sense to infer that the people who sent 800 amphoras of wine into the center of the Mediterranean were engaged in interregional trade.¹⁴

The New Institutional Economics reminds us that transaction costs may be affected by institutions as well as transport costs. Trade requires not only shops or carts, but also ways to compensate prospective merchants for their efforts in bringing goods to strangers. The means of payments, the security of contracts – even implicit ones – are aspects of the institutions that promote trade. Kessler and Temin describe some of the ways Roman merchants made sure that goods shipped were the same as goods received, that bills were paid, and other aspects of trade were performed with relatively little cost to the people involved in trade.¹⁵

The extensive grain trade across the Mediterranean in the late Roman Republic and early Roman Empire is well known.¹⁶ Using a complex version of the theory of comparative advantage, Geraghty showed that the growth of Mediterranean trade led Roman farmers in the Italian countryside to shift from wheat to wine.¹⁷ This model allowed Geraghty to conclude that while free labor in Italy lost income as grain prices fell, their loss was largely offset by economic opportunities in the city of Rome and the *annona*. Kessler and Temin argued that the grain trade in the Mediterranean in this period led to the integration of prices across the whole area.¹⁸ Wheat prices were lower in places far from Rome, such as Spain and the Middle East. In fact, the price discounts look like the cost of transporting wheat across the sea, implying that the price of wheat was equalized around the Mediterranean under the Pax Romana, subject only to the effect of transport costs.

ECONOMIC GROWTH

Hopkins proposed his famous taxes-and-trade model of the Roman economy in 1980. He argued that the Roman collection of taxes stimulated monetization and economic growth in the early Roman Empire.

This simple model implies a whole series of small-scale changes in production, distribution and consumption, whose cumulative impact over time was important. There was a significant increase in agricultural production, an increase in the division of labor, growth in the number of artisans, in the size of towns where many of them lived, development of local markets and of long-distance commerce.¹⁹

Hopkins suggested a variety of ways to discern economic growth in this passage: the growth of agricultural production, non-agricultural production, towns, and trade. None of these indicators, however, indicates directly how fast economic growth progressed. They need to be inserted into some kind of framework to result in an estimate of Roman economic growth. Hopkins' accompanying estimate of the level of production does not help because it was derived by analogy with modern conditions and does not point toward the use of ancient evidence at all.

To provide evidence of economic growth, we need to define what we mean by this comprehensive term. The best measure is the growth

of goods and services produced per person. This is a more restricted measure than changes in welfare because it looks only at the goods and services produced by the economy. All other things being equal, an increase in these goods and services should increase welfare, but other things may not have remained the same when economic production increased. The growth of goods and services produced per person also is a better measure of economic growth than the structural change used by Hopkins, for an economy can grow in many ways and with many different types of structural change. It is the results of structural change that are of interest to historians trying to discover the effects of events, institutions, and political decisions on the lives of ordinary people.

Economists speak of the growth in goods and services produced per person as intensive growth as opposed to extensive growth – the growth of *total* goods and services. Since population is in the denominator, growing population does not indicate economic growth. We use the product of economic growth and population growth to discuss military power, but discussions of economic growth typically take population to be determined by other factors. The interaction of population and economic growth will be discussed more in the context of the Malthusian model.

Goods and services are produced by workers and other factors of production like land and capital. These factors of production must be paid, perhaps by wages and rents, perhaps by other less formal means. Economic growth therefore can be measured either by examining the goods and services produced or the incomes received. Taxes and other charges by landowners or warlords may interfere with the equation of goods and services with incomes, but this is more of a concern for large modern governments than ancient ones. The terms 'per capita income' and 'per capita production' can be used interchangeably when discussing ancient economies.²⁰

The growth of trade discussed in the last section clearly increased Roman incomes. Exploiting the gains from trade brings only temporary economic growth as the gains are realized over time, but these temporary gains might have lasted over a century to produce gains that are apparent even now. Increasing the efficiency of production, particularly in agriculture, also led to economic growth. Terracing was common, extending the range of land on which crops, particularly grapes and olives, could be grown. Wine and oil presses also used the Archimedean screw, enabling grapes and olives grown on new land to be processed more efficiently. The screw was used widely in cereal agriculture to drain land, extending the range of land that could be used

for this crop as well. Our evidence is spotty, but evidence from many different areas suggests that these innovations had diffused over large ranges of the Roman Empire.²¹

Evidence of widespread improvements in consumption is accumulating, and Roman citizens must have had increasing incomes to buy the enhanced food and consumer durables. Jongman cited a variety of estimates showing that real wages, that is, the purchasing power of wages, increased in the late Republic and early Empire.²² He surveyed the occasional evidence of documented wages, subsistence annuities, and slave prices – as an index of wages of free workers with whom Roman slaves competed. The data for any one of these measures is spotty, but the pattern of all of them is the same. This common pattern suggests that the occasional observations are capturing underlying trends whose existence is attested to by the variety of evidence that fits the pattern. Real wages rose after the Antonine Plague and fell unevenly after that. Labor income was the major part of total income in the agrarian society of ancient Rome, and an increase in real wages is a good index of an increase in total income.

How could there be economic growth in a basically Malthusian world? To answer this question, it is necessary to explain how the Malthusian model works. Malthus argued two hundred years ago that the size of a population was limited by the resources available to feed it.²³ By resources, most people mean land, understanding that the way land is used and other resources may be relevant as well. This Malthusian relation is known to economists today as the declining marginal product of labor when the number of workers on a given plot of land increases. Economics is called the dismal science because of this limitation on the ability of land to support a growing population. A larger population means that each person has less food and other products, that is, each person is poorer than he or she would have been with a smaller population. This is the same assumption used to generate an upward-sloping supply curve and convex PPF earlier.

For most workers near a Malthusian equilibrium, their diet consisted largely of grain in one form or another. We therefore approximate their real wage by looking at the ratio of the money wage to an index of the price of goods workers bought, giving grain a heavy weight in this index. If we divide money wages by the price of grain alone, we get a measure of the marginal product of labor, since farmers typically hire workers up to the point where the last (marginal) worker produces just enough grain to pay for the wages he earns. For ancient times, the real wage and the marginal product of labor can be taken as equal since

farm workers often based their diet on the products they produced and we lack data to differentiate the two magnitudes.²⁴

Return to Figure 3.1 and interpret it as showing the supply and demand for labor. The marginal product of labor is the demand curve for labor. An employer will hire workers up to the point where the marginal product – the increase in production gained by adding the last worker – equals the wage. If the employer hires more workers, the increase in production does not pay for the added workers. If the employer hires fewer workers, the last worker hired contributes more than his or her wage and the employer can see a way to increase output (production) more than input (wages) by hiring more workers. While the figure shows the total supply and demand of workers to the market, each farmer sees only the price he can get for his product. He faces a horizontal demand curve for his output, and he hires workers up to the point where the marginal product of workers equals this price. In ordinary markets, competition between workers will ensure that the decisions of individual farmers lead to the equilibrium of supply and demand in the labor market.

This explanation is for a profit-maximizing employer hiring workers in a market economy. This setting may have been the exception rather than the rule in the ancient world, but the logic of labor demand still holds. A Roman farmer or owner of a large estate had to consider how many workers, free or slave, to employ on his land. While he did not use the same language we use today, he saw the same gains and losses from using more or less labor. Given the imperfect recording of production long ago, we cannot expect any precision in the farmer's decision, but we expect the reasoning from modern markets to indicate the direction in which ancient employers tended to move. In particular, following the model of supply and demand explained earlier, we can expect ancient farmers to respond to changes in the environment in predictable ways.

Malthus needed an additional relation to find an equilibrium point on this line. Malthus did this by specifying a relation between worker's wages – taken to be their income – and their birth and death rates. Births rise with income, both as nutrition rises and as younger marriages become feasible. Death rates fall as income rises, infant mortality declines, and plagues, wars, and pestilence become less frequent. Modern research has confirmed the first of these relations, while generally failing to find convincing evidence of the latter.²⁵ For most purposes, only one relation is needed, provided the other one does not operate in the reverse direction.

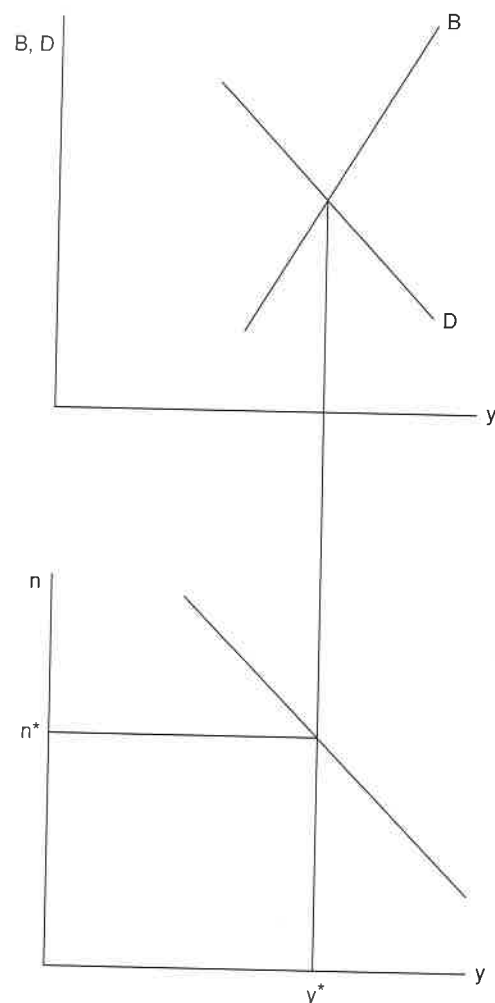


FIGURE 3.4 The basic Malthusian model

The preceding discussion is summarized in Figure 3.4. The horizontal axis on both graphs is the same: per capita income, represented by y . (Isn't it odd that economists often graph income, represented by " y ," on the x -axis?) The top graph shows the determination of population size. Population grows if births exceed deaths; it falls if births fall short of deaths. The equilibrium is where the birth and death rates are equal, at y^* . The bottom graph shows that the resource constraint permits only a limited population size, n^* , at this income. Note that the model works well even if there is no relation between income and the death

rate. If the curve marked D in the top graph is horizontal – that is, if it shows the death rate unaffected by income – y^* is still the equilibrium, and the analysis proceeds as before. The full Malthusian model was taken to restrict the range of early history. Clark's description is clear: "Anything that reduced the death rate schedule – advances in medical technology, better personal hygiene, improved public sanitation, public provision for harvest failures, peace and order – reduced material living standards [by increasing population]." ²⁶

Consider the effect of a plague, like the Antonine or Justinianic Plagues, in this model. Let us assume that the population fell by approximately one-third, without aiming for spurious precision. The effects are shown in Figure 3.5. Population fell from n^* to n_1 . As population fell, income rose above the previous equilibrium income, y^* , because the marginal product of labor rises as population falls. Birth rates exceeded death rates at this higher income, as shown in the upper graph. Population grew as a result. It continued to grow until income was reduced to its previous level, y^* , where births and deaths were once again equal. As can be seen in the lower graph, per-capita income was unchanged at the new equilibrium, and the population returned to its former size.

Figure 3.5 shows two arrows. The horizontal one shows the effect of the plague, which reduced the population rapidly. The economy moved quickly along this arrow to the new point on the PPF. Then the excess of births over deaths slowly began to move the economy along the second arrow and bring the economy back to its equilibrium. Even though the two arrows look the same on the graph, they describe very different processes, one fast and one slow.

How long did this whole process take? We do not have much evidence from the Roman plagues, but we know more about the aftermath of the Black Death of 1349 in England. Immediately after the plague, money wages of farm workers shot up. For the Malthusian model, however, we need to know the path of real wages, that is, the extent to which the rise in money wages exceeded the rise in the price of grain and other consumables.

Real wages did not rise nearly as fast as money wages in the immediate aftermath of the plague. Instead they rose gradually and peaked a century after the plague, in the middle of the fifteenth century. It took a very long time for the Malthusian system to return to its equilibrium. It cannot be surprising that the return to the Malthusian equilibrium took a long time. Higher incomes after the Black Death may have resulted in earlier marriages, which in turn led to more children. But it took a generation or more for the effects of this change

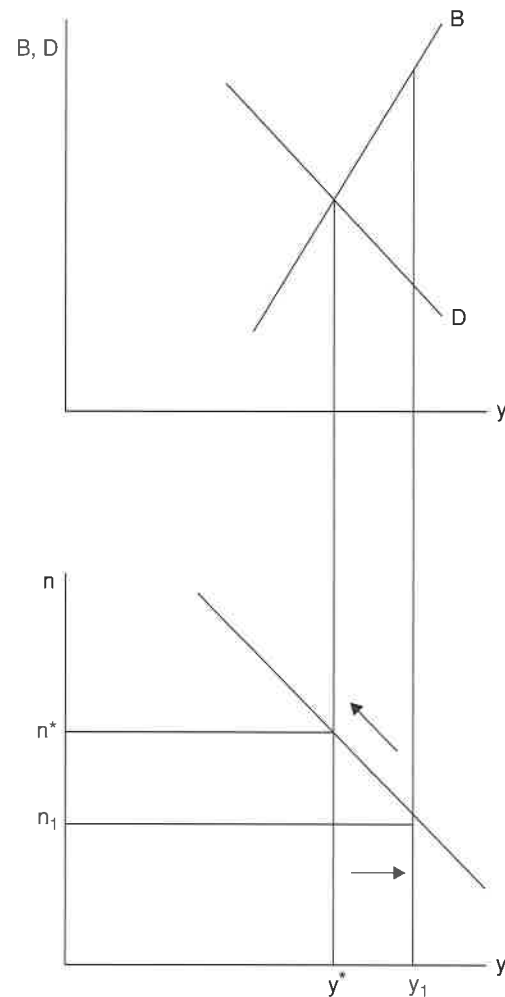


FIGURE 3.5 Effect of a plague

to become apparent in the agricultural labor market. If women changed their behavior slowly, it might have taken several generations to lead to population expansion. And when we start talking about generations, it requires only a few generations to make a century of delay. While we do not know much about family dynamics in the late fourteenth century, we do know that real wages did not start to fall until a century after the Black Death.²⁷

This is consistent with the limited evidence from the Antonine Plague. Scheidel collected fragmentary wage and price data from

Roman Egypt in the second and third centuries.²⁸ The ancient sources are not frequent enough to provide the detailed timing evidence of the Medieval data, but they suggest a long period after the plague when wages were high. If we regard the observations as random draws from records of wages and prices in the two centuries, we are implicitly assuming that the effects of the population decline in the Antonine Plague lasted as long as the decline after the Black Death. The rise in the real wage, that is, the ratio of wages to commodity prices, was smaller in the ancient world, however. Real wages were less than half again as large in the third century as in the second century, while real wages peaked at twice the pre-plague level in the 15th century, suggesting that the Antonine Plague was not as severe as the Black Death.

Consider now a different "shock" to the Malthusian system. Instead of assuming that the size of the population changed, assume that the Malthusian resource constraint shifted outward. This change could come from trade and regional specialization permitted by the Pax Romana. It could come from technological change that allowed land to be used more efficiently. It shifts the line in the bottom graph of Figure 3.5 to the right. For any given population size, the available land now allows the marginal product of labor and income of farm workers to be higher than before.

As shown in Figure 3.6, this sets up a population expansion. In the short run, the effects of this "shock" on per capita income are the same as the results of a plague shown in Figure 3.5, but for different reasons. The population changed dramatically during a plague, but it changes more slowly under normal conditions. Per capita income can change more rapidly, and it increases in the short run, leaving population unaffected. In the longer run, however, the equilibrium has changed. The excess of births over deaths causes population to rise. Equilibrium is reached when income returns to its previous level in the upper graph, y^* . Looking at the lower graph, we see that the population is larger at the new equilibrium than before, at n_2 instead of n^* . The effect of technical change has been to increase the size of the population, not per capita income, in the Malthusian equilibrium. As in Figure 3.5, the initial movement shown in the initial horizontal arrow was much faster than the subsequent movement shown in the diagonal arrow.

Note the differences between Figures 3.5 and 3.6. In both of them, income increases, setting off a rise in population. This is a rightward shift in both graphs. Although population grows in both graphs, the relation of this growth to the prior level of the population is different. In Figure 3.5, the population is always lower than n^* , and the growth

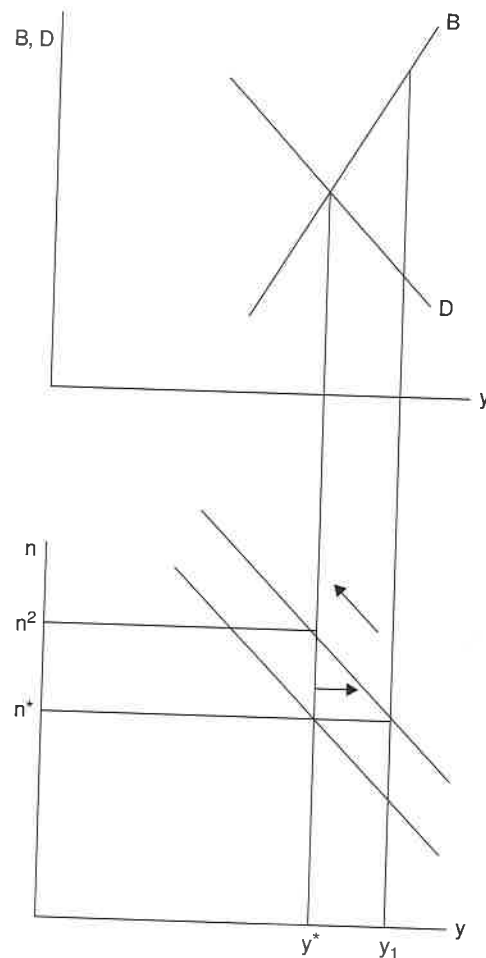


FIGURE 3.6 Effect of technical change

is only to regain the losses from the plague. In Figure 3.6, by contrast, population is always larger than n^* , as improved technology allows for a larger population. If the shift in the resource constraint is a one-time movement, then the population settles down to a new equilibrium level, n_2 , larger than n^* .

As before, the economy will not move instantly to this new equilibrium. It will take a long time, perhaps more than a century. During that time, per capita income will be high and population will be growing. If the new technology diffuses slowly or perhaps continues to improve, then the resource constraint curve will continue to shift

outward for a while instead of simply jumping from one position to another as shown in Figure 3.6. In that case, both incomes and population will continue to increase for quite a while before the pull of the Malthusian equilibrium is felt. If the resource constraint continues to shift outward for a while, then income can stay above y^* , Malthusian subsistence, for more than a century. If productivity continues to advance indefinitely, income can stay above y^* indefinitely.

Equilibrium in the Malthusian model shows constraints that operate on agrarian societies in the long run. The slow transition to a new equilibrium after a shock shows how Rome could have experienced economic growth for well over a century. Economics provides a coherent theoretical basis for debates about Roman economic growth.²⁹

CONCLUSION

This paper summarizes a variety of economic models and techniques that can help ancient historians interested in economic affairs. Illustrations of existing uses of these tools have been noted, and readers of this essay are encouraged to read them, gather more details about these tools, and extend the use of these tools in ancient history. The aim of these tools is to clarify the economic basis of Roman and other ancient cultures; they do not presume that these societies operated like modern economies, as noted throughout the discussion. Even without explicit market activity, supply and demand, comparative advantage, and Malthusian influences were very important in the ancient world. These models and regression analysis are useful additions to the tool boxes of ancient historians.

NOTES

- 1 At www.stanford.edu/~scheidel/CCRE.htm.
- 2 Polanyi 1977: 35–40.
- 3 Temin 1980.
- 4 Temin 2002.
- 5 Hopkins 1978: 99–102.
- 6 Eisner 1989: 26.
- 7 Temin 2001.
- 8 North 1981, 1990.
- 9 Acemoglu, Johnson and Robinson 2001.
- 10 Scheidel, Morris and Saller (eds.) 2007: 651–741.
- 11 Rosenstein 2008: 23.
- 12 Eck 2000.

- 13 Hopkins 1980.
- 14 Temin 2006b.
- 15 Kessler and Temin 2007.
- 16 Rickman 1980; Erdkamp 2005; Morley 2007a.
- 17 Geraghty 2007.
- 18 Kessler and Temin 2008.
- 19 Hopkins 1980: 102.
- 20 Temin forthcoming b.
- 21 Wilson forthcoming a.
- 22 Jongman 2007a.
- 23 Malthus 2004.
- 24 Clark 2007a.
- 25 Lee 1980.
- 26 Clark 2007b: 27.
- 27 Clark 2007a.
- 28 Scheidel 2002.
- 29 Millett 2001; Saller 2002; Jongman 2007a; Scheidel 2009a.

4: HUMAN CAPITAL AND ECONOMIC GROWTH

Richard Saller

Economists seeking to explain the unparalleled economic growth of the nineteenth and twentieth centuries have paid increasing attention to human capital – that is, the education, training, and health of the labor force. Over the past two centuries higher levels of education have provided the foundation for discovery of new knowledge and the resulting technological advances needed to sustain growth over long periods at unprecedented rates. Training and education of the work force has enabled the technology to be used in economic production. And the life span and health of the population have improved to permit longer life spans and more intensive use of the skills. The magnitude of these gains is striking, as the average life span has more than doubled and the productivity per worker has increased by an order of magnitude in the most developed economies.

Roman historians have considered various aspects of the subject, but none has conceptualized a study of the Roman economy based on human capital. This is not surprising, since only in the second half of the twentieth century, when investments in human capital have come to dominate investments in physical capital, has it become clear to economists that the quality of labor is a major driver of growth. In the absence of reliable quantitative data for Rome, this chapter aims to provide a description of the levels of education and training of various sectors of the Roman labor force, an analysis of the extent of institutionalization of education and training, and some broad comparisons with other pre-industrial economies in order to assess Rome's level of economic development. The challenge is to add precision to the assessment of Keith Hopkins (1995/96) of "modest, though significant growth" of the Roman economy.¹ While it is not possible to calculate a growth rate with any confidence, it is possible to assess Roman institutions for education and training against those of other pre-modern economies. I will argue that Roman imperial levels of urbanization, education, and literacy (unsurprisingly) exceeded those of previous societies, but