A critical introduction to

Macroeconomic Analysis

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Introduction

Macroeconomics and macroeconomic policies

In macroeconomics we study economic activity within the system in its entirety; phenomena such as growth, inflation and unemployment are analysed, and how the existing institutions (e.g. the country's government and central bank) can influence these phenomena through policy measures or changes to the rules of the game.

Generally you might suppose that enlightened economic policy (as with all other policies) should aim to achieve the best possible outcome for the country's inhabitants, and potentially others (such as future generations or inhabitants of other countries). However, to make the policy problem manageable, we need to have more specific targets which apply in different areas (health, education, the economy, etc.). With regard to management of the economy we focus on three key measures of success: (i) *a high level of production of goods and services (i.e. GDP), both today and in the future*; (ii) *a high degree of inclusivity in the economy, and thus low unemployment and low inequality*; and (iii) *a high degree of predictability and stability in the macroeconomic environment, and thus security for economic operators*. In short, high growth, low unemployment, and stability. In the final chapter (forthcoming!) we also consider the goal of high environmental quality and long-run sustainability. To some extent the goals overlap, in the sense that if policy makers focus on one of the targets, the others may also be met as a spin-off. For example, a stable economy provides a good basis for growth, and having a lot of people who are unemployed is obviously not conducive to high GDP, other things being equal. But the goals do not always go hand in hand. For example, achieving stability and low unemployment is relatively easy in a planned economy, but at the expense of the dynamism in the economy which leads to economic growth and thus high GDP in the future.

Studying macroeconomics provides a glimpse into the world of economic policy and politics. Why is there unemployment, and why do the different political parties disagree on how it should be addressed? Why do we have an independent central bank? Every citizen should understand basic macroeconomics! Furthermore, it's incredibly fun and interesting.

This book

In macroeconomics, as in all science, we build models to try to understand a complex reality. These models can be precisely specified in the form of mathematical equations, or they can be more loosely defined verbally. In economics there is a strong preference for mathematical models because they allow for an unambiguous derivation of the results from the assumptions, meaning that shoddy or downright incorrect verbal reasoning can be avoided. Therefore I try to use exactly (mathematically) specified models as much as possible in this book.

There is an obvious problem with this approach: how do you make the models sufficiently easy to understand while highlighting the key issues in macroeconomics, i.e. growth, unemployment, and the business cycle? My goal is to present only very simple models—in which concrete and precise assumptions lead to concrete and precise results—and then I discuss what we can learn from the model that is relevant for understanding the real (complex) economy. Often the reasoning is so simple that it need not even be derived mathematically, but sometimes you need a little simple mathematics.

Another thing that sets this book apart from the crowd is that we put the money at the centre of the analysis. Without money, we have either no trade at all, or barter. Nor do we have financial assets or liabilities. (This is true by definition, since a promissory note is a form of money.) Without money there is no inflation, no interest, and no business cycle. Furthermore, there are no currencies or currency exchange rates. In short, money is the key to a modern economy in which agents specialize in different activities as well as working in groups for firms. In order to trace the path of money through the economy, we use the *the circular flow*, an image in which the main characters (or agents) are households, firms, the government, and the banks. Everything is ultimately owned by the households, but all of the agents are involved in economic transactions. The circular flow shows the movements of money associated with such transactions.

Note that money can be coins and bills, but can also be other things: if I have money at the bank it does not mean that the bank has a stack of gold coins—or even paper banknotes—in a safebox with my name on it. Rather, it means that the bank's computerized accounts show that it (the bank) owes me money. Furthermore, it means that I have the power, at short notice, to purchase goods and services from other agents by transferring that 'money' to them.

Outline of the book

We start with the simplest possible economy and build gradually on the complexity of the analysis.

- *An economy without money*. We begin by considering an economy without money. In the simplest case we assume a village on an isolated island in which all decisions about resource allocation are made together. How does such an economy work? How can we characterize the production process, is saving and investment possible, and can production in the economy grow in the very long run? Is there unemployment in such an economy? How does the economy respond to external shocks? The purpose of this analysis is to provide a benchmark against which to compare the market economy which is the main subject of the book. We find that the market facilitates growth of productivity in a modern economy, and thereby also facilitates growth in GDP. However, the market system also creates the business cycle and contributes to the existence of unemployment when compared to the economy without money.
- *The circular flow, money, and interest*. In this chapter we focus on learning concepts and understanding how the economy as a whole works. We do this primarily through tracing the path of money and goods through the economy. We do not tackle our overall goals for the book, which are to understand, explain and predict economic growth, unemployment, and the business cycle. However, we building a solid foundation to be able to do so in future chapters. We introduce the key players in our story, known in economics as *agents*: these are households, firms producing goods consumption and investment goods, firms in the financial sector, the government, and the central bank.
- *Economic growth*. In the next three chapters we study economic growth, i.e. growth over time in the value of goods and services produced in the economy. We find that the key to long-run growth is technological progress which drives increases in efficiency. How to achieve such progress depends on the initial state of the economy: an economy far from the technological frontier can borrow technologies from leading economies, and rapid growth is linked to large investments in modernization of the capital stock; an economy at the technological frontier needs to create incentives which encourage innovation.
- *The business cycle*. In the next three chapters we focus on the business cycle, in particular we learn what drives business cycles from a Keynesian perspective, and analyse how *fiscal policy* and *monetary policy* can be used to manage the business cycle. We begin with extremely simplified economies, and build up the complexity of the models gradually. We find that recessions are typically triggered when an increase in household saving is not matched by an increase in firm investment. Regarding stabilization policy, the role of expectations is crucial, explaining why governments cannot achieve the holy grail of high growth and low unemployment through expansionary policy.
- *Unemployment*. We devote two chapters to the analysis of unemployment. Why are there not jobs for all? Or, why are there jobs 93 percent of those who wish to work, but not the other 7 percent? We show that there are a range of alternative explanations, most of which have a degree of truth in them. Note that the most important explanations have at least as much to do with the behaviour of those who *have* jobs, compared to the behaviour of the unemployed.
- *Open economies*. Finally, we open up our economy to international trade. How does trade work? (The circular flow.) How does trade affect growth, unemployment, and the business cycle? What is the best system for managing national currencies and exchange rates in the presence of trade? What causes crises such as the recent one in the euro area?

CHAPTER 1

An economy without money

We begin by considering an economy without money. In the simplest case we assume a village on an isolated island in which all decisions about resource allocation are made together. How does such an economy work? How can we characterize the production process, is saving and investment possible, and can production in the economy grow in the very long run? Is there unemployment in such an economy? How does the economy respond to external shocks?

Note that an economy without money is conceivable in the cases described below, with 100 people on an island. However, a modern economy without money is almost inconceivable because of the enormous difficulties that would arise in allocating resources: who should work where, which individuals should receive which goods, and so on. So the purpose of this analysis is not to argue that an economy without money would be a good idea; rather, it is to provide a benchmark against which to compare the market economy which is the main subject of this book. We find that the market—apart from facilitating efficient allocation of resources—facilitates growth of productivity in a modern economy, and thereby also facilitates growth in GDP; however, the market system also creates the business cycle and contributes to the existence of unemployment when compared to an economy without money.

1.1. Production in an economy without money

MODEL ECONOMY 1.1. *Assume an island community with 100 people, without money. The group decides collectively what job each individual should do—agriculture, silviculture, hunting, building, etc. —and then they share the goods produced. Population is assumed constant.*

Before proceeding, we draw a simple picture of the production process, Figure 1.1. Here we have households on the left, and the economic arena to the right. (This will be where firms belong later on.) When individuals go to work they put work-hours into the economic arena on the right, as shown by the lower arrow. In the workplace they produce goods and services, which go to households via the upper arrow. Thus there is a flow of inputs (labour) into the production system, and a flow of outputs (goods and services) back to households. When we analyse the market economy there will be corresponding flows of money in the opposite directions, payments for hiring labour and purchasing goods and services.

Now to gross domestic product, GDP.

DEFINITION 1. *GDP is defined as the total (gross) value of all the goods and services produced in an economy during a year (or some other specified time period). It is denoted Y.*

In model 1.1 GDP is the value of the consumption goods produced, denoted C. We thus have

$$Y = C.$$

Because there are no markets it may be hard to work out what Y actually is, since it should be measured in monetary units (such as USD/year). However, we assume that although there are no markets in this economy, its production can be valued on international markets. We assume that $Y = 20\,000$ USD/year, and hence that y (GDP per capita) is 200 USD/year.

1.2. Increasing production: Economic growth

How might the members of society increase their production? First let us characterize the production process as the use of three types of input—labour, land, and capital—in order to produce of flow of goods and services. (A fourth possible input, non-renewable resources, will be discussed later in the book.) Given this characterization it is straightforward to categorize all the possible ways of boosting production: the islanders must either raise the quantity of one or more of the inputs, or their quality.

1.2.1. Raising quantity. In this section we show that the islanders can raise the quantities of labour and capital, but that this cannot give growth in the long run: working harder or longer hours rapidly hits physical limits, while investment in capital goods (such as tools) may give short-run growth if capital is scarce initially, but it cannot—on its own—give long-run growth.

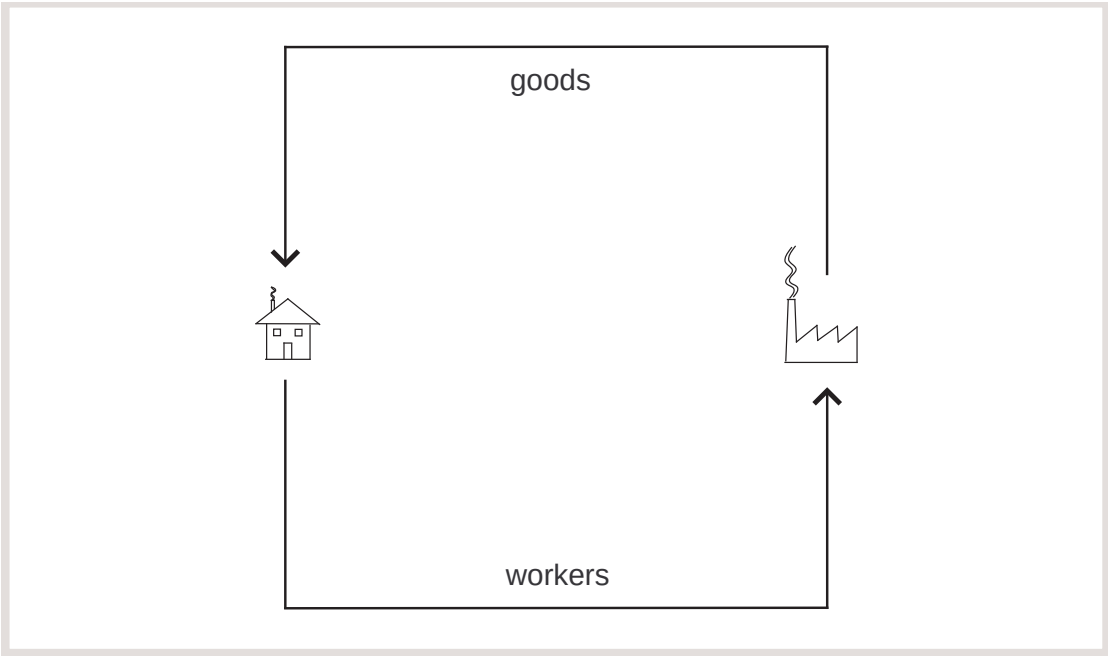


FIGURE 1.1. Model economy 1.1

It is easy to see that the possibilities for growth through raising the quantity of labour are limited. Since we assume the population is fixed, the quantity of physical labour supplied per day can be boosted if the villagers work harder (either more intensively, or longer hours). However, there are of course limits to how far they can get using that method; there are only 24 hours in a day. Thus they cannot achieve economic growth in the long run this way. On the other hand, if we let the population grow we may get growth in total production, but there are two problems: firstly, land will become scarce; and secondly, we are really interested in GDP per capita rather than total GDP, and GDP per capita will not rise when the population rises.

Another obvious way to boost production is to use more land. However, for simplicity, we assume that land is fixed; they are, after all, on an island. So again, using more land cannot yield economic growth in the long run.

The third input is capital. Capital is defined as the fruits of productive effort *retained for future use* rather than *consumed*, and it is therefore variable. Capital is an extremely important concept. In reality there is a grey area between 'pure' consumption goods such as food, and 'pure' capital goods such as machines in factories. Consider for instance a car: is it a consumption good or a capital good? What about a battery? We draw the line between goods which are used by firms to produce further goods, and goods that are used (purchased) by consumers. If a good is purchased by a consumer then it is a consumption good, whereas if it is used by a firm then it is a capital good (if it can be used many times) or an intermediate good (if it can only be used once). In Model economy 1.1 there are of course no firms, and we think of capital as tools.

MODEL ECONOMY 1.1, continuation 1. *Let us return to our society of* 100 *people, and assume that it is a relatively simple economy based on agriculture and hunting. Capital goods may include things such as hoes, axes, bows and arrows, and kilns. We denote such goods as* tools. *Now assume that each worker with a tool is twice as productive as a worker without a tool, both in making new tools and in making consumption goods. It is 1 January 2014, and the stock of tools is zero. However, the islanders decide to set one person onto tool-making, and after one year the first tool is finished. What was GDP in 2014? What will it be in 2015?*

Without tools, GDP per year was 20 000 USD, or 200 USD per capita. With the (single) tool, one worker is able to produce to a value of 400 USD per year, thus total GDP rises to 20 200 USD/year. What about GDP during the period that the tool was being made? Recall that GDP is the total (gross) value of all the goods and services produced in an economy during a year; that must include capital goods, i.e. the tool. If we assume that workers are equally productive (in value terms) both when making tools and when producing consumption goods then GDP in 2014 is unchanged (20 000 USD/year).

The flow of goods is illustrated in Figure 1.2, where capital (investment goods) is retained in the economic sphere rather than going to households. Note nevertheless that capital goods are still *owned* by

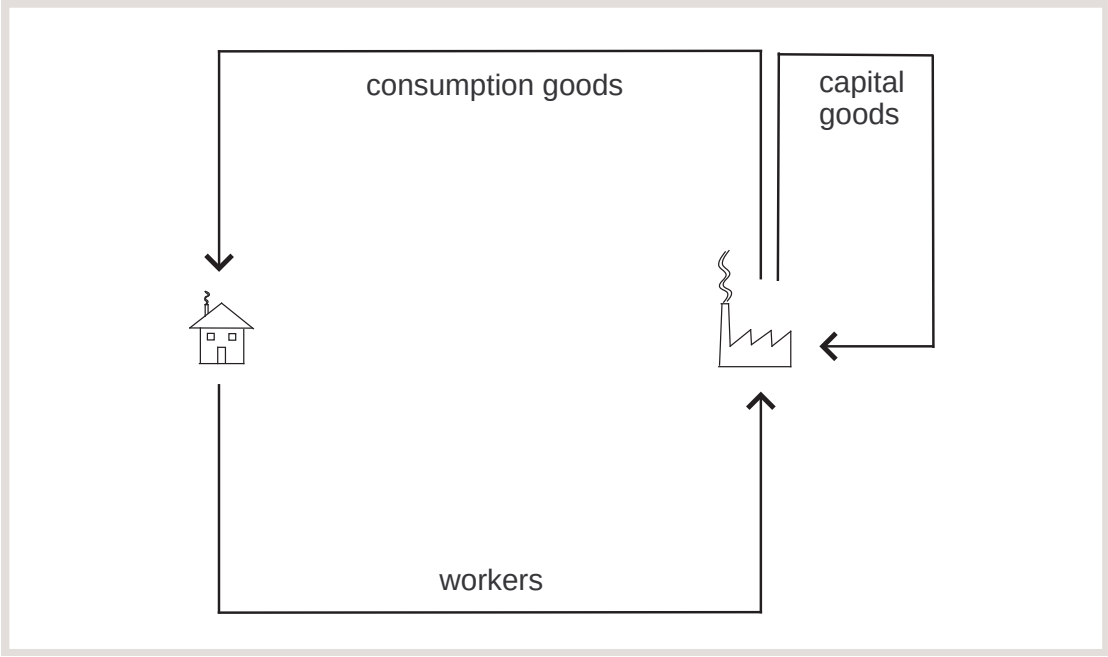


FIGURE 1.2. Model economy 1.1, continuation 1

households. Furthermore, given the production of capital goods we need to rewrite our equation for GDP to include such production:

$$Y = C + I.$$

GDP is the sum of the value of consumption and capital goods produced during the year, and the switch towards investment causes a temporary drop in consumption C but no drop in GDP Y. In the longer term both C and Y rise. But what happens in the very long run?

MODEL ECONOMY 1.1, continuation 2. *Now assume that the tool-maker's success inspires the islanders, and from 2015 onwards 20 of the 100 islanders set to work making tools. What happens?*

The tool-makers will, over the next few years, build up the stock of tools in the economy. When there are 100 tools everyone has access to a tool full time, so each worker produces to a value of 400 USD per year, and (assuming 80 workers producing consumption goods and 20 producing tools) we have

$$C = 32\,000,$$
$$I = 8\,000,$$
$$Y = 40\,000 \text{ USD/year}.$$

Furthermore, when there are 100 tools there is no value in producing further tools, since additional tools do not raise productivity. Thus the 20 tool-makers can return to making consumption goods, and we have

$$Y = C = 40\,000 \text{ USD/year}.$$

The sequence of events is illustrated in Figure 1.3. Note that raising investment in capital goods will always give a short-run decrease in consumption. However, if capital goods are scarce it may result in an increase in consumption in the medium term. But, finally, if investment is raised too high then it will be detrimental to consumption even in the very long run, since having access to more and more of the same capital goods will not make the workers using them more productive. Finally, note that in reality capital goods wear out over time; in economics we call this process *depreciation*. One consequence of this is that even in a long-run steady state (with constant capital) some capital investment is required in order to maintain the stock of capital. We return to this analysis in Chapter 4.

1.2.2. Raising quality: Technological progress. So building up the quantity of inputs (such as capital) cannot give growth in GDP per capita in the long run. Now we consider rises in the *quality* of inputs, which we denote as *technological progress*. We divide the process of technological progress into two stages: firstly, the discovery or invention of new designs or ideas for machines, consumption goods, or production processes, and secondly the diffusion of the ideas throughout the economy. We can think of the first stage as involving some form of research and development (R&D), and the second stage as involving capital investment. To see this, consider the following example.

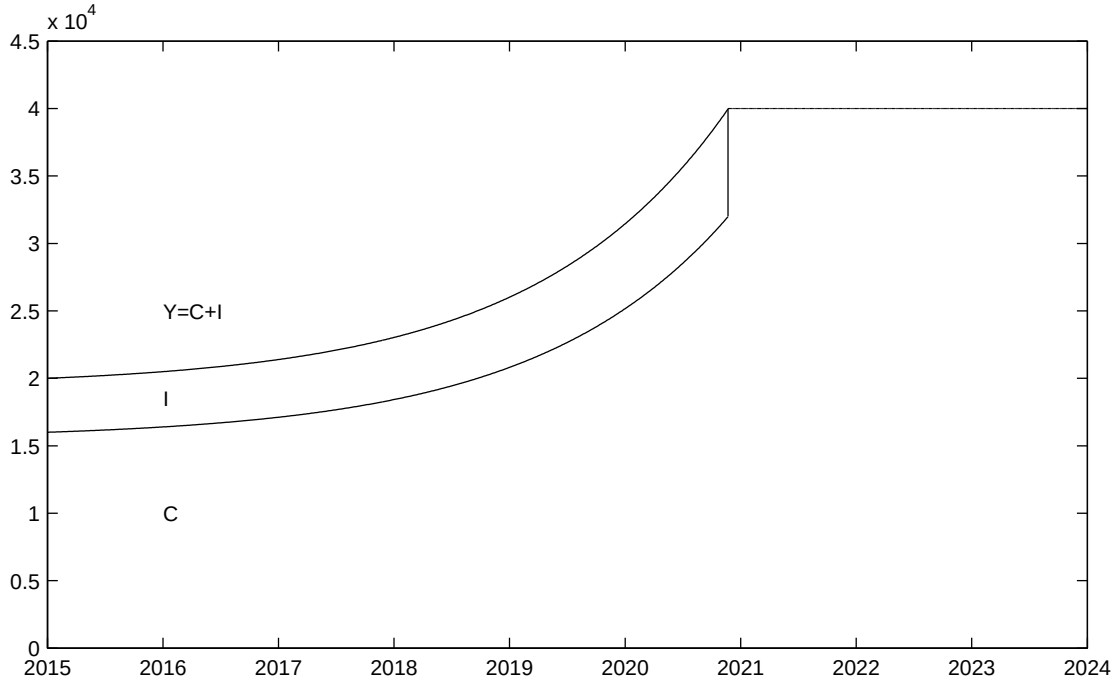


FIGURE 1.3. Growth in consumption, investment, and GDP in model economy 1.1, continuation 2.

MODEL ECONOMY 1.1, continuation 3. *Now assume that the islanders are not happy with their* 400 *USD/year per capita income, and they realize that in order to raise it they must come up with new ideas. They thus put the 10 former tool-makers to work again, but this time on R&D. After 10 years they have developed designs for a new family of tools to replace the old ones, where a worker with a new tool can produce goods to a value of 800 USD/year. What happens next?*

What happens next depends on the further decisions of the islanders. If (for instance) the 10 researchers go back to production work then nothing will change, since the designs alone will not lead to increased production. On the other hand, if the 10 researchers are put back to work producing new tools, then gradually (as the new tools are finished) GDP will rise, reaching a new level of 800 USD/year (per capita) when all workers have new tools. At this point growth in GDP will stop. Assuming no depreciation (the tools never wear out) the tool-makers can return to producing consumption goods, and C will rise from 720 to 800 USD/year, while I drops down to zero. The model economy teaches us that to achieve long-run growth in GDP the cycle of discovery and investment must be repeated over and over again.

1.3. Unemployment

Unemployment may seem like a riddle: why should talented people have to remain unemployed, is it not wasting their abilities? Given that the unemployment rate is usually between 4 and 10 percent, one can also ask why there always seem to be just a little too few jobs for everyone to get one? Should we not be able to create a few more?

MODEL ECONOMY 1.2. *We return to our island, but now we focus on the labour market. There are 100 adults of working age. Everything is done as it always has been, and children follow in their parents' footsteps. Of the 100 adults, 70 work, 25 are outside the labour force (because for instance they are at home caring for their children), and 5 are unemployed. Given the description above, those 5 must be the children of unemployed parents. Right?*

Somehow this picture just doesn't add up. Surely in such an economy everyone should be able to find something to do, some way in which to contribute? Clearly there may be people who do not want to work, and even people who can not work because of age or illness. But these people are outside the labour force, not unemployed.

DEFINITION 2.

- *The number of unemployed: All the people who do not have a job and are actively seeking work.*

- *The labour force: All those who want to work, i.e. the sum of the unemployed and all those who do have jobs.*
- *The unemployment rate: The number of unemployed as a percentage of the labour force.*

So if unemployment does not arise in this simplest possible economy, what could cause it? Technological progress, perhaps?

MODEL ECONOMY 1.2, continuation 1. *We return to the island economy, and assume that 5 people work making clothes. However, the researchers invent an automatic loom, and once it is ready to use only 1 person is needed to make clothes for the entire community. The other 4 textile workers become unemployed. Right?*

Again, it seems unreasonable that unemployment should arise here. If the group decides on the allocation of resources jointly, surely the other four textile workers will be assigned to some other form of production instead. They can help with agriculture or forestry, tool production, etc. If they have not got the necessary skills then a period of investment—in the form of training—may be required.

It requires very specific conditions if unemployment is to be triggered by technological progress in this economy. It may be that 4 textile workers are so old, and all other pursuits so demanding, that new tasks cannot be found for them. However, in that case it is doubtful whether the 4 should be characterized as unemployed since they are incapable of work. Or it could be that the market for all products is fully saturated; people are perfectly happy with what they have, and productivity increases lead not to more production, but rather to less work. This seems unlikely, but even if it holds on the island then it is definitely not a good description of a modern economy.

Another popular candidate for causing unemployment is external (foreign) competition.

MODEL ECONOMY 1.2, continuation 2. *We return to our island, and denote it Simp Isle. Simp Isle is discovered by another island nation, Soph Isle (another economy without money). On Soph Isle technology is far more advanced, and GDP is much higher than on Simp Isle. Soph Isle wants to trade with Simp Isle. But such trade will lead to (productive, advanced) Soph Isle outcompeting workers on Simp Isle, and thus lead to unemployment. Right? Or, perhaps, it will lead to the cheap and cheerful workers on Simp Isle outcompeting the expensive, cosseted workers on Soph Isle, leading to unemployment there? Or will unemployment be created on* both *islands?*

Clearly, no unemployment will be created by such trade. Since neither economy has money, trade will take the form of barter. Perhaps Soph Isle will send stilettos and dinner jackets to Simp Isle, while Simp Isle sends timber to Soph Isle in return. Thus—on both islands—there will be some reorganization of productive effort, with Soph Isle raising its production of clothing and cutting down on forestry, with the reverse happening on Simp Isle.

How then *does* unemployment arise?

MODEL ECONOMY 1.2, continuation 3. *Assume now that the islanders decide their system for allocating work is too authoritarian. They decide to set up a* labour market, *which functions as follows. Each year individuals submit bids where they state their preferred work and their desired compensation for that work. Furthermore,* employers *are appointed, individuals who run* firms *making the various products in the economy. The firms pay their workers and sell their products on the* goods market. *Those who end up without a job are given some minimum level of compensation to help them through the year.*

The point of this example is not to show exactly how unemployment arises, but to show how the existence of markets open up all sorts of possibilities for unemployment to arise. The key message from the above examples, taken together, is as follows.

> The key to understanding unemployment lies in understanding the operation of the labour market. Other factors—technological change, trade, immigration, etc.—may have indirect effects on unemployment through their effect on the operation of the labour market, but they are unlikely to have direct effects.

How does the 'operation of the labour market' lead to unemployment? Later in the book we shall see that there are many possible explanations, and that there is some truth in many of them. Economists are not always in agreement on which ones are most important and which would be best forgotten.

1.4. Stability and the business cycle

According to the standard picture—for instance, the story most often communicated in the media—recessions are typically caused by concern among households about the future. When households feel such concern, they reduce their consumption, which leads to firms being unable to sell their goods, leading them to reduce their production and lay off workers. But what happens in the economy without money?

MODEL ECONOMY 1.3. *Return to our island economy, and assume now a very basic development level in which the 100 adults work the land with hoes. Ten people work on repairing and making new hoes when necessary, 10 work on soil improvement measures (such as irrigation systems, prevention of erosion, etc.), and 80 work directly on food production. One day the people gather to discuss the future, and conclude that they are worried about hard times in the future and decide therefore to reduce their food consumption. Is there a recession as a result?*

In the island economy the result of this decision will not be a recession. If the people are worried about the future they may cut their food consumption, but they will not cut their productive effort. If food is storable they may continue allocating production resources as before, and hence build up reserves of food (their *inventories*, to use the term from economics); this is a form of investment. Alternatively, they may decide to reallocate productive effort from food production to capital investment. In particular, if they are concerned about a deterioration in growing conditions they may choose to invest more in soil improvement measures, i.e. they may shift some workers from production of consumption goods to investment. All in all, we expect the reduction in consumption C to be compensated by an increase in investment I. Recalling

$$Y = C + I$$

we thus expect GDP to be unchanged. In fact, if we take the analysis a step further, we might even expect GDP to go up: if the people are concerned about future hard times they are likely to work harder today, sacrificing leisure for the sake of insuring themselves against future poverty. This will raise current GDP.

So there is no business cycle on the island in the sense that we understand the term. There may of course be large fluctuations in GDP, but these are caused by external shocks, such as bad weather or even natural disasters. Such events can reduce Y severely, and thus lead also to reductions in consumption, C. However, they definitely do not lead to unemployment and recession, but rather that the people work a lot harder to build up production and prosperity again.

Finally, the island economy teaches us that if a shortfall in consumption is to cause a downturn, it must be because it is not matched by a corresponding increase in investment. Put differently, individual households' decisions to save are not matched by firms' decisions to invest. Again, to find the reasons for this we need to analyse the operation of the market, in this case the market for money (savings and investment) is the natural place to start.

1.5. Summary

GDP per year—the value of everything produced in the economy in a year—is the sum of the value of consumption goods and investment goods (e.g. tools, machines) produced in the economy. A shift away from consumption and towards investment in capital goods will have no immediate effect on GDP, but in the medium run (when some of the capital goods are finished) GDP may increase. In the long run, however, when there is sufficient capital in the economy, further increases in investment will not yield further growth. Long-run growth depends on a cycle of R&D (e.g. the invention of new capital goods) and investment (production of the new capital goods, replacing the old ones).

The key to understanding unemployment lies in understanding the operation of the labour market. Other factors—technological change, trade, immigration, etc.—may have indirect effects on unemployment through their effect on the operation of the labour market, but they are unlikely to have direct effects.

A reduction in the rate of consumption by households is not enough on its own to cause a downturn in economic activity. In the economy without money such a reduction in consumption should be matched by an increase in investment, leaving economic activity (and hence also GDP) unchanged. On the other hand, in a market economy a reduction in consumption by households may not be matched by an increase in investment by firms, and under these circumstances their might be a downturn. So it seems that the key to understanding the business cycle lies in understanding fluctuations in consumption by households and investment by firms, and how they are linked (or, perhaps, not linked).

Exercises

Ex. 1.1 Assume an island community with 100 people, without money. The group decides collectively what job each individual should do—agriculture, silviculture, hunting, building, etc.—and then they share the goods produced. Population is constant.

(a) Discuss briefly how the islanders might achieve economic growth, as measured by the value of their net production in USD.
(b) Is unemployment likely to arise on the island, under any circumstances? Explain.

(c) How would the islanders react if they became increasingly concerned about the future? Would there be a downturn in economic activity? Explain.

Ex. 1.2 Accumulation of capital cannot drive economic growth in the long run. Discuss.

Ex. 1.3 Define GDP in a closed economy without government spending.

CHAPTER 2

The circular flow, money, and interest

In this chapter we focus on learning concepts and understanding how the economy as a whole works. We do this primarily through tracing the path of money and goods through the economy. We do not tackle our overall goals for the book, which are to understand, explain and predict economic growth, unemployment, and the business cycle. However, we build a solid foundation on which we build such explanations in future chapters.

2.1. Coconut island and five types of agent

First we build a simple economy with firms and households, production and consumption. Later on we add a financial sector, a central bank, and a government.

2.1.1. Households and firms. We begin with a single household and a single firm.

MODEL ECONOMY 2.1. *Assume an economy in the year 2000 with a single gold coin worth ten crowns, and a single person—Briony—who picks coconuts. Every day she picks two coconuts, and in the evening she collects her pay (10 crowns) from her firm. In the morning she buys the nuts from her firm (they cost 5 crowns each), eats them for breakfast, and goes to work. There are plenty of trees, and her production is limited by her ability to pick the nuts. The circular flow of money and goods in the economy on any given day is shown in Figure 2.1.*

This model economy illustrates several important variables and concepts. First, the circular flow. To the left we have the households (the individual) and to the right we have firms (i.e. her coconut business). The upper part of the diagram shows the *goods market*, where goods and services for consumption are traded, and the lower part shows the *factor market*, where factor inputs are traded. Note that the money always ends up on the left, *even if households do not get paid*. The reason is that households are the ultimate owners of everything in the economy. On Coconut Island, if the firm fails to pay its employee then it makes a 10-crown profit instead, and this profit goes to the same person.

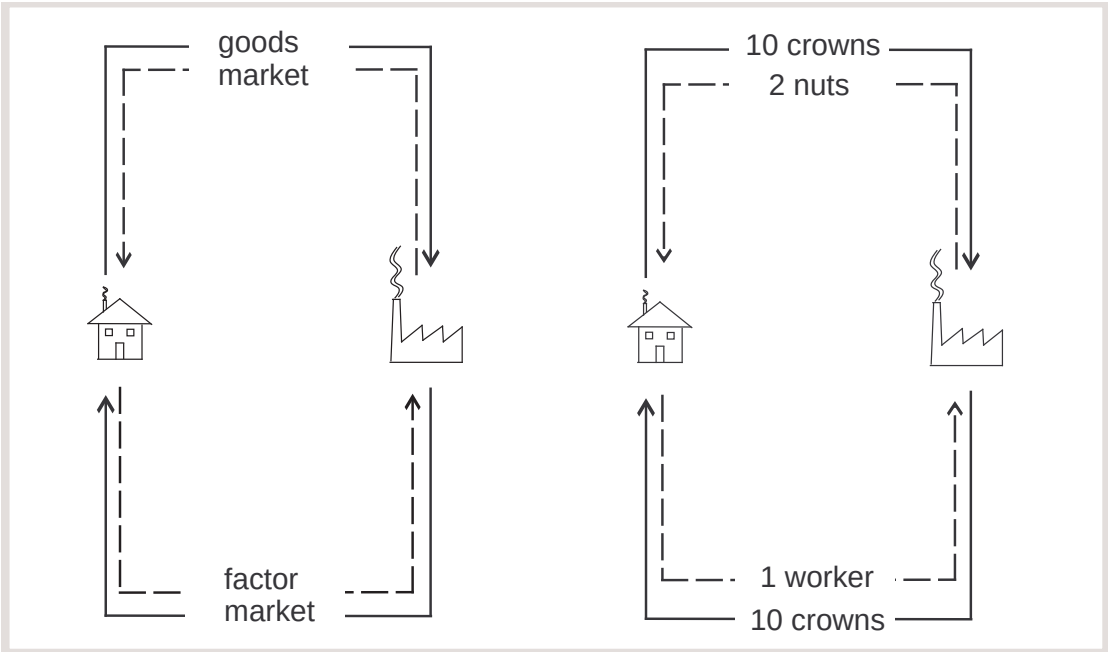


FIGURE 2.1. The circular flow on Coconut Island. The dashed lines show physical flows, the continuous lines show monetary flows.

This simple economy exemplifies a number of further concepts, as well as prices and wages. We now tackle these, starting with GDP, *gross domestic product*. This is the total value of everything produced in an economy over a period of time. Thus, we can express GDP in this economy as 10 crowns per day. Moreover, we can, using the model economy, explain our first theorem, the *quantity theory of money*. The quantity theory can be summed up simply with an equation:

$$MV = PY.$$

Here M is the amount of money in the economy, or the *money supply*, V is the velocity of money, P is the price level, and Y is real GDP.

The money supply M is the sum of (non-negative) monetary assets. What is a monetary asset? An asset is something owned by an economic agent with positive value, and a monetary asset (money) is an asset which is a generally accepted means of payment: so a house is an non-monetary asset, whereas a positive bank balance is a monetary asset. On Coconut Island M is simply 10 crowns. In a more complex economy, monetary assets include non-negative bank balances. Note then that if Bill and Bull are two agents who both have zero monetary assets, and then Bill buys Bull's car for 10 000 crowns (implying that Bill owe's the bank 10 000 crowns while Bull now has 10 000 crowns in monetary assets), then the money supply M has gone up by 10 000 crowns. We will return to this below.

The velocity of money is the number of times (on average, per unit of time) that money goes round the circular flow. On Coconut Island the velocity of money V is 1 /day.

Price level is measured relative to a base year. On Coconut Island the price of a coconut is 5 crowns, but this does not mean the $P = 5$. On the contrary, if the base year is 2000 then $P = 1$ crown/base-year-crown. On the other hand, if the base year is 1990 when coconuts cost 2 crowns each then $P = 2.5$ crowns/base-year-crown.

Finally, *real* GDP Y is the value of output per unit of time, *in base year prices*. PY is then called *nominal* GDP; it is the value of goods and services produced in an economy per unit of time, in today's terms (i.e. their value in current monetary units). Note that *units* are important to keep track of. In a meaningful equation, the units of the LHS and RHS (left-hand side and right-hand side) must match. Verify that this is the case for the equation $MV = PY$.

MODEL ECONOMY 2.1, continuation 1. *On New Year's Day 2001 Briony finds another 10 crown coin on the beach, and decides to increase her salary to* 20 *crowns per day. She hopes to buy more nuts for herself the next morning. Does her plan work?*

Presumably her plan will not work. Instead she still manages to pick 2 nuts per day, implying that the price of the nuts increases to 10 crowns per nut. *Real* GDP is unchanged, while *nominal* GDP has doubled : $Y = 20$ year-2001 crowns per day. In terms of $MV = PY$ we have that M has doubled while V and Y are unchanged, hence P must have doubled.

MODEL ECONOMY 2.1, continuation 2. *New Year's Day 2002 she tries a new trick. She will pay herself with her 20 crowns twice a day, first at lunchtime then in the evening, thinking that since she gets paid twice as much per day she should be able to double her coconut consumption. What happens?*

Again, the coconut price (and nominal GDP) doubles. However, this time it is V that has increased rather than M.

2.1.2. Banks. In the model economy 2.1 there was a fixed amount of physical money and no other form of money. The simplest situation is when money has an intrinsic value, such as gold, implying that coins would have exactly the same value even if they were melted down. However, such systems are inflexible. In more sophisticated economies than 2.1 other kinds of money—and a financial sector to manage them—are required.

MODEL ECONOMY 2.2. *Suppose now that there are 200 people on Coconut Island, of whom half work and half are retirees. There are lots of gold coins, and most are owned by the older workers and retirees, as workers save during their careers in order that they will be able to afford to buy coconuts during their retirement. Those who work earn 100 crowns per day, of which they save 30 and consume 70. Those who have retired spend 30 crowns a day on consumption.*

In order to get a clear picture of transactions in this economy we again draw the circular flow: Figure 2.2. We must now add a third market to the diagram—in addition to the goods and factor markets—i.e. the financial market. This market is shown in the middle of the diagram. We see that net savings are zero, $Y = 10\,000$ crowns/day, and $C = Y$.

This economy is simple to understand but difficult to work in. For example, workers must to save up and store large amounts of gold for their retirement. Furthermore, transactions are unnecessarily difficult when gold must change hands each time. And how do the islanders handle situations in which one of

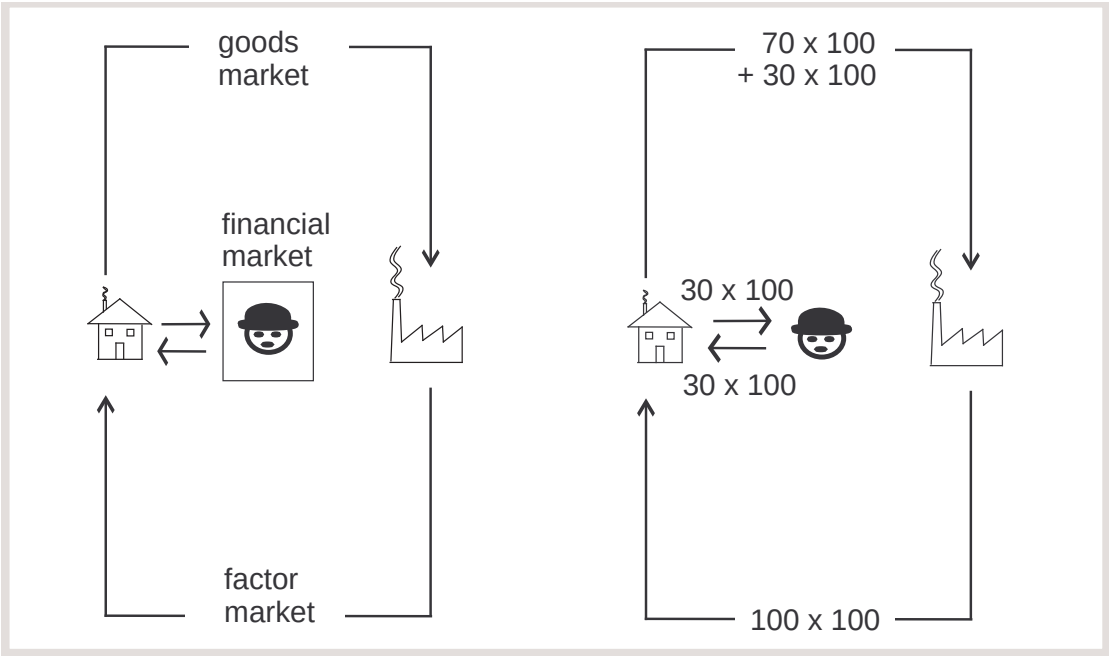


FIGURE 2.2. The circular flow with a financial market and savings.

them has a temporary need for money due to an unforeseen event? A major step taken to solve all these problems by creating a system of *credit*.

MODEL ECONOMY 2.2, continuation 3. *Assume that the inhabitants of Coconut Island find it inconvenient to use gold for transactions. They therefore decide that everyone should put their money into* banks *which provide deposit certificates in return. It is these notes (paper money) that people give in return for goods and services, and the gold remains with the banks at all times.*

The banks have reserves (gold) and deposits (liabilities in the form of certificates of deposit). The *reserve ratio* is defined as reserves / deposits, and is a measure of how exposed the banks are in case everyone wants to cash in their certificates for gold. The reserve ratio in this economy is thus equal to 1; the banks have reserves equal to the value of notes in circulation.

MODEL ECONOMY 2.2, continuation 4. *Assume now that the banks realize that they do not need to keep all the gold in safe custody. They can lend some out to those who need money today and can pay back later. The incentive for the banks is that they can then demand* interest, *i.e. borrowers must pay back a larger sum than they originally received. However, according to logic above, the banks do not need to lend out actual gold, they can simply release additional certificates of deposit!*

This system is called the *gold standard*. Although trading is done by exchanging pieces of paper (notes), agents always have the option to switch the notes against a fixed amount of gold (or sometimes another metal) at a bank. Banks are keen to lend—as long as they are confident that the money will be repayed—because they can charge interest on the loans. However, banks need to be careful about lending too much, because if a bank is too free in printing notes and lending them out then depositors at that bank will start to wonder about the bank's ability to pay back gold in the event that they want to cash in their notes. Furthermore, borrowers may find that agents are unwilling to accept notes from the profligate bank as payment. As soon as confidence in a given bank starts to waver, anyone holding notes issued by that bank will want to exchange them for other (safer) notes, or (even better) for gold. But because there are more notes in circulation than gold at the bank, the bank will go bust and many creditors (people holding notes) will not get their gold.

In a functioning financial market based on the gold standard, banks must compete to attract agents to deposit gold with them, because this gold allows them to lend more money and thereby earn more interest: they compete by offering to pay interest to depositors. In equilibrium—at least theoretically—the interest rate ends up at a level such that supply and demand for loans (money) match each other.

2.1.3. The central bank. There is an obvious risk inherent in the system above, and that is that some banks print and lend notes, even though they barely have any reserves (gold) as backup. The owners of these banks would be able to borrow these notes themselves and spend them, or lend them and

earn interest. In the short run, unscrupulous agents could easily make large profits. In order to prevent this from happening a central authority is required, which regulates the creation of notes. This authority is known as the *central bank*.

Given the system above, with a gold standard and all trade taking place through notes changing hands, we can think of the central bank as the sole issuer of notes. Given the gold standard, the bank must ensure that P (the price level relative to the base year) is held constant. The reason is that if P rises over time then notes fall in value over time, implying that holders of notes will prefer to exchange them for gold (which holds its value), leading to the collapse of the system. Given

$$MV = PY,$$

and assuming that V is fixed, then the bank must raise M (the number of notes in circulation) at the same rate as Y rises (recall that Y is real GDP, the value of everything produced in the economy per year in base-year currency). In order to get more notes into circulation the bank can buy other assets, and in order to remove notes from circulation it can sell such assets.

The system above is still a long way from the system used in modern economies. Two (great) steps take us up to and even beyond the modern system. The first is the renunciation of the gold standard; the second is the abandonment of paper money too!

As we saw above, a well functioning gold standard implies constant prices. If too much money is issued, pushing prices up, confidence in the system declines and problems arise, such as households wishing to revert to the use of gold, which may cause bank runs and economic crisis.[1] In order to prevent this the central bank must (without warning) reduce the rate at which it offers gold in return for paper money. But if the bank is forced to do this, what is the point of the gold standard?

It turns out that the gold standard serves little purpose. In modern economies we let the market decide the rate at which paper money can be exchanged for gold (i.e. the price of gold), and given

$$MV = PY$$

we know that this price will go up if the central bank allows M to rise faster than Y, assuming constant V.

So, one day the central bank on Coconut Island announces that it will no longer exchange paper money for gold at a fixed rate, but that the exchange rate (the price of gold) will instead by determined on the market. Shortly after this a new phenomenon is observed.

MODEL ECONOMY 2.2, continuation 5. *Assume now that the banks realize that they do not even need to issue notes; they can simply keep a record of each household's deposits, and make that record available for inspection by the household on demand. When Bill wishes to purchase some coconuts from Bull for 100 crowns, he contacts his bank and asks it to transfer 100 crowns from his account to Bull's account. No gold is shifted between safe boxes, and neither are notes rearranged; the bank simply subtracts 100 from Bill's balance, and adds 100 to Bull's. If Bull has an account at a different bank, then the banks' balances with each other must also be adjusted. If these balances start at zero then after the transaction Bill's bank must have a balance of minus* 100 *crowns at Bull's bank.*

Since notes are now unnecessary on Coconut Island, everyone holding notes takes them to the bank and deposits them there. The bank adds the appropriate amounts to the individuals' balances, and sends the notes back to the central bank for destruction.

The system described in model economy 2.2, continuation 5 is very close to the system used in modern economies today, with the proviso that the transactions all occur electronically rather than with human communication and pen and paper. Throughout the rest of the book we typically assume that money is purely electronic, because to assume otherwise is unnecessarily complicated given how close to the truth this model is. Furthermore, the future is on its side.

We now return to the model economy 2.1, and assume that all money is electronic. When an agent wants to buy anything she instructs her bank to transfer (electronically) the 'money' from her account to the seller's account. How does the central bank regulate the creation of money in such an economy? The central bank does this through two instruments.

(1) The central bank requires all banks to balance their books at the end of each working day. A bank's books are balanced when deposits at the bank are at least as great as total lending by the bank.

[1] A *bank run* occurs when many depositors, fearing the failure of the bank, decide to withdraw their deposits. Given a gold standard this means that they withdraw gold, which the bank very likely does not possess in sufficient quantities. If this happens to one bank it is very likely to spread to others.

(2) The central bank provides overnight loans at a certain interest rate, which we denote the *base rate*.[2] The interest is paid on a daily basis, but the headline number is the equivalent annual rate. Thus a base rate of 5 percent means a daily percentage rate of $(1.05^{(1/365)} - 1) \times 100$, i.e. 0.013 percent per day.

The effect of these instruments is that the base rate applies to interest rates on short-term risk-free loans between agents throughout the economy.[3] No borrowers want to borrow at higher interest rates than the base rate, while no lender can lend at a lower rate (because they would lose money on such a loan).

EXAMPLE 2.1. *Return now to Bill and Bull and their banks; let's call them Bill Bank and Bull Bank. The central bank has decided that the base rate should be 5 percent, however Bill Bank has decided to attract customers by lending money at 4 percent interest; Bull Bank, meanwhile, demands 5 percent interest on loans. Bill borrows 100 crowns from his bank to buy coconuts from Bull, who gets 100 crowns in his account. However, Bill Bank now owes Bull Bank 100 crowns, and must pay 5 percent interest on the loan. Bill Bank could always borrow from the central bank to pay off Bull Bank, but since the rate at the central bank is 5 percent, this won't help. Bill Bank will make a loss on its cheap loan.*

A related argument shows that no bank can demand *more* than 5 percent interest, since in that case borrowers would turn to another bank for loans. Finally, given competition between the banks they must all pay 5 percent interest on deposits, since this is the value of deposits to the banks. (A deposit of 100 crowns cuts the bank's total debts by 100 crowns, saving the 5 percent interest payment.) Thus the *interbank rate* will be equal to the central bank's base rate. In practice, rates charged to households and firms will differ from the base rate due to the banks' needs to cover their costs, and to compensate for the risk of default. Furthermore, the banks may well have *market power* allowing them to drive rates further from the base rate than they would in the presence of more competition.

Note that on Coconut Island—as defined so far—there is no net saving: one household's saving is another's borrowing, and the sum of saving across the economy is zero. It turns out that this holds more generally in closed economies, with one modification: the sum of *financial* saving is zero. For instance, if I am a worker on Coconut Island and choose to save half of my income one day instead of only 30 percent of it, then the result will be that the net revenue of firms declines by 20 crowns, and the firms will have to borrow the corresponding amount. My saving is another agent's borrowing.

2.1.4. The government. So far we have not mentioned the government. The government is a very important player in economy, not only because it determines the rules of the game (assuming it is doing its job), but also because it is a very important economic actor. To illustrate this, we add a government on Coconut Island.

MODEL ECONOMY 2.2, continuation 6. *Now suppose that the inhabitants of Coconut Island decide that they want a government that works for the common good. There are still two hundred people, of whom half work and half are retirees. Those who work earn 100 crowns per day, of which they save 30, consume 50, and pay 20 in taxes. Those who have retired have no income but spend 30 crowns a day on consumption. Government expenditure is 2000 crowns per day.*

Figure 2.3 show the circular flow for model economy 2.2, continuation 6. Note that GDP, Y, is now defined as

$$Y = C + G,$$

where G is government consumption. Furthermore, note that the government's budget is in balance. This need not be the case in general: governments can run deficits, and they can run surpluses.

MODEL ECONOMY 2.2, continuation 7. *Now we extend the analysis to include the interest paid on debts. Suppose—for simplicity—that in 2014 there are only 100 workers on Coconut Island (no retirees). Each of the workers earns 20 000 crowns per year, of which the state takes 20 percent in income tax, and the rest is spent on private consumption. The state spends 400 000 crowns per year on public consumption. The state also has a debt of 1 000 000, on which it pays interest at 5 per cent per year.*

In model economy 2.2, continuation 7 the government debt increases by 50 000 crowns in 2014, i.e. the government runs a deficit of 50 000 crowns or 2.5 percent of GDP; in order to finance its interest payments, the government must borrow 50 000 crowns. Furthermore, the government debt increases from 50 percent of GDP at the start of the year to 52.5 percent of GDP at the start of 2015.

[2] This rate has different names in different countries.

[3] This is the same as the interest rate on short-term loans and deposits between banks, where profit margins, risk premiums, and so on make a negligible difference to the rate.

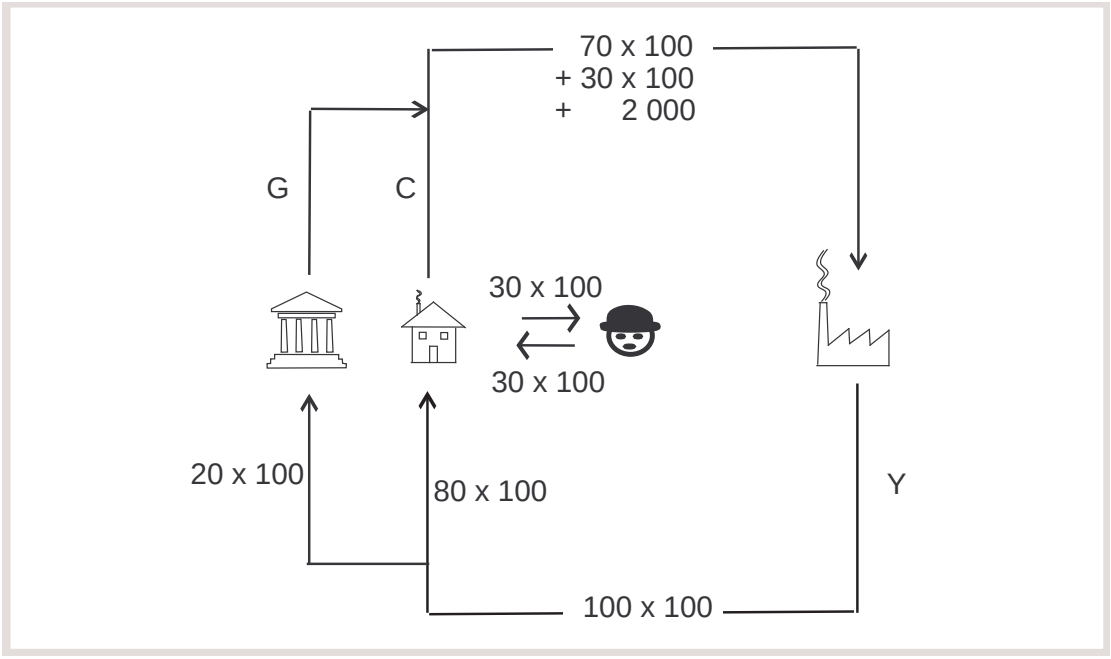


FIGURE 2.3. The circular flow on Coconut Island, showing the government.

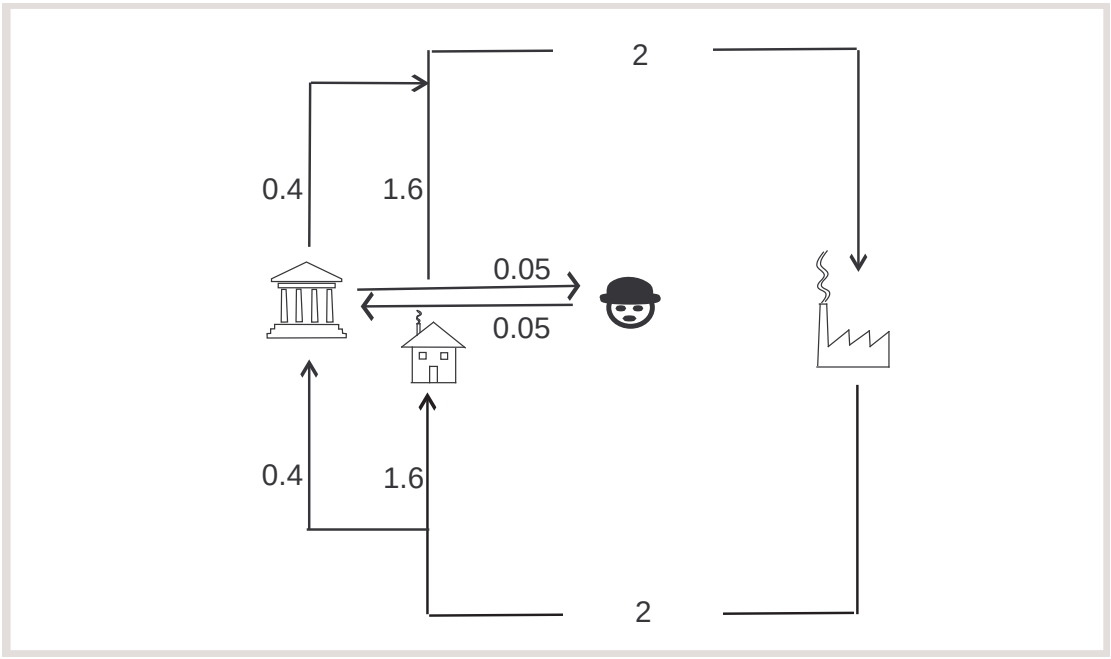


FIGURE 2.4. The circular flow on Coconut Island, showing government debt. Units are million crowns/year.

To sum up, the government can be seen as a kind of 'super-consumer', purchasing goods and services from firms, bringing in money from firms and consumers through tax, and also redistributing money to households through transfers. In addition, the government saves and borrows money just as an ordinary consumer does. There are various potential flows of income for the government. We have shown income taxes; another major source of income is sales taxes, in which case we should show a proportion of consumption expenditure being diverted to the government. With regard to expenditure, an important flow in addition to government consumption G is *transfers*, i.e. payments directly from the government to households. Such payments typically include child benefit, unemployment benefit, and state pensions.

2.2. Investment and capital

Now that we have established who the key actors (economic agents) are, it is time to widen the options for these agents by introducing *capital*, which we define as goods used by firms—together with labor—to produce goods and services. Even though such goods are used by firms, they are owned (like everything else) by households; households own the firms.

We noted above that the sum of financial saving in an economy is always zero. My financial saving is always someone else's negative saving. However, this does not mean that the sum of all savings is equal to zero, because there is another type of savings, *real saving*, or *investment* (or *real investment*). Since net financial savings are zero, we can conclude that net saving is equal to real saving is equal to investment:

$$S = I.$$

Economists say that there has been an investment when agents devote resources (such as labour) to the production of capital goods such as machinery. Capital goods should be compared with consumer goods: consumer goods provide benefits today, while capital goods are procured in order to increase the ability to produce goods in the future.

The distinction between financial savings and investment is clearly visible in the circular flow. In the previous section we had a model economy with two hundred people, of whom half were working and half were retirees, and in which the workers' saving exactly matched the retirees' negative saving. But what if these to flows fail to match? Then we have net investment.

Model economy 2.3. *Assume an economy with 200 people, of whom half are working and half are retired. Those who work have a net income of 250 crowns per day, of which they save 100 and consume 150. Those who have retired have a net income of 50 crowns per day, and consume at a rate of 90 crowns per day. Firms employ people to pick coconuts, but also to make the ladders which are used by the coconut-pickers.*

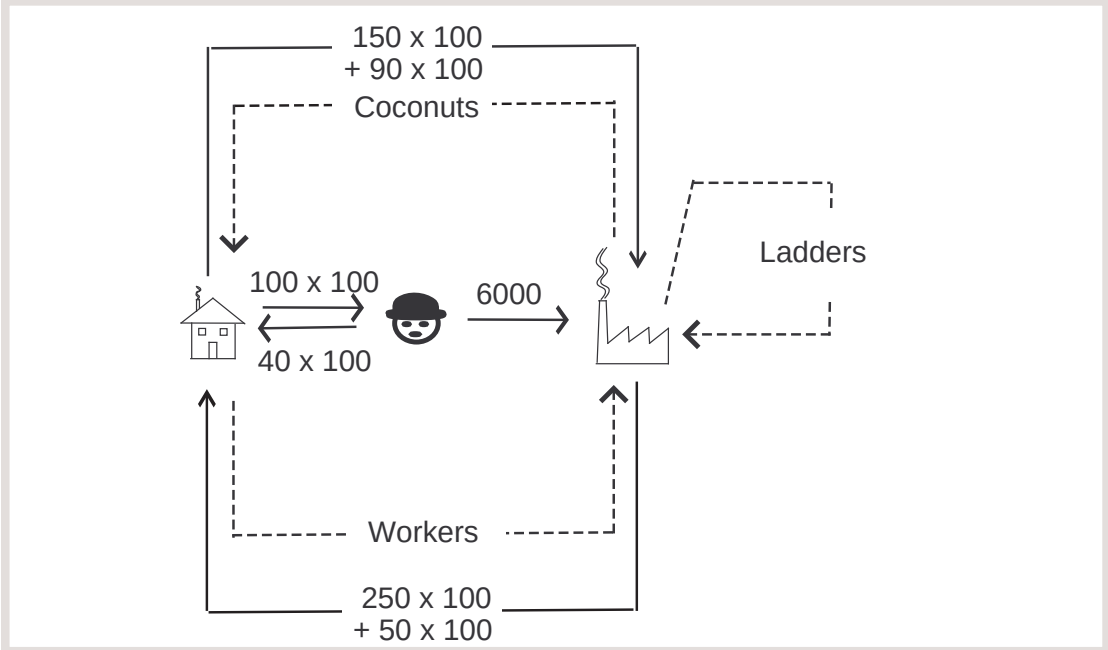


Figure 2.5. The circular flow on Coconut Island, showing investment.

Figure 2.5 shows how the 'excess' saving in model economy 2.3 must translate into borrowing by firms. Assuming that firms are not running at a loss (which they cannot be doing if we are in a long-run equilibrium) then this borrowing must be *capital investment*, i.e. firms are building up their stocks of capital (i.e. ladders) in order to be able to produce more in future periods. Investment in this economy is 6 000 crowns per day, which is 20 percent of GDP.

Model economy 2.3, continuation 8. *Suppose now that the salary is 200 crowns per day, and the interest rate is 3.7 percent per year, which is equivalent to* 0.01 *percent per day. What is the value of the assets owned by the typical worker, and the typical pensioner? What is the total value of capital in the economy?*

Since the salary is 200 crowns per day, interest payments on the average worker's capital holdings must be 50 crowns per day. Furthermore, interest payments on the average pensioner's holdings are also 50 crowns per day. Since the interest rate is 0.01 percent per day, this implies that both the average worker and the average pensioner hold capital worth 500 000 crowns, and the total value of capital in the economy is 100 million crowns. This should be compared to annual GDP, which is (assuming that there are 333 working days) 10 million crowns.

Note that $S = I$ is an unbreakable law; it follows by definition. This can be understood in different ways. Should you buy something (such as a machine) the money must come from somewhere. If it comes from your own income, you saved, and $S = I$. If you borrow it from someone else, they have saved, and $S = I$ again. If you borrow it from a bank, the bank must borrow it in turn from somewhere, or use its own money (equity) in which cases it is the bank (and ultimately its owner) who saves.

2.3. Relevance to real economies

2.3.1. What Coconut Island shows about the real economy.

Agents. On Coconut Island we had five types of *agent*: households, firms, banks, the central bank, and the government. All individuals in the economy belong to households, while the other four types of agent are legal entities, not people. Furthermore, we divide households into workers and retirees. This division is highly relevant to understand real economies.

The quantity theory. The quantity theory of money—

$$MV = PY$$

—is true by definition, but in practice, in modern economies, both M and V are elusive. Money is generally accepted means of payment, and the money supply is the sum of the generally accepted means of payment. On Coconut Island (Model Economy 2.1) M was initially 10 crowns, and later 20 crowns. But how do we add up 'generally accepted means of payment' in real economies?

In the narrowest sense, the money supply in the economy is equal to the amount of cash; this is generally denoted M0. However, this definition is far too narrow, excluding a large proportion of total 'money'. There exists a variety of other terms of broader scope, however the exact usage varies from one country to another. We denote M1 as M0 plus the sum of all non-negative balances in instant access bank accounts. Thus it is—in some sense—the sum of all 'fully liquid' assets. A problem with measuring the quantity of money in a modern economy is that less liquid assets—such as shares—are much more liquid than they used to be. Thus a household with zero holdings of M1 but large holdings of less liquid assets (such as shares) may still have the ability to make large purchases at short notice. If that is the case, what is the relevance of measuring M1?

Inflation. We saw that there could be inflation in Coconut Island, where inflation means that prices are rising. The inflation rate is measured in percent per year: for example, if prices were to double over the course of a year, the inflation rate would be 100 percent. If prices were to go up from 100 crowns/unit to 102 crowns/unit then the inflation rate would be 2 percent that year. When the prices of different goods go up by different amounts then the measurement of inflation becomes trickier: we must *weight* the effects of the price rises according to the importance of the respective goods: if the price of cars rises this affects inflation more than if the price of pencils rises, because we spend more on cars than we do on pencils.

To see how this works, assume an economy in which consumers buy cars and food; there is no investment. On January 1, 2000, the situation is as follows: each household buys 0.2 cars per year and 1000 kg of food per year; the price of a car is 200 thousand crowns, while the price of food is 40 crowns per kilo. Next assume that on January 1, 2001, the price of a car has increased by 10 percent while food prices are unchanged, while the consumption rates of cars and food are unchanged. Then the inflation rate during the year 2000 can be calculated as follows.

$$\begin{aligned}\frac{P_{01}}{P_{00}} &= \frac{0.2 \times 220\,000 + 1000 \times 40}{0.2 \times 200\,000 + 1000 \times 40} = \frac{84}{80} \\ &= 1.05\end{aligned}$$

Thus the inflation rate is 5 percent per year.

More generally, inflation is calculated as follows. First, we must put together a so-called 'basket' of goods, the composition of which reflects the purchases of the average consumer (assuming that it is consumer prices we are studying). Second, we must measure how much it costs to buy the contents of the basket at the given points of time. Inflation over the period is then the percentage increase in the cost of the basket. So far so good. However, there are two major problems: firstly, the average consumer's favoured mix of goods changes over time, meaning that the relative quantities of the goods in the basket must be updated regularly; secondly, new goods become available over time, including completely new

goods but also changes in the quality of existing goods. Changes in quality are particularly problematic for econometricians: it can be tricky to distinguish between a price increase and a quality improvement. For example, assume that computers have—over some period over time—become twice as expensive but four times as powerful. In that case, surely the 'real' price of computers has halved?

In addition, a distinction is made between the CPI (consumer price index), thus 'normal' inflation, and *underlying* inflation. To calculate the underlying inflation—the 'real' trend—the data is cleaned to remove the effect of one-off shocks such as an oil price shock or an increase in sales taxes.[4]

In Figure 2.6 we see historical inflation for Sweden and the UK. Note that the are large variations over the years, and that the inflation rates in the two countries seem to move together. There are at least three likely reasons for this: that both economies are affected by the same international factors; that the economies affect each other; and that there are international trends in economic policy, and when governments apply similar policies, similar results follow.

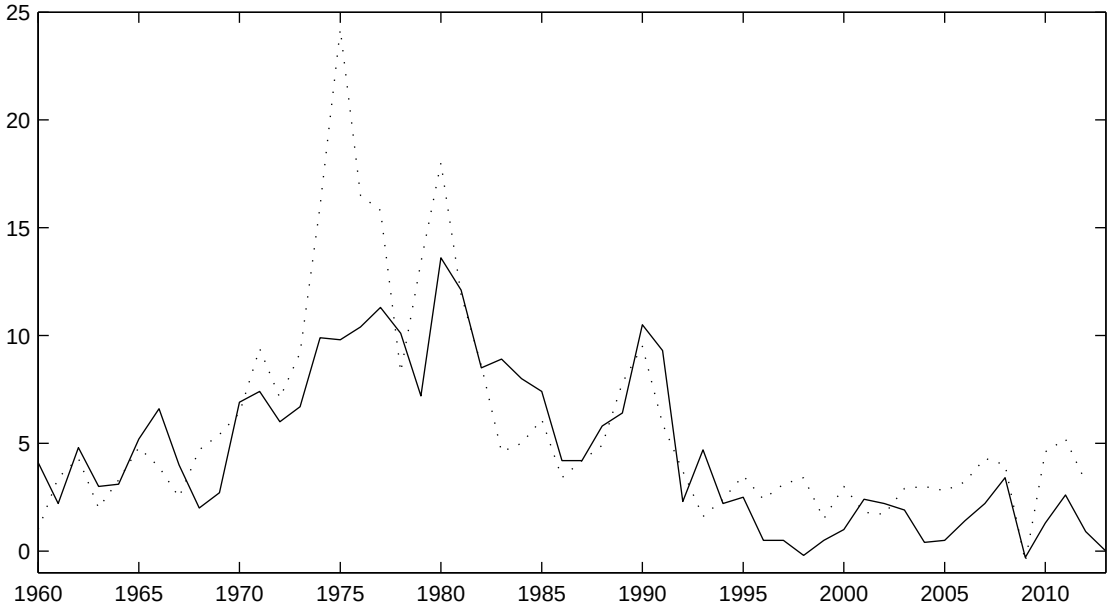


FIGURE 2.6. Inflation (percent per year) in Sweden and the UK since 1960. Source: Statistics Sweden and the ONS.

The financial system. When it comes to the financial system, the gold standard is interesting for historical reasons, but this system is not used in modern economies today: today *fiat money* is the norm. The system described by which the central bank determines the interbank lending rate is a good description of how monetary policy works in most OECD economies today. Note, however, that this system is relatively new: 20 years ago—and further back in time—the central bank controlled the interest rate by *buying and selling money*! The central bank bought money by selling *bonds*, a kind of security that guarantee the owner returns in the future. If for instance the central bank sold bonds, banks bought them for cash, the amount of money in the economy fell, and interest rates rose. If the central bank wanted to cut interest rates then it bought bonds from the banks.

The financial system is important in modern economies. On Coconut Island—and in reality—it is important for households, businesses, and government to be able to save and borrow money easily. Thanks to the financial system these people do not need to meet and agree on the terms of the loan: lenders and borrowers are linked by the banks. In addition, the parties also avoid having to negotiate conditions for the loan, check contract compliance, etc. Furthermore, the risk for the lender is dramatically reduced when she lends to a bank, instead of lending directly to another household or a firm.

Nevertheless, there are also more direct alternatives. Via *direct transfers* the borrower and lender come into direct contact with each other. For instance, a firm wishing to raise money may sell *bonds* to the public, which stipulate some stream of repayment, instead of negotiating a loan from a bank. Alternatively, firms may sell *shares*, which confer part-ownership of the firm and thus the right to a share of future profits.

[4]For more on inflation, see http://www.riksbank.se/sv/Penningpolitik/Inflation/Hur-mats-inflation/. For a newspaper article about the basket of goods see http://www.theguardian.com/business/2014/mar/13/inflation-basket-netflix-flavoured-milk-dvd.

The government. The government's role as an economic actor is clearly visible even in the simplified coconut economy. The government collects taxes, spends money on government consumption and transfer payments, and tends to build up financial liabilities relative to the outside world. (In a closed economy the outside world means households.) The government must pay interest on these debts. The government debt (or national debt) is usually expressed as a percentage of the country's total GDP per year. As we see in Figure 2.7, government debt as a proportion of GDP may be close to zero (e.g. Estonia) or well over 100 percent (Greece). It is natural that the state builds a (financial) liability of this sort; it owns a lot of capital assets. However, it is important that the debt should not become 'too large' such that the financial markets begin to doubt the country's ability to continue to pay interest on debt.

In reality, the central government borrows money from the financial markets on specific terms by selling *government bonds* (or simply *bonds*). In its simplest form a government bond is a promise from the government to pay a certain nominal amount on a certain date, such as in a year. Government sells these promises to bring in money. The price the government can get for such bonds is determined by the market. If the Swedish government sells bonds which promise 100 crowns to the holder in exactly 1 year, the price investors offer will depend on the interest they can earn on equivalent investments. More helpfully, assume that a completely risk-free investment is available which gives 1 percent nominal interest. Then the investor will pay $100/1.01$, i.e. 99.01 crowns for the bond if it is also judged to be risk-free. On the other hand, if there is thought to be some risk of default then the price offered will be lower.[5]

Financing the government debt by selling bonds implies that the government must periodically refinance that debt: each time a bond issue becomes due for repayment, the government must sell new bonds in order to pay the money due on the old ones. This process allows financial markets to adjust the nominal interest rate paid by the government on its debt. If for instance the risk of default is thought to have risen since the last bond sale, then the government will receive less (per bond) when it sells, and it must sell a greater number of bonds in order to raise the necessary cash.

In Figure 2.7, we see that the national debt can be very different between countries with very much in common. However, it is not the level of the debt but the rate at which the debt rises that is most important to the financial markets; in the three years 2008–2011, Greece's national debt rose by more than 60 percent relative to its GDP, implying that the government budget was in deficit by more than 20 percent of annual GDP for the whole country. It is thus hardly surprising that the financial markets doubted Greece's ability to repay.

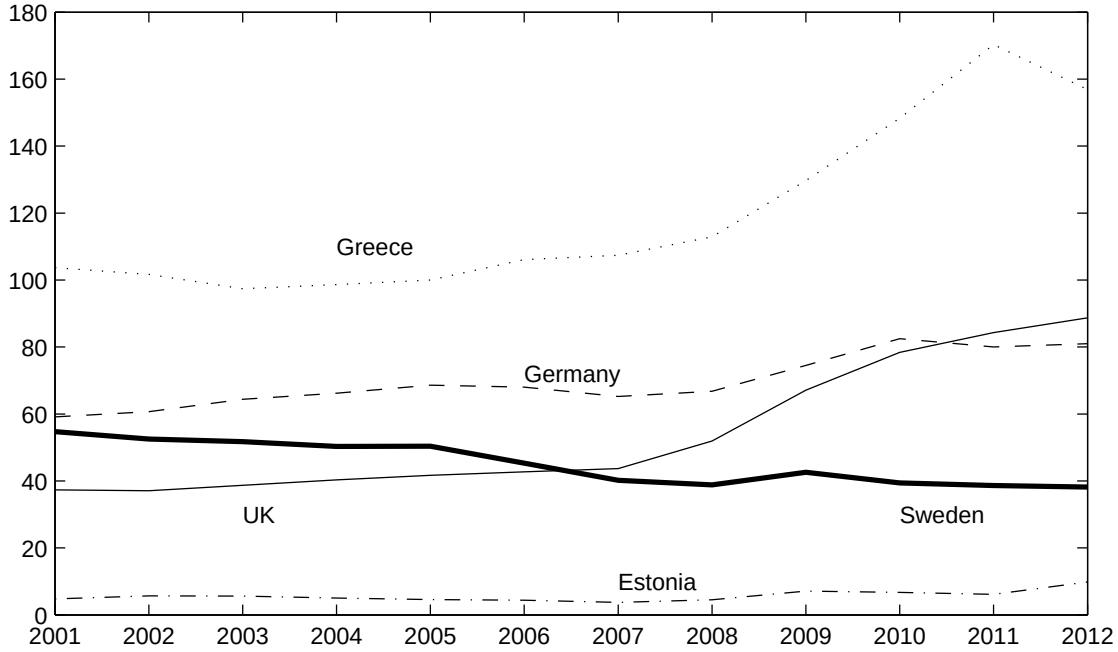


FIGURE 2.7. Trends in government debt as a percentage of annual GDP for selected countries. Source: Eurostat.

[5]At the time of writing, a Swedish government 1-year bond offers a yield (interest rate) of 0.723 percent. This should be compared to the Swedish base rate of 0.75 percent. The fact that the bond yield is slightly below the base rate implies that there is —on balance— an weak expectation that the base rate is more likely to fall than to rise during the next year.

Investment and capital In model economy 2.3, continuation 8 we concluded that the value of capital in the economy was 10 times greater than annual GDP. This value of capital is much too high when compared to real economies, even though the proportion of total income going to capital owners rather than workers—33 percent—is about right. The reason is that the model has no *capital depreciation*, nor growth. If capital depreciates by 8 percent per year then owners will want to be compensated for this depreciation when they hire it out, as well as receiving the interest rate on money. Allowing for this a more realistic gross annual return on capital is 0.03 percent per day, implying that capital stocks are worth 33 million crowns in total, 3.3 times annual GDP.

2.3.2. What Coconut Island does not show about the real economy. Our analysis of Coconut Island can be seen as an accounting exercise. We track money through the economy and see how decisions could result in (for example) increasing government debt. We defined the concepts of GDP and inflation, and saw how inflation can occur in a very simplified context. However, we have not learned anything about GDP growth, economic fluctuations, and unemployment, which are the main subjects of the book.

To create growth in GDP requires of course that something grows. It could be the population, but that will not raise GDP *per capita*, and that is what we are most interested in. In order for GDP per capita to increase, worker productivity must increase, and for that, there are a number of possible causes. One possible cause is that workers get more *capital* to work with, i.e. more machines or tools. However, it turns out that the key to growth is not capital but *technology*.

The business cycle involves periods during which the economy's resources are under-used (recessions) and over-used (booms). To create cyclical fluctuations in our model economy we need to introduce shocks (such as the bad news or the sudden concern for the future); these shocks disrupt the economy's steady progress. Furthermore, it will prove to be necessary to introduce imperfections into the well-oiled economic machine if such shocks are to lead to economic fluctuations; in an ideal economy (with perfect markets throughout) negative shocks lead not to the under-utilization of resources in the economy, nor do positive shocks lead to overexploitation. The key is investment: in an economy with perfect markets an adverse shock leads to an *increase* in investment, while in real economies the result is the opposite.

Unemployment is even more difficult to explain. On Coconut Island it is difficult to see why anyone would need to be unemployed. You just have to 'get on your bike' and pick! Again we focus on how the mode of operation of the market economy can lead to a significant proportion of those who want to work being unable to find work.

Finally, what happens when the economy is open, that is when the economic agents in the economy interact in different ways with agents in other countries? It turns out that most of our results are fundamentally similar, albeit with some modifications.

Exercises

Ex. 2.1 You live on an island and pick coconuts, 2 per day. You have 20 dollars and pay yourself with them every night. In the morning you can buy the nuts from your firm, eat breakfast, and go to work. Illustrate the circular flow. What are M, V, P and Y?

Ex. 2.2 If GDP growth in a country is 3% per year, the velocity of money is constant, and the central bank wants to achieve an inflation rate of 2 percent per year, how fast must the money supply increase? Explain!

Ex. 2.3 In a closed economy the government is running a deficit and the government debt is increasing. Axel thinks this is wrong because the debt will be a burden for future generations, while Bert believes that Axel is wrong because the government does not borrow from future generations, but rather from today's citizens. Who is right?

Ex. 2.4 In an economy, there are four hundred people, three hundred people working and a hundred who have retired. Those who work earn 100 USD per day, and both workers and retirees receive 30 USD per day as returns on their capital. Workers save 30 USD per day, and retirees spend 60 USD per day on consumption. The financial transactions are handled by a bank that lends money left over to companies who want to invest in capital.

(a) Illustrate the circular flow.
(b) What is the GDP of the economy?
(c) What is the level of the nation's investment, as a percentage of GDP?
(d) What proportion of GDP goes to capital owners?

Ex. 2.5 Assume an economy—Coconut Island—with 100 workers, and no capital. Each of the workers earns 100 000 SEK per year, of which the government takes 20 percent in income tax. The government spends 1.8 million SEK per year on government consumption. The government

debt at the start of the year is 50 percent of GDP, on which the government must pay interest at 2 percent per year. The economy is in long-run equilibrium in the sense that inventory investment is zero.

Illustrate the circular flow. What is the government budget deficit (or surplus) that year?

Ex. 2.6 In a year, 1999, the prices and quantities of three products change as follows.

	Tennis rackets		Chocolate	
	Price, SEK.	Quantity.	Price, SEK.	Quantity.
1998	200	10	5	200
1999	300	10	10	200

(a) What is the percentage change in prices of the different goods?
(b) What is the rise in the consumer price index?
(c) Has the price change of tennis rackets been relatively higher or lower than for chocolate?
(d) Has the welfare of some consumers increased or decreased relative to other consumers? Explain.
(e) Explain why it is harder to measure inflation when the amount of goods purchased are subject to change due to price changes.

Ex. 2.7 Assume that the Spanish government wants to raise money by selling government bonds. Anyone who buys such a bond obtains EUR 1000 after exactly one year. How much can the Spanish government raise per bond if the risk-free interest rate in the euro area is 5 percent per year, and the market believes that it is certain that Spain will be able to fulfill its obligation to pay?

CHAPTER 3

Economic growth 1: Empirical observations

We now return to the first of our key topics, economic growth. What determines how much is produced per capita in an economy, GDP? What determines the growth rate of GDP? And how can the government act to achieve a better outcome, for instance a higher growth rate? Before tackling these questions, however, we return to the definition of GDP and economic growth, and study some broad empirical observations about growth in different countries over very long time periods. These observations give us a benchmark against which to compare the predictions of our models.

We discuss five main observations in this chapter. Firstly, over thousands of years up to around 1700, growth rates in GDP per capita were very slow on average all around the globe. Furthermore, there was also a very slow increase in global population. Secondly, since industrialization the growth rates of the leading economies have been remarkably constant in the long run, and there is little or no sign that they are about to slow down. Thirdly, there are *very large* and *very persistent* differences in GDP between countries: some countries have persistently much lower GDP than others. The fourth—somewhat paradoxical—observation is that despite the persistent differences in GDP, very rapid catch-up may also be observed, i.e. economies with relatively low GDP per capita may experience very rapid growth, faster than anything observed in the leading economies. The final observation is that the growth process involves structural change in the economy: a doubling in GDP does not simply involve double the production rate per person of the same goods and services, it involves new (more valuable) goods and services, produced in new ways.

3.1. Mathematical prologue

Throughout the book we often plot growth rates using a logarithmic scale on the y-axis. The reason is that when we display a variable growing at a constant rate on a normal (linear) scale then the graph is hard to interpret: we can see that growth is dramatic in the long run, but not much more. On the other hand, when we plot using a logarithmic scale on the y-axis then the figure is much more informative.

To see the advantage of the logarithmic scale, consider a variable y which has the value y_0 when $t = 0$, and is growing at a constant rate g. That is, we have

$$y(t) = y_0 e^{gt}.$$

This equation shows that y is growing *exponentially*, i.e. at a constant rate. Now take the natural logarithm of each side of the equation, in which case we obtain

$$\ln y(t) = \ln y_0 + gt.$$

If we plot $\ln y$ against t this is simply a straight line with slope g: thus we can read off the growth rate from our logarithmic plot as the slope of the line. For instance, if the slope of the line is 0.03 then the growth rate is 3 percent per year.[1]

3.2. Pre-industrial growth

We begin with a very brief look at pre-industrial growth. The evidence regarding pre-industrial growth is presented in Figure 3.1. The first thing to notice from Figure 3.1 is the remarkable constancy of production per capita. Second, note that the level of production—equivalent to the purchasing power of 100 US dollars in 1990—is close to the minimum level necessary for survival. Third, note that population has risen slowly over the period. Finally, note that the vast majority of the global population during this period worked in agriculture, implying that the dominant consumption good was food and there was little structural change. These facts together lead us inexorably into a Malthusian analysis.[2]

[1] Strictly, the growth rate is slightly higher than 3 percent per year because of compounding, however for low growth rates the difference is very small.

[2] See Malthus (1798).

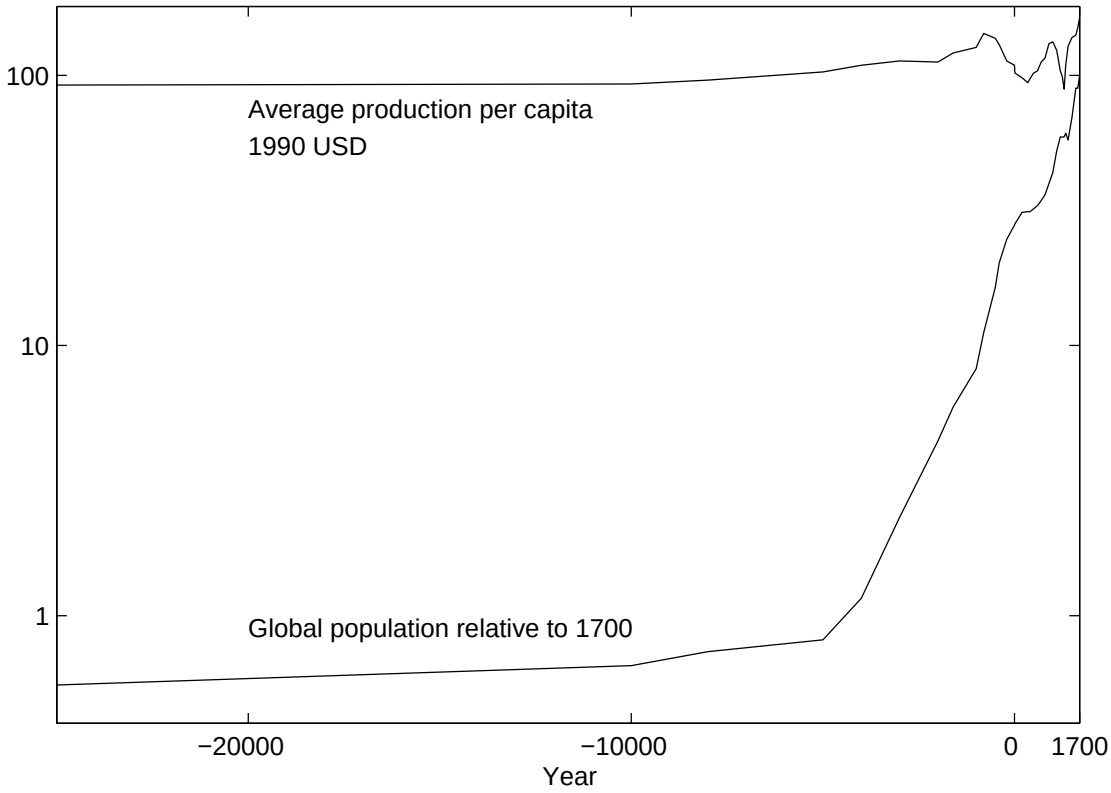


FIGURE 3.1. Global growth in average gross production per capita, and population. (Data from Brad DeLong, Estimating World GDP, One Million B.C. – Present.)

MODEL ECONOMY 3.1. *Assume again an island economy, and assume that the quantity of land is an important limiting factor for the economy, along with the level of technology; better technology allows the population to extract more production from the land. In 5000 BCE the income level per capita is 100 USD/year. However, at this time a new technology is discovered, production rises, the people's health and well-being increases, and infant mortality declines. Since more infants survive to adulthood, the population increases. Since land is fixed, production fails to rise in proportion to the population, and production* per capita *declines. Population growth stops when production per capita is back down to 100 USD/year.*

This model is perfectly in accordance with the data of Figure 3.1. Furthermore, the figure tells us that the rate of technological progress is *glacial* over the period under study. A back-of-the-envelope calculation shows that even over the period of much more rapid growth (after around 5000 BCE) the growth rate of population is just 0.07 percent per year, i.e. about 50 times lower than the average growth rate of global product over the last century.[3] Why was growth so slow up to 1700 compared to growth over the last 300 years?

3.3. Patterns in growth across time and countries

3.3.1. Constancy over time. The next empirical observation we consider is the remarkable constancy of growth rates after the industrialization process has started. The classic illustration of this is growth in the U.S. since 1870, as shown in Figure 3.2 (the idea for this figure is taken from Jones (2005), Growth and Ideas). Note that the scale on the vertical axis is logarithmic, implying that a straight line indicates a constant rate of growth. Furthermore, the slope of the curve indicates the growth rate. The slope of the dotted line is approximately $2.5/135$, i.e. 1.85 percent per year. Note also that the U.S. was close to or at the leading edge technologically throughout the period.

3.3.2. Persistency of differences across countries. An observation closely related to the constancy of growth rates is the persistency of differences between the GDPs of different countries. That is, the GDP of different countries tends to grow at the same rate at the the same time. This tendency is illustrated in Figure 3.3 for three European countries and the US since 1950. Here we see that the GDP per capita of

[3] Over a 6700-year period population increases by a factor of about 100. $100^{1/6700} = 1.0007$, hence the growth rate is 0.07 percent per year.

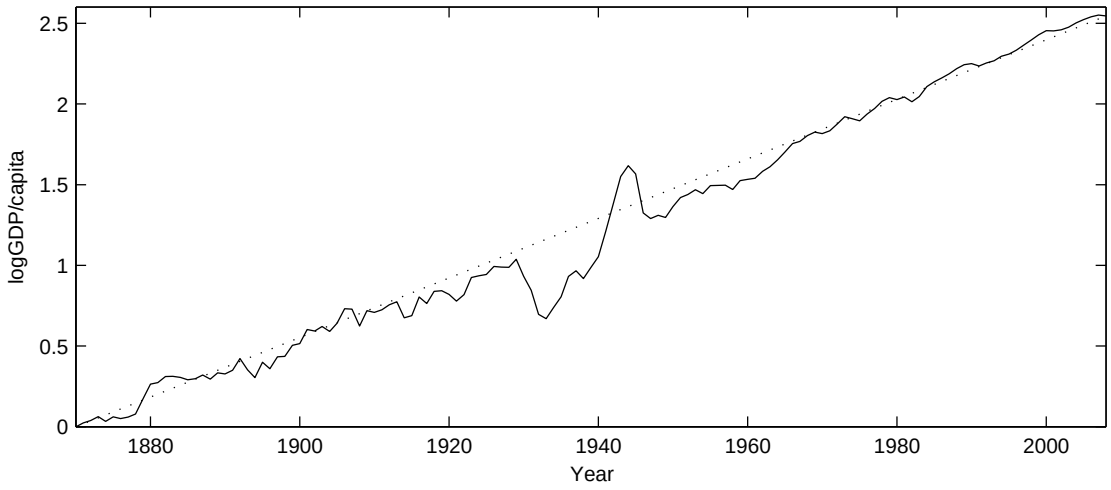


FIGURE 3.2. Growth in GDP per capita since 1870 in USA. Note that the scale is *logarithmic*, which implies that a constant growth rate (in percent per year) corresponds to a straight line in the figure. Data from Maddison (2010).

the richer European countries is persistently around 30 percent below the GDP per capita of the US. (Note that when two curves are separated by 0.35 on a natural log scale, this corresponds to the lower curve being 30 percent below the upper curve. Mathematically we have $\exp(-0.35) = 0.70$, i.e. 70 percent.)

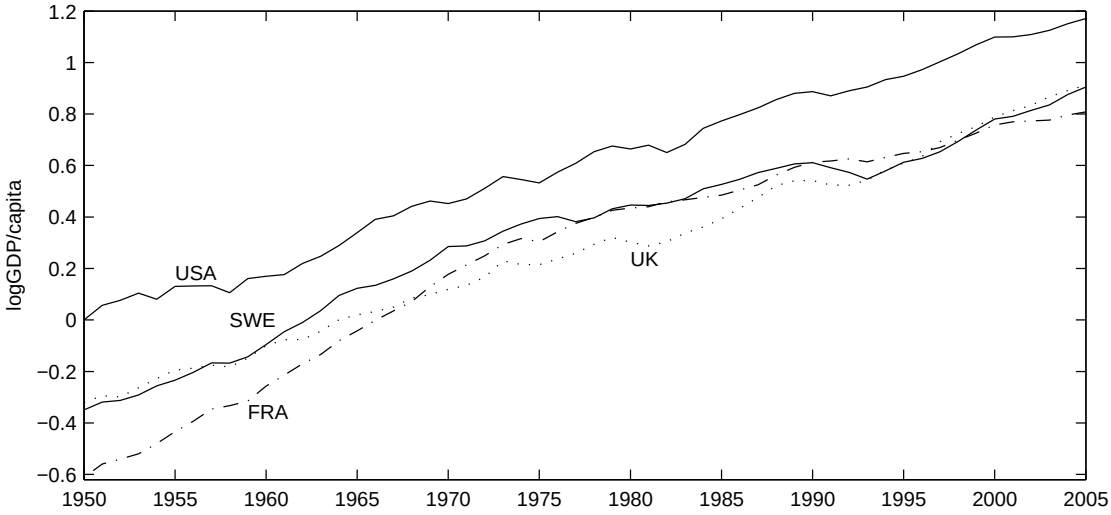


FIGURE 3.3. GDP per capita since 1950: comparison between USA, Sweden, UK and France. Data from Maddison (2010).

Perhaps more significantly, very large differences in GDP are also shockingly persistent. Indeed, as Figure 3.4 shows, they may even grow over time. In the figure the divergence between the lines shows that the gap in average GDP per capita between Africa and the US has grown significantly since 1950. In 1950 the GDP of the average African was at around 9 percent of the average American; by 2008 it was just 5 percent.[4]

3.3.3. Catch-up. To complete the picture regarding growth patterns, note that countries are not doomed to remain in the same positions relative to one another. Bad luck or bad management can lead to a country falling back in the 'GDP league table' (as happened to many countries in South America during the 20th century); on the other hand, good luck or good management can lead to a rapid rise towards the GDP frontier. Perhaps the most obvious example of a rising economy is China. In Figure 3.5 we compare the GDP per capita of the US and China over the period from 1870, showing the gap first widening dramatically, and then narrowing.

[4]The gap on the log scale increases from around 2.4 to 2.9. In percent we have $\exp(-2.4)$ and $\exp(-2.9)$.

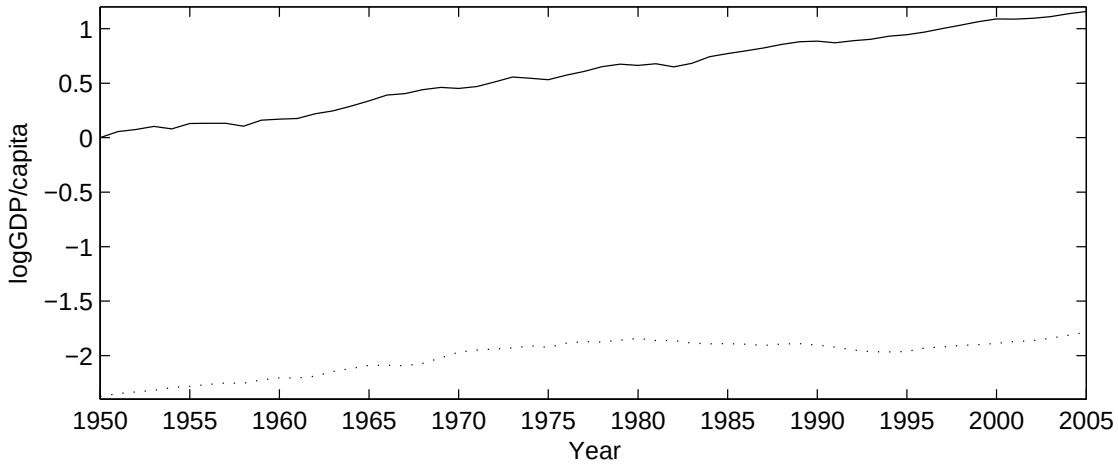


FIGURE 3.4. GDP per capita since 1950: comparison between the average for Africa (dotted line) and the US. Data from Maddison (2010).

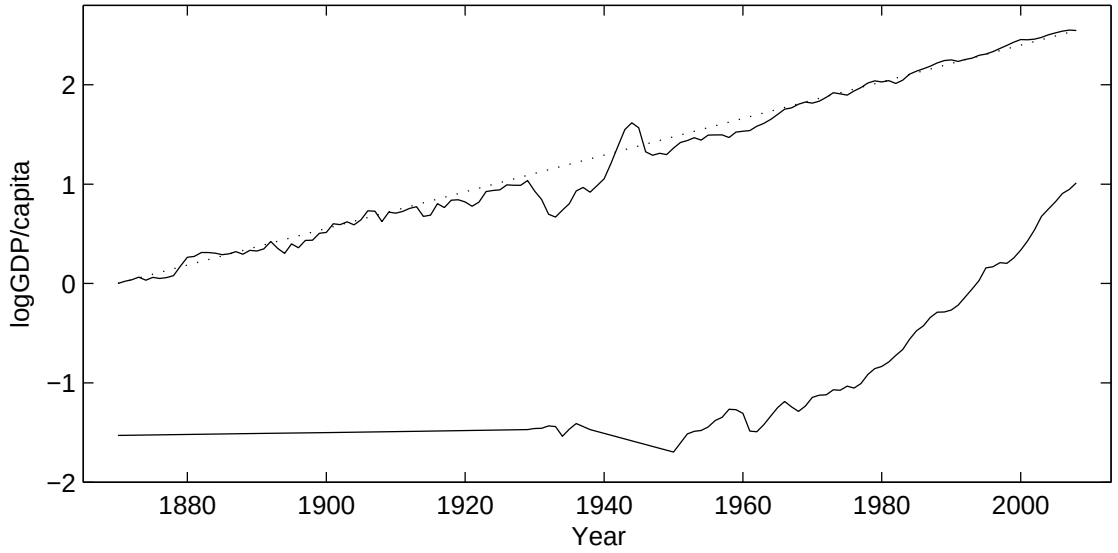


FIGURE 3.5. GDP per capita since 1870: comparison between the US (upper curve) and China. Data from Maddison (2010).

3.4. Structural change

Finally, note that the growth process involves structural change in the economy: a doubling in GDP does not simply involve double the production rate per person of the same goods and services, it involves new (more valuable) goods and services, produced in new ways.

Overall we tend to observe the following pattern during the growth process. At the start of the industrialization process almost the entire population works in agriculture, hence by far the dominant product is food. As agricultural productivity (per worker) rises, the need for food can be met by fewer workers, hence workers shift into the industrial sector (moving to towns and cities in the process). As industrial productivity rises, the production of industrial (manufactured) products increases very rapidly. However, the productivity of workers in service industries tends not to rise so fast, so workers tend to shift over time from manufacturing (where they are less in demand) to service industries.

3.5. Measurement of GDP, and growth

Regarding the difficulties of measuring economic growth and GDP, they are easily overstated. GDP should give a measure of the production of marketable goods in an economy, and it does this rather well. A bigger problem—which we did not mention above—is that the relative values of different currencies on the international market does not always reflect their relative domestic purchasing power. Interpretation of GDP is potentially a bigger problem than measurement: it should be very clear that GDP

is not in any way a measure of happiness, nor even of well-being, it is a measure of productive capacity and its utilization.

Note that the models do not deal with *inequality*. In the accounting framework with constant shares of labour and capital, the wage rises at the overall growth rate. However, in real economies the wages of different groups tend to rise at different rates. Over many decades, the wage differential between college-educated and non-college workers has tended to increase, thus the wages of non-college workers have risen more slowly than the overall growth rate. In the last ?? years, wages of the highest earners have risen very rapidly in many OECD countries, while middle-income wages have risen much more slowly. In the US, for instance, ?? data to come. The rapid increases in inequality over the last 20 years have caused the issue to rise back up the political and economic agenda in many countries, and this trend is likely to increase.

Exercises

Ex. 3.1 Explain why it is easier to interpret a graph of GDP over time when the (natural) logarithm of GDP is plotted.

Ex. 3.2 Are European countries such as France and Sweden falling behind the United States in terms of GDP?

Ex. 3.3 What is the most remarkable feature of U.S. growth since 1870?

Ex. 3.4 Explain why technological progress prior to 1700 led to a greater global population but not higher GDP per capita, at least for the majority. How rapid was that progress?

Ex. 3.5 The question is about the development of GDP per capita in the United States and China since 1870. Use Figure 3.5 to help you answer the questions.

(a) GDP per capita in the US is more than 10 times higher today than in 1870. Does that mean that US citizens consume 10 times more today than in 1870?

(b) China's growth has accelerated considerably since the late 1970s. The amount of capital per capita has also increased tremendously over the same period. Can we therefore conclude that the capital increase is the main reason behind the growth?

CHAPTER 4

Economic growth 2: Capital accumulation and technology adoption

We now turn to the analysis of how foregoing consumption for the sake of capital accumulation and technological progress may be linked to growth in the short and the long run. Recall that in Chapter 1 we showed that long-run growth depends on a cycle of technological progress and investment in new capital, and that capital accumulation alone cannot yield long-run growth. In this chapter we redo the analysis of Chapter 1 in considerably more depth, adding depreciation to the model of capital accumulation, and calculating returns to labour and capital in the model with technological progress. Finally, we consider at greater length how the model economy can help us to understand real economies.

4.1. Capital accumulation on Coconut Island

Robert Solow developed his famous growth model in 1956, and showed that 'pure' capital accumulation (by which we mean accumulating greater numbers of tools or machines of the same type as already exist in the economy) cannot lead to long-term growth. Here we come to the same conclusion with an adapted version of his model, building on Model economy 1.1, continuation 1.[1]

Model economy 4.1. *Assume that* 1000 *people live on Coconut Island, and they have moved on from picking nuts to producing a range of products with the help of capital goods including things such as hoes, axes, bows and arrows, and kilns. However, for simplicity we assume that there is just one fundamental product, a widget. A widget can be rapidly (freely) converted into a loaf (i.e. a consumption good) or into a tool (i.e. a capital good). A worker without a tool can make* 0.25 *widgets per year, corresponding to* 0.25 *loaves or tools. The prices of a widget is 400 crowns (which is also the price of loaves and tools, since they are interconvertible). GDP per capita is therefore 100 crowns per year. A worker with a tool is twice as productive as a worker without a tool. Finally, tools wear out. When a tool is used, there is a 10 percent chance that it falls apart at the end of the year.*

It is 1 January 1960, the stock of tools is zero, production of widgets is 0.25 per person per year, and GDP per capita, Y, is 100 crowns per year. However, the islanders decide to devote 20 percent of widgets to making tools rather than loaves. What happens in the economy over time?

Prior to 1960 there are no tools and no investment, and we have

$$Y = 100, \;\; C = 100, \;\; I = 0.$$

In 1960 20 percent of production is saved and we have (per capita)

$$Y = 100, \;\; C = 80, \;\; I = 20.$$

Assume for simplicity that tools made in 1960 cannot be used until 1961. Recall that each worker produces 0.25 widgets per year, of which 20 percent is converted to tools. So at the end of the year there are 0.05 tools per person, i.e. 50 tools in total. So in 1961 50 workers (or 5 percent of all workers) have tools and are therefore twice as productive. This implies that total widget production is raised by 5 percent, and we have

$$Y = 105, \;\; C = 84, \;\; I = 21.$$

At the end of 1961, 5 tools fall apart. On the other hand, 52.5 new ones were made ($21 \times 1000/400$). So the total stock of tools rises from 50 in 1961 to 97.5 in 1962.

What is the *long-run equilibrium* in this economy? The more tools there are, the more fall apart each year, which tends to reduce the number for next year. On the other hand, the more tools there are, the more productive are the workers, *up to a point*. When all the workers have tools, there is no benefit to further accumulation of capital (i.e. tools). Let us consider the point at which everyone in the economy has a tool, i.e. the stock of tools is 1000. Then total production is 500 widgets per year instead of just 250 (recall that workers are twice as productive when they have tools with which to work), of which 20

[1] The key point is that more capital cannot lead to growth in the long run, if the capital is all of the same type. Instead, growth must be based on an increase in something else, which Solow called 'total factor productivity' (TFP), by which he meant the productivity of labour and capital combined. Solow could not explain why TFP rises, but he showed that a rise in TFP must be the key factor behind long-run growth.

percent, i.e. 100, are converted into new tools. Furthermore, when the stock of tools is 1000, that implies that 100 will fall apart at the end of the year (10 percent of the stock). So at this point there is balance between tool production and *depreciation*, i.e. the rate of loss of tools due to wear and tear. So in the very long run we have

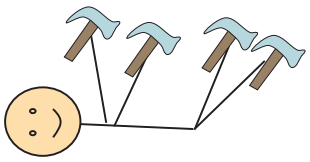
$$Y = 200, \quad C = 160, \quad I = 40.$$

The model illustrates how an economy with neither technological progress nor population growth will approach a long-run equilibrium in which all the key quantities in the economy are constant: in particular, GDP, consumption, and investment are all constant. This is illustrated in Figure 4.1(a). In the long-run equilibrium there is a balance between production of new capital and its depreciation. Such a balance—or *steady state*—will be reached whatever the level of investment in the economy, however, with more investment there will be more capital in the steady state. In our simple model, beyond the point at which everyone has a tool there is no value whatsoever to extra capital, hence a level of investment giving rise to more than this level of capital is excessive and wasteful. Consider for instance the following.

MODEL ECONOMY 4.1, continuation 1. *In 2010 an economist arrives and tells the population that in China the investment rate is 50 percent rather than just 20. They decide to follow suit, raising their investment rate to 50 percent in order to raise their capital stock and boost production in the long run. What happens?*

The result of the massive increase in investment can be seen in Figure 4.1(b). GDP stays the same at the time of the change, since the level of productive effort is unchanged. However, widgets are turned into tools instead of consumption goods, hence C falls dramatically whereas I rises: $Y = C + I$. Since there are not quite 1000 tools in the economy when the change is made, the boost in investment leads to a rapid increase in production as the number of tools approaches 1000. This point is reached after only a couple of months, and production then levels off; beyond this point the extra investment leads to the accumulation of tools for which there are no workers. Note how the dramatic rise in investment leads to a dramatic loss of consumption, both in the short run and in the long run.

So we see that extra investment in capital goods *does not result in long-term growth*. The reason is that the market for capital goods quickly becomes saturated, and additional items of the same kind provide no additional output. One can think of tools as hammers. If there are very few hammers, then producing more of them may boost productivity in the economy. However, once everyone has a hammer there is no point in raising the number of hammers further.



MODEL ECONOMY 4.1, continuation 2. *In 2010—in an alternative scenario—there is a natural disaster and half of the tools in the economy are destroyed. What happens?*

The result of the natural catastrophe can be seen in Figure 4.1(c). The lack of capital has a significant short-term effect, but after a few years the country approaches its old level of production. Note how the effect of the drastic loss of capital is both rather small and short-lived.

MODEL ECONOMY 4.1, continuation 3. *In 2010—in a second alternative scenario—an economist advises the people that investment in capital does not lead to long-run growth, and they cut investment to just 10 percent. What happens?*

If investment is 10 percent this implies that only 10 percent of widgets are converted into tools. In long-run equilibrium the rate at which tools are produced—i.e. $0.1 \times Y$ must match the rate at which tools fall apart or depreciate, $0.1K$, where K is the number of tools. But total production is the sum of production from those with tools and those without tools, i.e.

$$1000Y = 0.5K + 0.25(1000 - K),$$

hence total production of tools is

$$0.05K + 0.025(1000 - K).$$

In equilibrium we have

$$0.1K = 0.05K + 0.025(1000 - K),$$

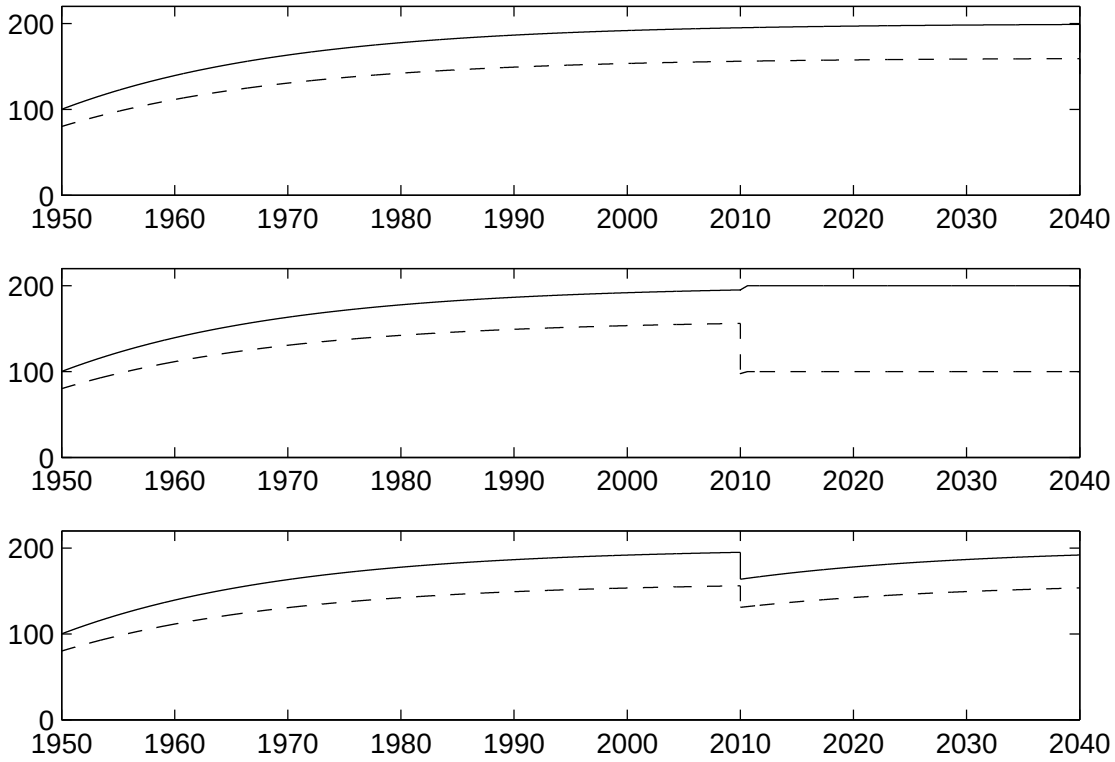


FIGURE 4.1. The three cases: Model economy 4.1, and 4.1, continuation 1 and 4.1, continuation 2. The continuous lines show GDP, the dashed lines show consumption. The gap between consumption and GDP is of course investment.

and hence

$$K = 333,$$

implying that $Y = 133$ crowns per year. So when the saving rate is halved to 10 percent, GDP drops in the long run by one third.

To sum up, the model gives us two major predictions. Firstly, that big differences in savings rates between countries should cause modest long-run differences in the *levels* of GDP between those countries. Secondly, that recovery from shocks to the capital stock should be rather rapid, of the order of 10 to 20 years.

Turning to the data presented in Chapter 3, the model fails to explain any of the major observations about long-run growth which we discussed there, i.e. the constant rate of GDP growth, persistence of (very large) differences in GDP between countries, potential for dramatic catch-up, and structural change. Considering our intuitive knowledge about the growth process, this is hardly surprising. We know from our own experience that long-run growth is not driven by firms accumulating more and more of the same capital good. Instead we see cycles of renewal in the economy in technological progress (the creation of new designs) is followed by replacement of old (obsolete) capital goods by new (modern) capital goods. We therefore turn now to a model which describes this process in a simple way.

4.2. A model of growth through investment in new technology

In the previous section we learned that in order to continuously increase output it is not sufficient to continuously increase the amount of capital. What then is the cause of long-run growth? In this section we will see that it is essential to continuously adopt new technology. The history and growth of GDP per capita is largely the history of technological development. Is our production of goods and services is higher per capita than it was 100 000 years ago because we have more stone arrowheads today? Or is it higher because we have developed technologies such as agriculture, the smelting of iron and steel, the printing machine, and the computer?

MODEL ECONOMY 4.2. *Assume an economy in which there are people and machines, and each machine needs one person to operate it. Machines last for ten years, at which point they fall apart irreparably and must be replaced by new machines. In the year 2000 there are 100 people and 100 (new) machines. Of these, 80 people—each with a machine—work on the production of consumer goods, while 20 people—*

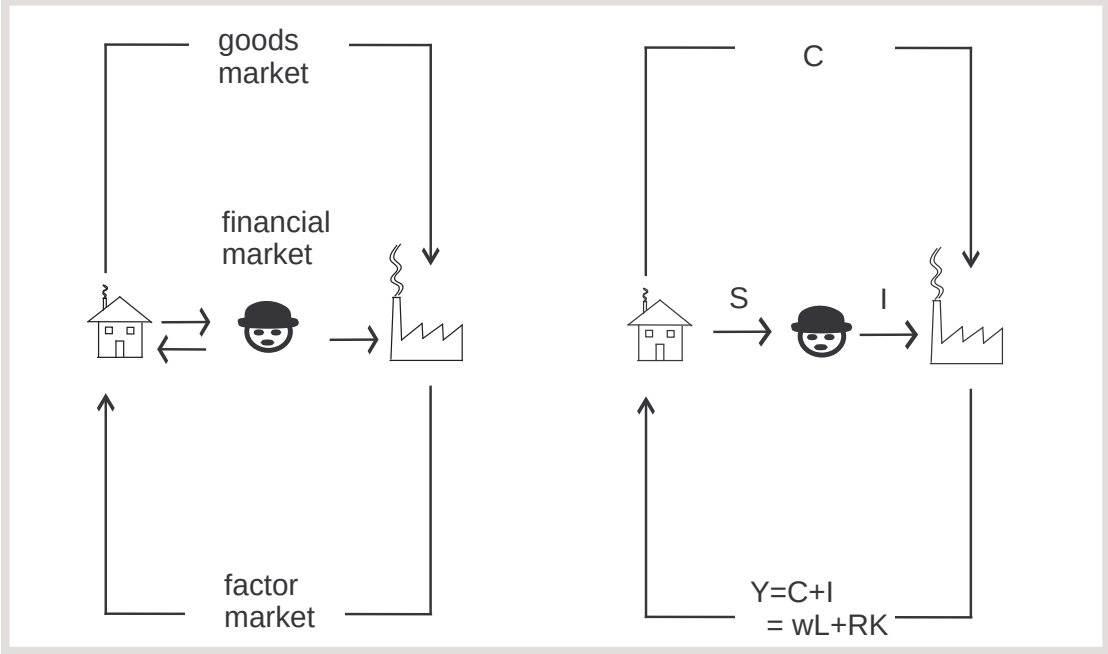


FIGURE 4.2.

each with a machine—work on the manufacture of the next-generation machines. 100 new machines are ready in 2010, and they are 20 percent more productive than the old. That is, they generate 20 percent higher output per period. All workers command the same wage, which is 100 crowns per year in 2000.

To understand this economy, first return to the fundamental picture of the circular flow of money in the economy, illustrated in Figure 4.2. Here we see the fundamental equation $Y = C + I$. We also know that Y—the flow of payments from firms to households at the bottom of the picture—is made up of wage payments to workers wL, and rental payments to capital owners, RK.[2] So when Y increases, the sum of these payments—to capital and labour—must increase by the same amount. Furthermore, if we assume that capital and labour take *fixed shares* of the total cake, then payments to capital and labour will grow at the same rate as overall GDP. In reality it is true that the shares of capital and labour are rather constant, with capital owners typically taking around 30 percent of GDP, and workers taking the remaining 70 percent.

Now we turn to the specific economy in question, illustrated in Figure 4.3. Figure 4.3(a) shows the total flows during each period of 10 years, where Y_1 is GDP per year. We know the flow of wages, but we know nothing so far about the value of the capital accumulated in the economy, nor the flow of payments to capital. Furthermore, since we do not know returns to capital we cannot work out GDP either. The fundamental problem is that we do not know the interest rate. Recall that we know that workers making machines are paid 100 crowns each per year in period 1. Who pays these workers? It must be investors who borrow money in period 1, planning to make a profit by hiring out the machines in the following period. What price do the investors set? It depends on the interest rate.

MODEL ECONOMY 4.2, continuation 1. *Assume that the real interest rate per period of 10 years is 100 percent. What is GDP in period 1? What is the labour share, and what is the capital share?*

Recall that to make the 100 new machines to be used in period 2, 20 workers with 20 machines must be employed throughout period 1. Thus 20 percent of the economy's resources are directed to investment, costing 20 percent of GDP, Y_1, each year. Therefore the total investment cost through period 1 is $0.2Y_1 \times 10 = 2Y$ crowns in total. The interest rate is 100 percent per period, and (for simplicity) we assume it applies at the instant we move from one period to the next (rather than building up from day to day), implying that the owners of the capital must pay back $4Y_1$ crowns at the end of period 1, implying that they must earn $4Y_1$ crowns hiring out the machines in period 2 in order to break even. Therefore—assuming perfect markets—the cost of renting the machines must be $4Y_1$ crowns in period 2, or $0.4Y_1$ crowns per year.

The final insight we need to characterize the growth path is that there is balanced growth at 20 percent per period. This means that if the cost of machine hire is $0.4Y_1$ crowns/year in period 2, it must

[2]Here w is the wage and L the number of workers, and R is the price of machine hire while K is the number of machines.

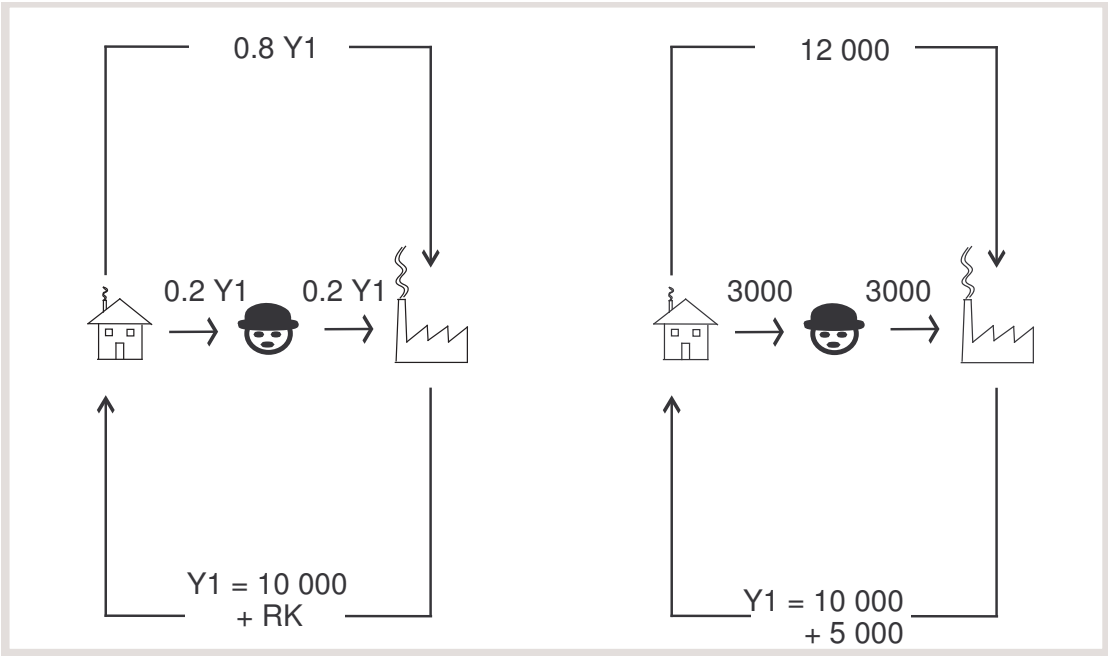


FIGURE 4.3. The circular flow in economy 4.2: (a) based on the information we are given initially; (b) after we have calculated returns to capital.

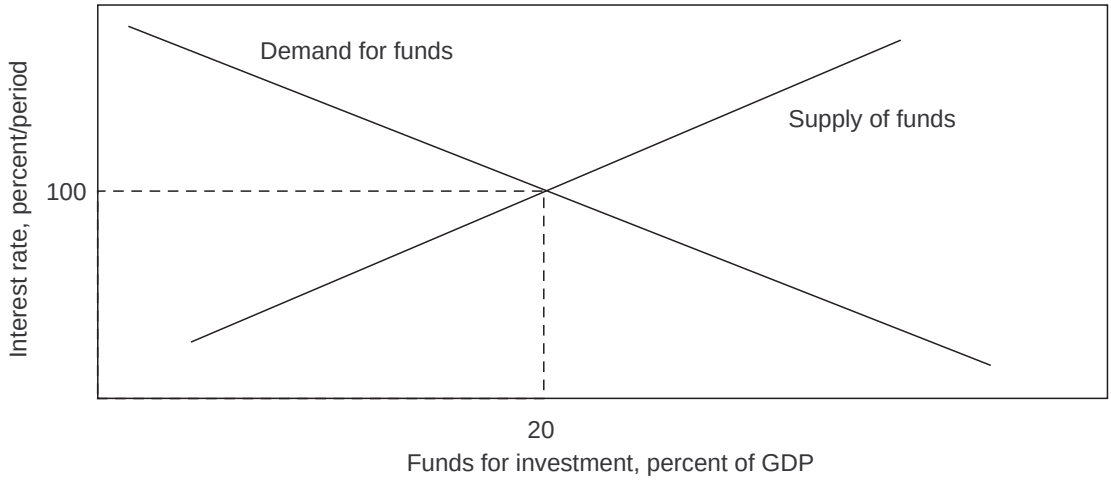


FIGURE 4.4. The supply and demand of investment funds

be $(0.4/1.2)Y_1$ crowns/year in period 1, i.e. $0.33Y_1$ crowns/year. Thus payments to capital are 33 percent of GDP. Since per capita payments to labour are 100 crowns/year, per capita payments to capital must be 50 crowns/year, and GDP per capita must be 150 crowns/year. See Figure 4.3(b).

We have now characterized one growth path of this economy. However, we are far from done with our analysis, since so far we have simply assumed the investment rate (20 percent of GDP) and the interest rate (100 percent every 10 years). In real economies these numbers arise as a result of the decisions of economic agents. We now set about building a simple model to describe this process.

For now we assume that total expenditure per year (i.e. nominal GDP, PY) is fixed, and the only question is how this expenditure is allocated between consumption and investment. To analyse this allocation we consider the supply of and demand for investment funds. The supply of investment funds should be an increasing function of the interest rate, which we can think of as the price of such funds: the higher the interest rate, the more a household can earn by foregoing consumption and lending its money to those who wish to borrow. Therefore we have an upward-sloping supply curve. The demand for investment funds, on the other hand, should be a decreasing function of the interest rate: the higher is the interest rate, the fewer investment projects will be profitable. Therefore we have a downward-sloping demand curve. The result is a standard diagram, Figure 4.4, the only slightly non-standard feature being that the 'price' of investment funds, on the y axis, is the interest rate.

Now we can use the figure to analyse the effect of various shocks in the economy on the interest rate and the investment rate. First, assume (as in the economy without money) that households become concerned about the future, expecting bad times ahead. Their propensity to save therefore increases, and the supply curve for investment funds shifts to the right. From the figure we can see that the result must be a decrease in the interest rate, and an increase in the investment rate. Thus consumption does indeed decrease, and investment increases, just as it did in the economy without money.

What is the effect of this shift in resource allocation, from C to I? Since $Y = C + I$, there is no immediate effect on GDP. However, over time there will be an effect. Since more resources are devoted to investment in new machines, this should allow the machine-makers to produce higher quality machines for the next period (recall that the number of machines is fixed, one per worker). Thus GDP will be higher in the next period, thanks to the higher propensity to save in the current period.

We now briefly consider two other shocks and their effects. Firstly assume that households become more optimistic about the future, causing them (ceteris paribus) to save less and consume more today. Thus the supply of money shifts to the left, the interest rate rises and investment declines. Assuming that lower investment translates into lower quality machines in the next period, the growth rate also declines. Secondly, assume that firms become much more optimistic about the returns to investment. This causes them to demand more investment funds today at a given interest rate, since their expectations about future profits are higher. Thus the demand curve shifts to the right, and both the interest rate and the investment rate rise. Assuming that higher investment translates into higher quality machines in the next period, the growth rate rises.

4.3. Relevance to real economies

Recall that we have studied two economies in this chapter. First a Solow-type economy with pure capital accumulation and no long-run growth, then a more sophisticated model in which there is a cycle of renewal in the economy and growth is driven by investment in better technology, embodied in better capital. What is the relevance of these model economies? In considering this question, we focus on the four facts about growth in modern (industrial) economies: constancy of growth; large and persistent differences in GDP; catch-up; and structural change.

4.3.1. Model 4.1. In model 4.1 there is no long-run growth, so it fails completely on this count. On the other hand, there may be persistent differences in the model economy, due to differences in the saving rate. If households in one economy save more than households in another, then the first economy will build up more capital. As long as the market for capital is not saturated, this will lead to a (persistently) higher level of GDP. The problem with this story, however, is that differences in saving rates between countries are generally not very large, and should typically (according to the model) only lead to rather small differences in long-run capital stocks, and these small differences are nothing like sufficient to explain the very large and persistent differences in GDP between countries. The average GDP per capita across Africa is not one twentieth of the average GDP per capita in the USA because of a low saving rate in Africa. Thus the model also fails to explain the large and persistent differences in GDP which we observe. Turning to catch-up, the model predicts that GDP of all economies should converge rapidly, and cannot explain why an economy such as China may have a long period during which its GDP falls further and further behind the leading economies, only to turn around and move into a period of almost explosive growth. Finally, as there is only one product in the economy, there is no structural change. Summing up, the key function of the model is to *rule out* pure capital accumulation and differences in saving rates as the key to explaining the salient facts about economic growth in the long run.

So the model focusing on pure capital accumulation has little to say about long-run growth. But it does have something to say about more short-run processes, such as the recovery of an economy from a catastrophic loss of capital. Recall that the model predicts that this recovery should be rather rapid, and this is exactly what we observe. This is well illustrated by the case of German recovery after WW2, as shown in Figure 4.5. We see that after just 15 years the economy has almost regained its old trend line, despite the very drastic loss of capital and hence also productivity in 1945.

4.3.2. Model 4.2. We now turn to model 4.2. Can this model explain any of the four key phenomena we highlighted in the previous chapter? That is, constancy of growth, large and persistent differences in GDP, catch-up, and structural change. The short answer is that it seems to have the potential to do so, but the model as presented so far does not.

Regarding constancy of growth, the model posits a continuous cycle of renewal and technological progress, and this cycle is what lies behind the steady growth in GDP. According to the model, as long as technological progress can continue to raise productivity at a constant rate, then growth can continue at the same rate. This picture of the growth process seems to be reasonable when we consider changes in

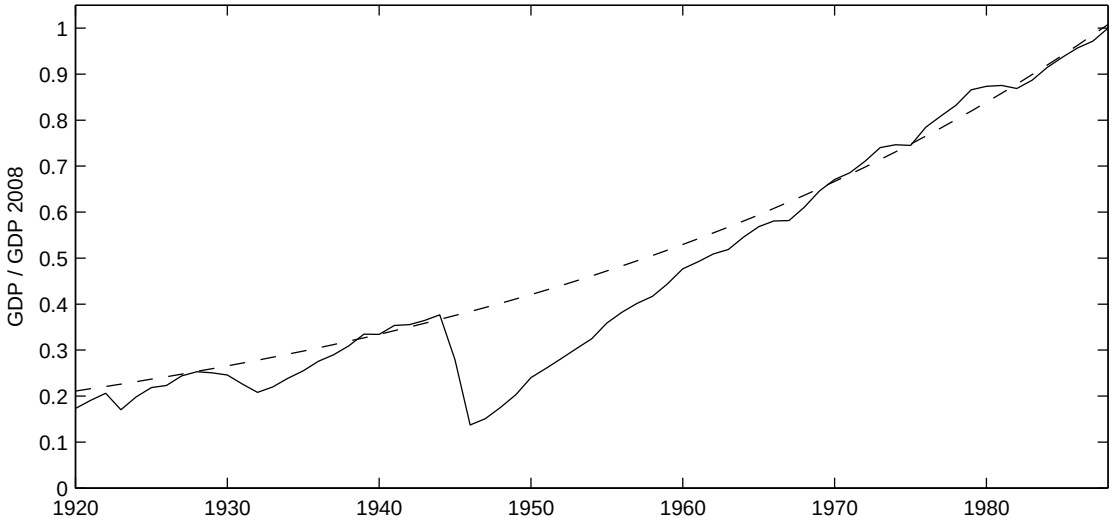


FIGURE 4.5. German real GDP, compared to an estimated constant-growth trend (growth rate 2.3 percent per year). Data: Maddison.

individual economies over the course of several decades, where we see a succession of new technologies arriving and spreading, allowing more efficient production of existing goods (such as cereals), and also allowing production of more valuable goods (consider the evolution of televisions and telephones over the last 60 years).

Why might there be persistent differences in the levels of GDP between countries? For instance, why are European countries persistently around 30 percent behind the US in terms of GDP per capita? And why is average GDP per capita in Africa just 5 percent of that in the US? According to the model economy, very large differences must be due to differences in the level of technology: countries with low GDP are much lower down on the spiral of increasing technology. Why can't they then jump right up to the top, copying the leading economies' technologies? The model puts questions like this one at the centre of understanding long-run growth: there are many possible answers which fit within the spirit of the model, and we will consider some of them in the next chapter.

Catch-up—and the possibility of falling further behind—is easily explained in the model. If a country fails to invest in improved technologies (by which we mean technologies which are better than those currently in use in that country) then its GDP will not grow in the long run, hence it will fall further behind other countries in terms of GDP. On the other hand, if a country is behind then it has a great opportunity to grow fast (catch up) since it has the ability to learn from the advanced technologies of the leading economies. The leading economies, if they wish to increase their GDP, must develop completely new technologies, since they have no one to copy. The more obvious difficulty (as already mentioned) is to explain why catch-up doesn't happen more quickly.

The model is clearly capable of dealing with, and even explaining, structural change. Since the model posits cycles of renewal, it is clearly possible to extend it to allow the mix of products to change over time depending on (for instance) technological possibilities and preferences. As with the other growth facts, however, a lot of work must be done to build up the simple model we have presented into something which can deliver convincing explanations and predictions in real economies.

Finally, we consider the quantitative assumptions and predictions of model 4.2. In this model, the share of payments going to labour is 67 percent, and the share going to capital owners is 33 percent. The growth rate in GDP per capita is 1.8 percent per year (20 percent every ten years, $1.2^{1/10} = 1.0184$), and the real interest rate is 7 percent per year (100 percent every ten years). Finally, the investment rate is 20 percent (since 20 percent of labour and capital is employed making new capital), and the depreciation rate is 7 percent per year (again, 100 percent every ten years). These numbers are close to the values typically observed in real economies.

Exercises

Ex. 4.1 Assume an economy with a single product, widgets. Widgets can be easily (freely) converted to consumer goods or capital goods (machines): one widget gives one unit of consumption, or 0.2 machines. The price of a widget is 1 SEK. Machines are used in production, and a worker with a machine is twice as productive as one without a machine.

Assume that the economy starts off in a state with no machines, and that the population suddenly decide to save 20 percent of their income, forever. Describe what happens (in general terms) to Y, C and I in the short run, the medium run, and the long run.

Ex. 4.2 Assume an economy with a single product, widgets. Widgets can be easily (freely) converted to consumer goods or capital goods (machines): one widget gives one unit of consumption, or 0.2 machines. The price of a widget is 1 SEK. Machines are used in production, and a worker with a machine is twice as productive as one without a machine.

In the initial state—in the year 2000—there are 1000 workers and no machines, and each worker produces 1 widget per year. Of the total widget production, 20 percent is converted into machines and 80 percent is converted into consumption goods.

(a) Draw the circular flow for the year 1900. What are Y, C, and I?
(b) How many machines are there in 1901? What are Y, C, and I?
(c) Assume that 8 percent of machines break down irreparably each year. Furthermore, assume that by the year 2000 there are 1000 machines in the economy. What are Y, C, and I? Is this a long-run steady state of the economy?
(d) Illustrate approximately how Y, C, and I develop between 1880 and 2000, assuming there is no investment prior to 1900.
(e) Assume that the investment rate rises to 40 percent in the year 2000. What happens as a result?

Ex. 4.3 Assume an economy in which there are people and machines, and each machine needs one person to operate it. Machines last for one period (corresponding to several years), at which point they fall apart irreparably and must be replaced by new machines. In period 1 there are 100 people and 100 (new) machines. Of these, 75 people—each with a machine—work on the production of consumer goods, while 25 people—each with a machine—work on the manufacture of the next-generation machines. 100 new machines are ready in period 2, and they are 25 percent more productive than the old. That is, they generate 25 percent higher output per period. All workers command the same wage, which is 100 crowns per period in period 1. The interest rate is 100 percent per period. Finally, assume that the economy is growing steadily, in the sense that the growth rate, savings rate, and interest rate are all constant.

(a) Draw the circular flow, and fill in wage payments.
(b) Denote GDP in period 1 as Y_1 (in units of crowns per period). Write down expressions for C_1 and I_1 in period 1.
(c) Given that the interest rate is 100 percent, how much must capital owners in period 2 (i.e. those who invested in capital in period 1) pay back to those from whom they borrowed in period 1? Write your answer in terms of Y_1.
(d) Now rewrite your answer for part (c) in terms of Y_2.
(e) Now write payments to capital in period 1 as a function of Y_1.
(f) Characterize the allocation in period 1 by completing your picture of the circular flow. In particular, state (for period 1) GDP, the wage, consumption, investment, and the shares of labour and capital.

Ex. 4.4 Plot a schematic diagram showing the supply of and demand for investment funds as a function of the interest rate. Use your diagram to analyse the effects of the following shocks, in an economy in which the quality of next-generation machines is an increasing function of investment.

(a) Households suddenly become more concerned about the future.
(b) Households suddenly become less concerned about the future.
(c) Firms suddenly become more optimistic about the future, in the sense that they expect higher returns to investment *ceteris paribus*.

CHAPTER 5

Economic growth 3: Endogenous growth

In the previous chapter we saw that the key to understanding growth lies in the understanding of the cycles of technological change and investment in new capital goods which drive it. Furthermore, we have seen how capital investment can be profitable since machines can then be hired out to recover investment costs and interest. However, we have not studied the specific issues related to the adoption and development of new technology by agents in the economy, issues which may help us to explain why some countries fail to grow while others grow rapidly, and why some countries remain behind the technological frontier while others drive that frontier forwards. When we have a model which can explain the incentives which lead firms to adopt new technology, or develop it from scratch, then we have a model that can truly explain economic growth, i.e. an endogenous growth model.

We focus on explaining growth in two different situations. The first case is a country with much lower productivity than the richest economies. In such a country the key to growth is to successfully upgrade the capital stock (probably both human capital and physical capital), not to perform cutting-edge research. The second case is a country whose firms already use the latest, most productive, technologies. Here the only way to grow further is for its firms (or government) to develop new technologies themselves.[1]

5.1. Growth through adoption of new technology

In this section we consider the situation for countries far from the technology frontier. Why do some countries (for instance China over the last 35 years) adopt new technologies and grow rapidly, whereas others do not adopt, and suffer stagnation or even negative growth rates (such as many African countries in the 1980s and 1990s).

5.1.1. The mechanics of rapid 'catch-up' growth. Regarding the mechanics of adoption, a wealth of evidence shows that countries far from the frontier can grow their economies very rapidly through adoption, much more rapidly than countries at the frontier can grow through R&D. Furthermore, it is not uncommon to see dramatic shifts in the trend growth rate, coinciding with policy or other changes affecting the country in question. A classic case is China, as illustrated in Figure 3.5 (Chapter 3). After a long period of stagnation and reversals, economic growth in China started to take off in the 1970s, and at the end of that decade it rose to the double-digit rate is has held ever since. What triggered this, and what stops other economies following a similar path?

To attempt to answer the above questions with the help of rigourous economic theory is well beyond the scope of this book. Instead, we discuss some likely answers with the help of some basic economic insights, and present some heuristic evidence at the same time.

First, note that a very high rate of growth—such as that observed in China—demands a very high rate of investment. Recall the model economy 4.2. To achieve rapid growth in the model economy, firms must either renew their capital at very short intervals, or they must take very large steps forward each time they renew their capital. In either case, a high overall rate of investment is required (relative to the existing level of GDP). Returning to China, there the investment rate is around 50 percent, implying that around 50 percent of factors of production (workers and machines) are dedicated to producing investment goods such as new capital, and 50 percent are dedicated to producing consumption goods.[2]

MODEL ECONOMY 5.1. *Assume an economy similar to 4.2. However, this economy is open, and far behind the technology frontier. It produces only consumption goods, which it either consumes itself of sells. If it sells, it buys in return capital goods, i.e. new machines. New machines are available in a series of different qualities, where higher quality machines yield higher GDP per capita; but higher quality machines also cost more.*

Specifically, each rung of the ladder gives 20 percent higher GDP than the previous rung, and the machines to achieve it cost 20 percent more than the machines for the previous rung. The current GDP

[1] An alternative is to wait for other countries to develop new technologies and then copy them, but that way the country will suffer a drop in productivity relative to the economies which perform the research and adopt first.

[2] Note that in an open economy—trading with the rest of the world—an alternative is to produce only consumption goods, export 50 percent, and use the proceeds to import capital goods.

Rung	GDP	Investment	$I/Y \times 100$	Growth
5	24 883	4977	50	9.5
4	20 736	4147	41	7.6
3	17 280	3456	35	5.6
2	14 400	2880	29	3.7
1	12 000	2000	20	1.8
0	10 000	1667	17	0.0

TABLE 5.1. Rungs of the quality ladder. Units of GDP and investment are USD per capita per period, and units of growth are percent per year.

per capita is 10 000 *USD per ten-year period, and for* 2000 *USD per capita the country can upgrade—in the next 10-year period—to machines that yield* 12 000 *USD per capita per period.*

Now assume that the country invests in new machines that are five rungs up the ladder compared to its current machines, for each member of the population. What is investment as a proportion of GDP? What is consumption? And what is the growth rate in GDP per capita, per year?

To solve this model, we calculate GDP on each rung, and the investment required to attain each rung, using the information given, and denoting the initial rung as rung 0. We then calculate the corresponding investment rates in percent, and growth rates in percent per year. This information is shown in Table 5.1.

Reading off from the table, to jump up five rungs the country must invest 4977 USD per capita in new machines, whereas GDP over the 10-year period is 10 000 USD per capita. So the investment rate is 50 percent, implying that 50 percent of the country's production is exported in order to pay for the imported machinery. The country then achieves a jump in GDP from one period to the next of 149 percent, corresponding to 9.5 percent per year.

In a closed economy, high I implies high S, i.e. a high *savings rate*, however in an open economy (which trades with other economies) this is no longer the case. In either case (open or closed) the key to kick-starting growth in a stagnant economy is *not* a very high domestic savings rate: the key is instead to generate confidence that investment put into the economy will give a healthy return to the investor. Without such confidence, high domestic savings will translate into high investment in foreign countries, i.e. capital will leave the domestic economy, or in a closed economy the savings will be used to bid up the prices of assets such as land or gold.

5.1.2. The economics of adoption and investment. What is the key to 'investor confidence'? (Note that we should not identify investors with *foreign* investors, they may equally well be domestic nationals.) After decades of searching for the key, economists have concluded that there is no one key. It is not the existence of an educated workforce, it is not the presence of infrastructure, it is not a lack of rules and regulations, it is not law and order, it is not the presence of a stable political system. Instead, the key is all of these things, and more. In short, the *institutions* of the country should be growth-friendly, investor-friendly.

Regarding the specifically economic environment, key factors include stability of the economic system, and openness. Stability of the system is crucial because of the (often long) delay between investment and returns; if investors judge that there is a high risk of economic crisis or upheaval during the lifetime of the investment this will drastically reduce the investor's willingness to invest. Openness (in particular openness for trade) is crucial because it allows new ideas to come into the economy, and it allows investors greater opportunities to get returns from their investments. Regarding openness, note that countries typically trade most with their near neighbours, and it is therefore a big advantage for domestic growth if neighbouring economies are rich, or growing rapidly.

Regarding the more general institutional environment, a lack of bureaucracy, a lack of corruption, an educated population, and a well functioning civil society would all seem to be advantageous when it comes to attracting investors (whether domestic or foreign). Again, the key is to understand that investment implies costs today and hoped-for benefits tomorrow. Factors—such as corruption—which cause investors to lose confidence in actually receiving such benefits are likely to be very negative for growth prospects. Fear of revolution or civil war would have an even more powerful negative effect.

Regarding openness, we discussed openness to trade, but another important type of openness is openness to *change*. Since growth is based on the replacement of old, less productive technologies by new ones, it is a process that is at once both creative and destructive: hence the term *creative destruction* coined by Joseph Schumpeter.[3] When the new ideas succeed, their instigators are likely to grow in wealth

[3]See for instance Schumpeter (1942), *Capitalism, Socialism and Democracy*.

and power, implying that the previously wealthy and powerful lose status. Thus it is not obvious that the powerful individuals in a given economy want economic growth at all. According to Daron Acemoglu —a highly influential macroeconomist who has written on growth and institutions among many other questions—the likelihood that leaders are anti-growth increases if they are far removed from the ordinary population.[4] One thing bringing leaders closer to the people is a functioning democracy.

QUESTION 5.1. *There are two economies in the world, with 100 million people each, who have absolutely no contact with each other: they called Safeland and Growthia. In Safeland the people enjoy a high level of prosperity—on a par with today's OECD economies—and are happy with their lot. Having got this far, they now choose to do things 'as they always have done'. There is no research, no development, and a steady-state economy. Everyone knows their place in this economy: the norm is that children follow in their parents' footsteps. In Growthia 10 percent of the population are researchers, and the new discoveries spread continuously through the economy. New industries sprout up constantly, and entirely new demands are made on the workforce from one decade to the next. In which of the economies is the growth rate highest? In which of the economies is unemployment highest? What do you think about alienation? Happiness?*

Finally, a brief word on taxation. Other things being equal, investors (just like almost everyone else) prefer low taxes. This is because, by definition, low taxes on returns to investment mean that investors get to keep more of their returns. So, not surprisingly, if a government taxes returns on capital and stashes the proceeds in foreign bank accounts then this will discourage investment. However, if the government taxes returns on capital and uses the proceeds to pay for infrastructure, education, police, health care, etc., then it is far from obvious that the result will be negative for growth, since these things contribute to a good institutional environment within which firms can thrive. So the pros and cons of high taxes with respect to economic growth are similar to the pros and cons of high taxes with respect to the quality of life in general. There's no need to sacrifice high taxes on the altar of growth: if you think that high taxes benefit society as a whole then they are unlikely to harm growth.

5.2. Growth through development of new technology

We now turn to a market economy on the technological frontier. If GDP in such a country is to grow, the firms in it must develop completely new technologies which can then be put to use to raise productivity (either by making the same products with fewer inputs, or by using the same inputs to make more valuable products).

5.2.1. The properties of ideas. We can think of new technologies as designs or blueprints. Until they are put to use, they are not embodied in physical capital; they are intangible. From now on we simply refer to new technologies as new *ideas*.

The special properties of ideas have profound consequences for the growth process. In economic jargon we say that ideas are *non-rival*. Moreover, they can be *non-excludable*. To see what these concepts mean in practice, consider the following question.

QUESTION 5.2. *Assume you work making pizza and pizza recipes. Which is easiest to sell? One day you bake 50 pizzas. The next day you devote to research, and find that when you put yeast in the pizza dough, the pizza becomes much tastier. What day provides greater benefits for society?*

A pizza is rival: if I have eaten it, or am planning to eat it, you can't eat it too. And a pizza is excludable: I can easily stop you eating my pizza, as long as you are not prepared to resort to violence or threats. The same cannot be said of a *recipe* for pizza. Any number of people can use the same recipe at the same time: it is completely non-rival! Furthermore, it is very hard for me to prevent you putting yeast in your pizza dough once you have seen me doing it: ideas are non-excludable, at least in the absence of special measures such as secrecy or patent laws.

Bearing in mind the properties of ideas, consider now the following model economy.

MODEL ECONOMY 5.2. *Assume a closed economy in which there are 1000 individuals, each with their own firm. Each firm manufactures—with the help of machines—consumption goods traded on a market, and new machines to replace the old ones. Each individual spends 20 percent of her time on building new machines, and 80 percent of her time on producing consumption goods. The economy is in equilibrium with zero growth: new machines are produced at the same rate as the old wear out. Technology, in the form of the designs for the various machines, is freely available for anyone to use.*

The individuals want to invest more in the future, and therefore they begin to spend more time building machines, and less time producing consumption goods. However, they soon find that this method does

[4] See for instance Acemoglu (2009), *Introduction to modern economic growth*.

not help in the long run: when the number of machines rises there is an initial rise in productivity, but this rise rapidly levels off. They realize they must invest in new technologies if they are to achieve long term growth. However, not one of them actually does any research. Why not?

The problem is that if a given individual (or firm) puts time and resources into research, she will have nothing she can sell at the end of this period. Her new idea—if she comes up with one—is non-rival and non-excludable, so everyone else can use it without paying if they want to. Hence she is unable to profit from her research: more to the point, she makes a *loss* from her research, since she is not compensated for the time and resources she put in. Thus if ideas are non-rival and non-excludable this impedes investment in new technology, new ideas. This is ironic because fundamentally it should be a good thing for society that ideas have these properties: it means that one person's discovery can result in enormous benefits for the whole of society. Put differently, there are *positive externalities* from research.[5]

5.2.2. Market power and profit. Assume now that the problem of non-rivalry and non-excludability is solved, for instance by a system of *intellectual property rights* (patents). How do new ideas translate into higher profits? (Note that they must do if their inventors are to recover their costs.) It is very easy to see the answer to this in an economy with just one product; by extension we can see what happens in an economy with many different products, as in the following model economy.

MODEL ECONOMY 5.3. *Assume an economy with a single product, a widget. Widgets are made using labour and capital, and the production function is* $Y = 10K^{0.3}L^{0.7}$. *Y has units of widgets/day, and the function implies that a firm employing one worker and with one machine can make 10 widgets/day. The wage is 7 crowns/person/day, and the cost of hiring capital is 3 crowns/machine/day, implying (based on the microeconomics which we won't go through here) that it is in fact optimal for a firm to hire workers and machines in equal numbers. The price of widgets is then 1 crown/widget, and firms make zero profits.*

Assume now that one person, Bob Stiles, does some research and comes up with a new way of making widgets which we assume—for simplicity—uses the same labour and machines but yields 12.5 widgets per day. Bob patents his idea: no one can use it without his permission.

What happens in model economy 5.3? Since Bob has the patent, he alone can produce widgets using his new technique. Furthermore, since Bob can make 12.5 widgets for every 10 crowns he spends hiring inputs, Bob's cost per widget is just 80 cents. But he can sell widgets for 99 cents and drive all other producers from the market, while still paying 7 crowns per day to workers, and 3 crowns per day to machine-owners. So Bob makes a profit of 19 cents per widget on the entire global production of widgets!

MODEL ECONOMY 5.3, continuation 1. *Assume now an economy similar to the above, but there are hundreds or even thousands of products. The makers of these products compete with each other* monopolistically*: if the maker of one product can lower her price she will raise sales at the expense of other products. Each of the products is made based on a production function similar to the function above, but the knowledge needed to produce each product is specific to that product. Firms therefore specialize in particular products, and build up knowledge relating to that product. The more knowledge a firm can build up, the more attractive the package it can offer consumers (lower price, higher quality). This allows it to raise its market share and make larger profits.*

The two examples show how the presence of *market power* (if you like, monopoly) allows owners of patents to productive ideas to make larger profits than they would have made in the absence of the patent, thus providing an economic incentive to perform research.

5.3. Research policy

The introduction of the patent system might have been the end of the story, but it is not. The reason is that the patent system is a far from perfect tool for encouraging research and hence economic growth in the long run. We now look briefly at why this is, and analyse the alternatives facing a government which wants to boost research—and hence growth—in a technologically advanced economy. We find that the patent system still yields too little research; furthermore, it leads to too little production of the patented goods, and prices that are too high.

5.3.1. Patents and prices. In order to get a sense for optimal policy, we think about what would be done in the economy without money from Chapter 1.

[5] Explain this term!

MODEL ECONOMY 5.4. *Assume an economy with hundreds of firms making different products, where there is no market, but the households decide collectively on the allocation of resources. A team of people allocated to research comes up with a new discovery which can potentially lead to an increase in productivity of many of the different products made in the economy. What do the households decide to do with the discovery?*

The question is trivial: the households will ensure that the discovery is spread throughout the economy and used to the full where ever it is applicable. This outcome—the socially optimal outcome—is significantly different from the outcome which would arise under the patent system, where the innovators would take out a patent on the discovery and then sell the rights to its use. The fact that they would put a price on the use of the idea—even though it is non-rival—would lead to it being used less than it would be used in the economy without money, and without patents.

The problem for the regulator of the market economy is that without patents, there will be no (or very weak) incentives to do the research and come up with the idea in the first place. Ideally a (dishonest) regulator might wish to promise patents to successful researchers, but systematically renege on the promise in the event of success. This strategy is not only dishonest but also blatantly impractical: researchers would seen realize what was going on, and therefore stop doing research. The solution is a compromise: successful researchers are granted patents for a limited period of time only. During this period they can make profits thanks to their idea, and after the patent period has run out society can maximize its benefits.

Sometimes the negative consequences of patent protection may be large, for example where there are a few people with high willingness to pay for a product and many with low willingness to pay. This is true for many drugs, such as drugs against HIV / AIDS. In such cases it may be worthwhile for the producer to keep the price high to make high profits from those with high willingness to pay, though it leaves those with low willingness to pay without the option to buy the drug, despite the fact that production costs are low. This is the main reason for allowing patents expire after a few years: inventors get a few years to earn returns on their discoveries, and later the public gets the opportunity to utilize them to the full.

Of course, many innovations are not patented at all. Innovations can be divided into two broad categories: product innovations (new products) and process innovations (new processes for making the same old products). An important practical difference between the two is that process innovations are often relatively easy to keep within the firm without the need for patenting, whereas product innovations are typically (although not always) impossible to keep secret. If a firm keeps a process innovation secret the effect is similar to when the firm has a patent: the firm is able to reduce its costs, but because other firms are unable to reduce their costs the firm does not need to reduce its prices in proportion to the cost reduction, and hence it can start to make (excess) profits. As with a patent, this is not a socially optimal situation: once the innovation has been made, the best thing for the economy as a whole would be if all firms got to know about it and could use it. However, this is not in the interests of the innovating firm.

5.3.2. Patents and R&D effort. Even with patents, there is no guarantee that the optimal amount of research will be performed. Given perfect markets, an individual producing some good will be compensated precisely for the *value added* that she contributes; that is, she is compensated for the full value that her production gives society. However, this is not the case for researchers, even when patents exist. It is possible theoretically that the compensation may be either too high (hence leading to 'too much' research), or too low ('too little' research). However, in practice most economists are agreed that *too little* research is carried out in the economy. The main reason is that a patent does not compensate the researcher for the fact that her idea can be used as the foundation for *further, even better* new ideas. Thus the value of the idea lives on long into the future, even when the idea itself is no longer used.

In order to boost research further, governments typically sponsor research through research subsidies, and also through dedicated organizations supported by the government, such as universities. However, such subsidies are also fraught with difficulties. The problem here is that it's very hard to make sure that the research paid for by the government is actually performed. Furthermore, it is hard for the government to know what would have been done in the absence of a subsidy: maybe the firm just pockets the subsidy and carries on with research it would have performed anyway. These difficulties are connected to the nature of ideas (non-rivalry) and the inherent uncertainty of the research process. If the government pays a firm to build a bridge, then if the bridge is not built the government can sue. But if the government pays a firm to perform some research, and the firm reports back at the end that the research did not lead to any useful new ideas, what can the government do? To provide state aid to university research is of course a great way to get out socially useful research for a small cost while contributing to students' education. Right?

5.4. Relevance to real economies: Case studies

We round off our analysis of economic growth by considering a series of brief case studies, in which we present some observations about economic growth in different countries and time periods, and then check the ability of our models to make sense of these observations.

5.4.1. Relative levels of GDP in 1500. Our first example was originally put forward by Kremer (1993) and later discussed by Jones (2005). Up to the end of the last ice age, humans were able to migrate around the world thanks to the low sea levels. From this time—around 10 000 BC—through to around 1500 AD many regions and countries were isolated from each other. Separate regions include: Eurasia/Africa; the Americas; Australia; Tasmania; and Flinders Island. The regions are ordered in terms of population size, with the population of Flinders Island being around 500 at this time. If we assume that they all had similar technologies in 10 000 BC (due to their ability to interact) then we can study their growth in isolation from this time up to 1500 AD. What was the growth performance? It turns out that the larger the population, the more rapid the growth: the level of technological sophistication was highest in Eurasia/Africa, and lowest on Tasmania. On Flinders Island the population had died out completely. Why?

The reason is straightforward. Because ideas are non-rival, the greatest number of ideas per person will be attained (all else being equal) in the region with the largest population, since there are more people to come up with ideas, and each idea can then be used by the entire population. For growth, big is beautiful! This is also one of the key reasons why growth is favoured by openness to trade: such trade allows the rapid exchange of ideas and thus boosts the rate of technological progress.

5.4.2. The US and Europe. As we saw in Chapter 3, US GDP is persistently higher than GDP in the richest European economies. Why is this? Do not these economies to a very great extent share the same technologies, implying that they should have the same level of GDP?

The reasons for US leadership of the GDP league are complex, but one very important factor is rather simple: Americans work harder than Europeans. They work for longer hours, and take less holiday. This difference has an important *level effect* on GDP. It does not lead to faster growth in the US, it simply leads to a somewhat higher level of GDP per capita. It is very important to distinguish between growth in GDP and the level of GDP. Consider for instance the effect of the relatively high taxes on labour income in many European countries. Such high taxes may reduce the incentives to work, and thus the average European may choose to work less than the average American. This may cause the lower level of GDP in Europe; but the long-run growth rates of GDP are the same in Europe and the US, as we saw in Figure 3.3.

5.4.3. China and the Asian tigers. By the Asian tigers we generally mean Hong Kong, Singapore, South Korea, and Taiwan. Along with some other economies in south-east Asia—including China—these economies have undergone very rapid growth since the 1960s. Their growth rates have been well above anything ever seen in the leading economies such as the U.S.A. The reason they have been able to achieve such rapid growth is of course that they are able to adopt technologies already developed in other countries, as discussed in Section 5.1 above. There is nothing to suggest that their growth will continue in such a way that their GDP per capita will outstrip that of the U.S.; on the contrary, once their GDP approaches that of the leading economies then they must rely more and more on research rather than adoption for further growth, and hence growth slows.[6]

Exercises

Ex. 5.1 Two countries, A and B have the same GDP in 2000. Country A, however, had twice the GDP in 1995, but production then dropped drastically because of the devastation associated with a lost war that is now over. The GDP of Country B grew steadily, by 2 percent per year, during the same period.

(a) Compare the countries' likely growth over the next 20 years.
(b) Explain the difference using Solow's theory of growth through capital accumulation.
(c) Explain the difference by reference to possible differences in the institutions in the two countries.

[6]Note that economies with relatively small populations—such as for instance Singapore—may be able to achieve extremely high levels of GDP by acting as tax havens. In a closed economy taxes are needed to support the functioning of the state which provides many public goods. However, in a small open economy one possible strategy is to set very low taxes and thus attract multinational firms to perform financial transactions through that economy. Even if only a very small proportion of the money passing through the economy is taken by the government in tax, it may add up to a sufficient—or even very large—income for the state if the population is small, while also providing benefits to private firms.

Ex. 5.2 (a) Why might a firm's investment in new technology give that firm less in return than the *social* return on the investment?

(b) Why might this be perceived as a problem for society, and thus also for the government's economic policies? How can the problem be solved?

(c) Could investment in new machinery give lower expected returns to the investor than the social return?

Ex. 5.3 Assume a closed economy in equilibrium with zero growth, with 1000 individuals, each with her own firm which manufactures, with the help of machines, goods that are then traded on a market. Workers allocate 10 percent of their time to building machines.

(a) In the year 2000 the individuals decide that they want to invest more in the future, and therefore they decide to allocate 20 percent of their time to building machines—which are highly demanded—and 80 percent to producing consumer goods. What happens to GDP over time?

(i) Right Away;

(ii) In the medium term;

(iii) In the long term.

(b) They realize that they must invest in new technology in order to achieve long-run growth. However, no-one is willing to invest. Explain why not, suggest two possible solutions to the problem, and discuss their advantages and disadvantages.

Ex. 5.4 Assume two primitive economies isolated from one another, but starting with similar technologies. One economy is a small island, current population 1000, the other a continent with a current population of 1 000 000.

Discuss the likely growth rates of GDP in the two economies over the following centuries, assuming that they remain isolated.

Ex. 5.5 In an economy without money, the growth rate depends on the quantity of resources allocated to improving productivity in the long run through technological change. The same applies in a market economy!

Discuss factors which tend to lead to too few resources being allocated to technological change in the market, compared to what would be allocated in a perfectly managed economy without a market. How can these problems be overcome?

CHAPTER 6

The business cycle 1: Empirical observations

So far we have assumed that the productive capacity of the economy is fully utilized at all times: all workers and all capital are fully employed producing goods and services. Now, however, we turn to the analysis of the business cycle, and a key element of this analysis is that in times of recession this is not the case: productive capital and workers are left idle. In Chapter 1—where we studied an economy without money—we showed that this has to do with the way that markets for inputs and outputs operate: in the economy without money there is never any reason to leave productive workers idle. In this chapter we establish some key empirical facts about business cycles. In the following chapters we propose and analyse a series of models to explain these facts.

6.1. Fluctuations in GDP

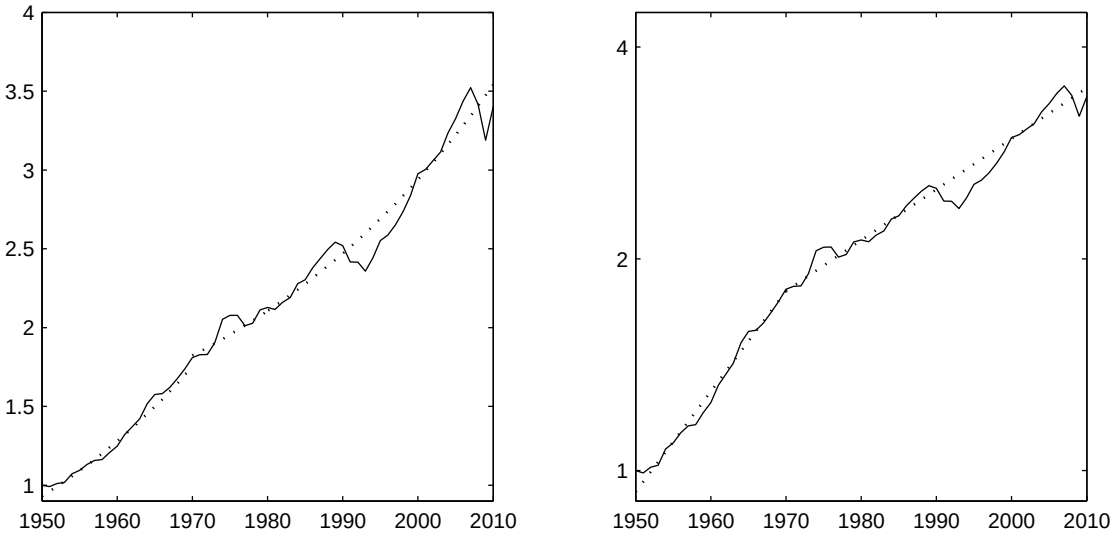


FIGURE 6.1. Real GDP in Sweden since 1950, relative to 1950. The dotted line shows an estimate of the trend—with a break in 1970—and the right-hand figure has a logarithmic scale on the *y*-axis. The trend is for growth at 3 percent per year, then 2.5 percent per year. Source: Lund University School of Economics and Management.

The study of the business cycle is the study of the periodic fluctuations of economic variables (such as GDP and unemployment): when we study the data it is easy to imagine a *trend* level of such variables, and then to compare the observations with the trend. In Figure 6.1 we show observations of Swedish GDP, and also plot a trend for comparison. The fluctuations are mostly small, but occasionally—such as in the early 1990s—they are large. Note that even after a large fluctuation the variable (in this case GDP) typically returns to the trend level previously observed. This is most striking when looking at data from the U.S., as shown in Figure 3.2 (Chapter 3). Here we see that there was a huge trough in the 1930s—the great depression—and a very large peak immediately afterwards, caused by the war effort. However, following the end of the war the economy returned to essentially the same trend line that it had been following in the 1920s!

6.2. Fluctuations in consumption, investment, and unemployment

Recall that GDP—in a closed economy—is the sum of consumption and investment, and that around 80 percent of GDP typically goes to consumption while 20 percent goes to investment. In Figure 6.2 we see that—in Sweden—investment represents just under 20 percent of total GDP, but that the fluctuations

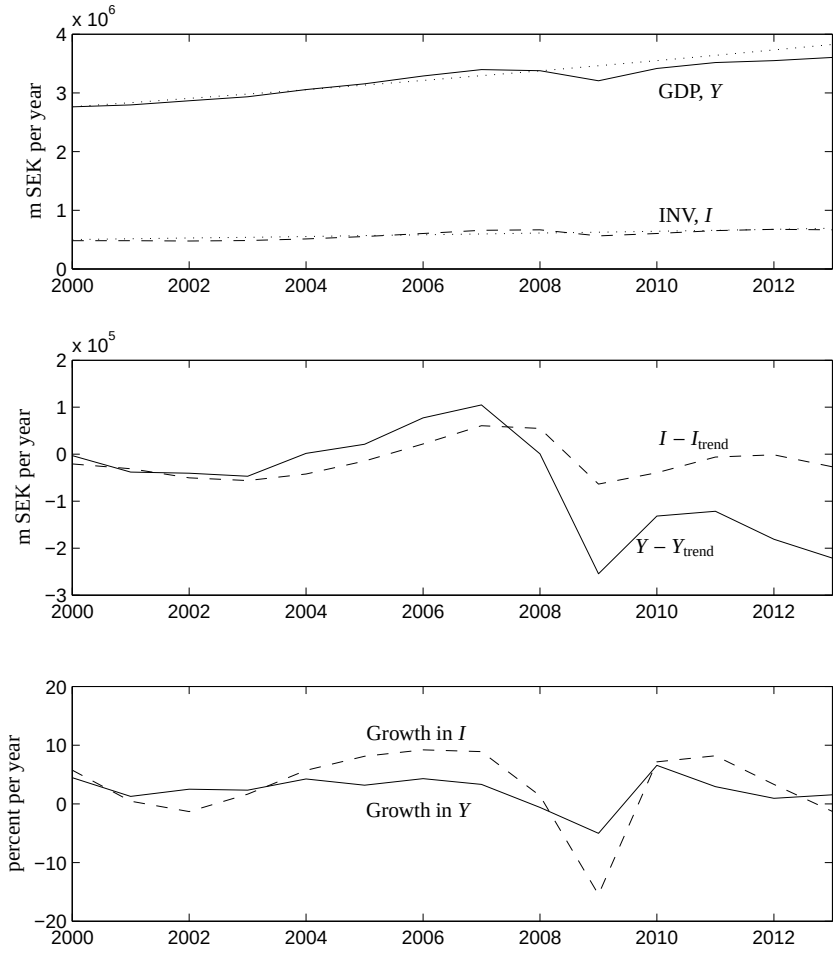


FIGURE 6.2. Cycles in GDP and investment in Sweden. The first panel shows the total annual GDP of Sweden, in millions of 2012 SEK, and also gross investment. Both are compared with an estimated trend. The second panel shows the difference between trend and reality (same units), and thus makes the fluctuations more evident. The third panel shows growth rates—in GDP and investment—in percent per year. Data from Statistics Sweden.

in investment account for about 50 percent of the total fluctuations in GDP. Thus, investment is far more volatile (cyclical) than consumption. This is clearly seen in the last panel.

What do we mean when we say that investment is more cyclical than consumption? Assume that both consumers and business owners expect bad times. Because of this, consumers reduce their consumption, while entrepreneurs reduce their investment. (This leads, in the next phase, to cutbacks in *output*.) Investment is more cyclical than consumption if the investment is reduced more (in percentage terms) than consumption. So, a downturn in the business cycle means a reduction in GDP relative to the trend, and that in turn implies that either (or both) of consumption and investment must fall relative to their trends. The data shows that both consumption and investment tend to fall, by roughly equal amounts in absolute terms, implying a much greater fall in investment in percentage terms.

Trend-GDP represents the value of everything produced in the economy when the economy's resources (labour and capital) are employed to the normal extent. If GDP drops below trend this should therefore indicate that the economy's resources (labour and capital) are employed less than normal: more capital than normal stands idle, and more workers than normal are without jobs. This is exactly what we see in the data. In Figure 6.3 we see this data for the US since 1955. The important panel in the figure is the lower one, showing that whenever GDP turns downwards relative to trend, unemployment turns upwards. On the other hand, when GDP turns up, unemployment turns down.[1]

A final empirical regularity worth noting—although hard to demonstrate neatly with data—is that economic downturns triggered by financial crises tend to be particularly severe and long-lasting. (We will

[1]An interesting feature is the failure of GDP to recapture the trend level post-2008, despite falling unemployment. It seems that the trend growth rate may have turned down, perhaps around the year 2000. We will be able to judge this better in around 10 years from now.

return to what other factors may trigger downturns in the next few chapters.) In the U.S. data we see a massive and long-lasting downturn following the financial crash of 1929 (Figure 3.2); the next very severe and long-lasting downturn follows the next financial crash, that of 2007–2008 (Figure 6.3). Turning back to Figure 3.3, the most severe downturn in the data shown there is for Sweden, starting in 1991, which again was a financial crisis, the only major such crisis suffered by any of the four economies in the period. Why does the failure of banks have such drastic consequences in the 'real' economy, i.e. every part of the economy except the financial sector? We return to this question below. A speculative hypothesis would then be that—since financial crises cause firms to be unable to invest—downturns triggered by a failure of firms to invest tend to be deeper and more persistent than those triggered by a failure of households to consume.

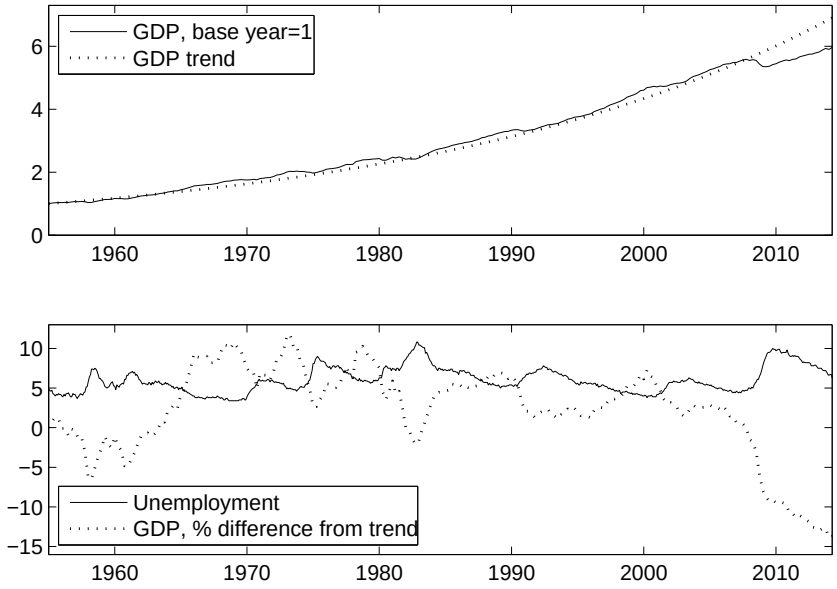


FIGURE 6.3. Relationship between GDP fluctuations and unemployment fluctuations. The top panel simple shows our assumed trend line relative to observed (quarterly) real GDP. The lower panel shows observed unemployment (in percent) and the difference between observed GDP and the trend, as a percentage of the trend. Data: OECD.

Exercises

Ex. 6.1 The year is 1993, and there is an economic crisis in Sweden. According to the Department of Economic History at Lund University, Swedish GDP per capita was 3705 1910-SEK per year in 1993. In retrospect we can see that trend GDP was roughly 4100 1910-SEK per year. In 2013 Swedish GDP per capita was 378 600 SEK per year

(a) Explain the enormous difference between levels of GDP in 1993 and 2013.
(b) GDP was below trend in 1993. By how much? Comment.

Ex. 6.2 Consider Figure 6.1.

(a) The left-hand panel seems to show constant growth, while the right-hand panel shows declining growth. Which is the better guide?
(b) The left-hand panel seems to show that the drop in GDP after 1990 was bigger than the drop after 2008, whereas the right-hand panel seems to show that they are equally large. Which is the better guide?

Ex. 6.3 Aggregate investment is strongly procyclical, while unemployment is countercyclical. Explain what this means. (Note: The terms are not defined above, use google!)

CHAPTER 7

The business cycle 2: A very simple Keynesian model

In this section we build and analyse a simple Keynesian model of the business cycle. It is Keynesian in the sense that we assume that households and firms make decisions about consumption and saving according to simple rules of thumb, and that these decisions lead to economic fluctuations, the business cycle.[1]

7.1. A model without saving and borrowing

The key to Keynes's explanation of why the business cycle exists is that when saving rates fluctuate, rates of investment in capital equipment do not follow them. When saving goes up, consumption goes down. If this is not compensated by an increase in investment, then there is a shortfall in *aggregate demand*.[2] If firms cannot adjust their prices, then they will not sell all their produce, and they will make losses. Firms react to this situation by reducing production and the amount of labour they hire; we have a *recession*.[3] We analyse the Keynesian explanation in a model economy with only electronic money, and in which the central bank's role is to determine interest rates.

Model economy 7.1. *Assume an economy in the year 2000 with 100 workers employed by a single firm to pick coconuts.*[4] *There is a fully developed financial system and no physical money. Each worker picks 10 coconuts each day, and in the evening she collects her pay (10 crowns) from the firm. She then uses the money to buy 10 coconuts from the firm (they cost 1 crown each), of which she eats 5 for dinner, and 5 for breakfast next morning, after which she goes to work. There are plenty of trees, and production is limited by the workers' ability to pick the nuts.*

Now assume that, one Monday afternoon, each worker becomes concerned about the future, and decides to spend only 8 crowns on buying coconuts, saving 2 crowns for a rainy day. Having saved those two crowns, the plan is to return to consuming 10 coconuts per day after that. What happens next?

What happens on Monday is straightforward. The firm only sells 800 nuts, and makes a loss of 200 crowns; on the other hand, it has 200 nuts extra in its inventory. This is illustrated in Figure 7.1. What happens on *Tuesday* is an open question: it depends of course on how the firm reacts. There are many possibilities, of which we consider three, denoted (a), (b), and (c). The first possibility we consider, (a), is that the firm sizes up the situation and lowers both the price of coconuts and the daily wage, each by 20 percent; from this point on, everything carries on as normal except that households now have net financial assets of 200 crowns, and the firm has net liabilities of 200 crowns. (But note that the households own the firm, so ultimately their financial assets are zero.) The second possibility, (b), is that the firm decides to ride out the storm, assuming that coconut demand will bounce back: it carries on producing as normal. Again, this outcome is sustainable into the future, and again it leaves households with net assets and the firm with liabilities. The third possibility—the Keynesian response (c)—is that the firm holds prices and wages constant, but it decides to cut production to 800 nuts per day on Tuesday, based on the assumption that since 800 were demanded on Monday, 800 nuts will also be demanded on Tuesday. It must therefore reluctantly dismiss 20 of its employees. The next phase of the chain reaction depends on how the unemployed workers react. Assume for simplicity that since they have no income and no assets, they choose not to consume anything. Now there are only 80 individuals working and consuming, the other 20 have dropped out of the economy. The firm finds that demand on Tuesday was indeed for 800 nuts, and congratulates itself on its foresight in dismissing 20 workers. See Figure 7.2.

[1] Keynesian economics gets its name from John Maynard Keynes (1883—1946), whose most famous work is Keynes (1936), The General Theory of Employment, Interest and Money.

[2] Aggregate demand is defined as the sum of households' total demand for consumption goods in the economy, and firms' demand for capital goods.

[3] Note that a recession in some countries has a very specific definition, such as a drop in measured GDP in two successive quarters. However, we are interested in recessions in a much more general sense as periods during which GDP is significantly below its trend level. On the other hand, a period during which GDP falls back towards the trend level from above is a *correction*.

[4] We say there is one firm for simplicity of exposition. In reality we should think of this firm as representing many identical firms.

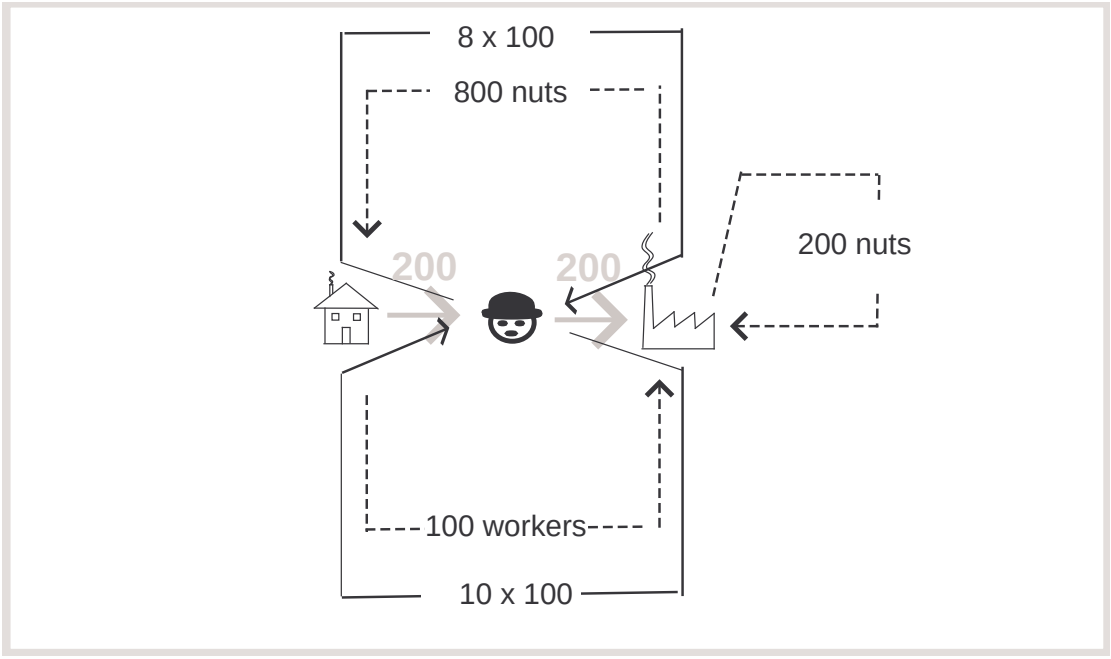


FIGURE 7.1. What happens on Monday in model economy 7.1. The grey arrows (and numbers) show the net flow of financial assets from the firm to households; the firm withdraws 200 crowns, net, from the financial sector, while households deposit 200 crowns.

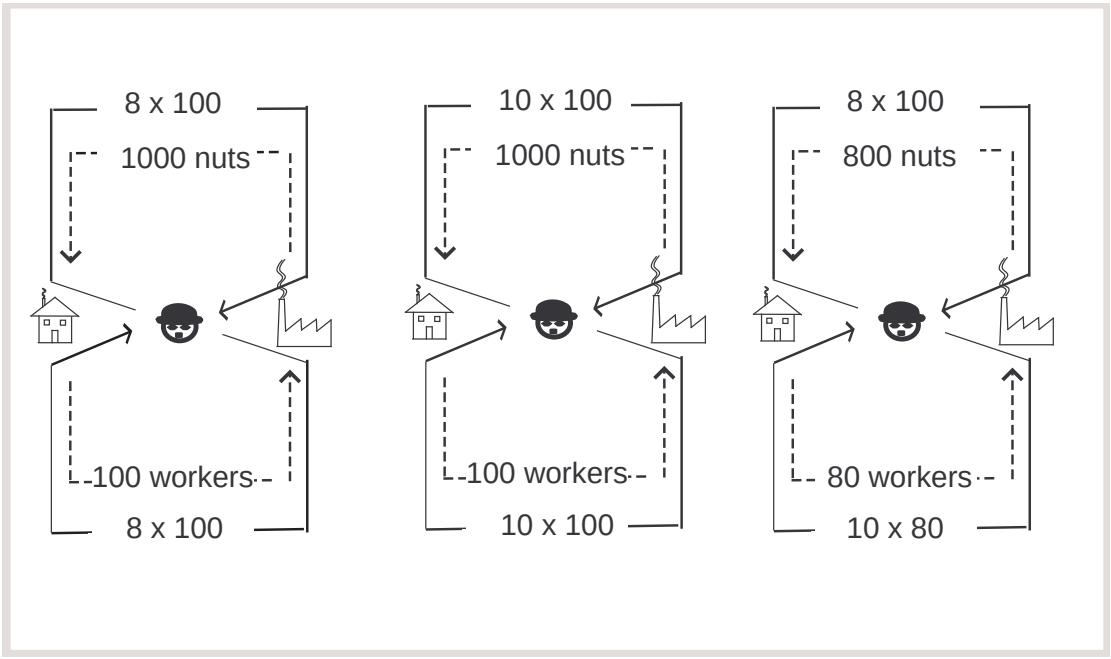


FIGURE 7.2. What happens on Tuesday: (a) prices adapt; (b) the firms carry on regardless; (c) firms cut their production.

So in the case when the firm reacts to the drop in demand by cutting production, the result is permanent recession, with production 20 percent below its potential level, and 20 percent unemployment. What can be done about this situation?

MODEL ECONOMY 7.1, continuation 1. *Assume case (c) with fixed prices and permanent recession. Meanwhile, the people decide to create a government to work for the collective good. The first action of the government is to borrow 200 crowns from the banks and give 10 each to the unemployed on Christmas Eve, so that they can at least buy coconuts that day. What happens next?*

In model economy 7.1, continuation 1, the result of the government borrowing will be that the economy returns to full employment, permanently. On Christmas Eve the firm sells 1000 coconuts and, assuming that the shift is permanent, calls in the previously unemployed workers the next day. As before, the firm congratulates itself on its foresight the next day, as all of the 1000 coconuts picked that day are sold.

7.2. Saving

In model economy 7.1—without saving—the economy never recovers from a shock until a new shock occurs, such as the intervention of the government in 7.1, continuation 1. This is not in accordance with Keynes. The key to economic recovery according to Keynes is that when GDP drops due to firms cutting back their production, consumption does not drop as much. There are many possible reasons for this: the unemployed continue to consume (through borrowing) even though they have no income; the unemployed do have an income, because the government borrows for them and transfers money to them; the employed do not consume all of their income, so when a worker becomes unemployed, aggregate consumption does not drop by as much as aggregate income. All of these mechanisms serve to to smooth consumption flows over time relative to the flow of production and income, and this also helps to smooth out the business cycle.

In the example below we take just one of the mechanisms listed above, and that is perhaps the most fundamental one: workers save some of their income, to use later when they have retired. In the economy there are both workers (saving) and retirees (who live on their savings). After a shock, there is a recovery over time, thanks to the fact that retirees continue to consume regardless of the business cycle. (Note: Retirees' consumption corresponds Keynes *autonomous consumption*.)

Model economy 7.1, continuation 2. *Now assume that in addition to the 100 workers, there are 100 retirees. Each worker picks 10 coconuts each day, and in the evening she collects her pay (10 crowns) from the firm. However, she now spends just 7 crowns buying coconuts; the other 3 she saves. On the other hand, each of the pensioners takes 3 crowns from her savings each day to buy coconuts.*

Now assume that, one Tuesday afternoon, each worker becomes concerned about the future, and decides to spend only 6 crowns on buying coconuts, saving 4 crowns for a rainy day. Having saved those 4 crowns, the plan is to return to consuming 7 coconuts per day after that. What happens next?

The sequence of events is shown in Figure 7.3. On Monday the economy is in its original long-run equilibrium. On Tuesday the consumption shock occurs and the firm is forced to borrow money to pay the wages. On Wednesday the firm cuts its production, laying off 10 workers, but consumption actually recovers partially and the firm sells off some of its inventory. On Thursday the firm raises production slightly, but consumption recovers a bit more and the firm sells off some more of its inventory. And so the process continues until the economy is back on its long-run equilibrium path.

Note that we can easily calculate the total loss of GDP, in comparison to the counterfactual outcome in which the consumption shock never took place. The sequence of GDP levels is shown in Figure 7.4. The loss of GDP on Wednesday is 100 crowns, then 70, then 49, and so. Denoting the total loss as D, the sequence can be written as

$$D = 100 \times (1 + 0.7 + 0.7^2 + 0.7^3 + \cdots),$$

which is the same as[5]

$$D = 100 \times \frac{1}{1 - 0.7} = 333.3 \text{ crowns}.$$

In the Keynesian model, the factor 0.7 is known as the *marginal propensity to consume*, while the factor $1/(1 - 0.7)$ is known as the *multiplier*: given a shock S, the size of the total loss in GDP caused by the shock is $S \times$ the multiplier.

The interpretation of the multiplier is straightforward. The starting point for analysis is (in terms of the model above), Wednesday morning. A consumption shock has occurred, and firms have decided to cut their production in response to this shock. The question is, what is the long-run (or knock-on) effect

[5] To see this, consider the following:

$$\begin{aligned} y &= 1 + g + g^2 + g^3 + \cdots \\ \Rightarrow\ g \times y &= g + g^2 + g^3 + \cdots = y - 1 \\ \Rightarrow\ y &= 1/(1 - g). \end{aligned}$$

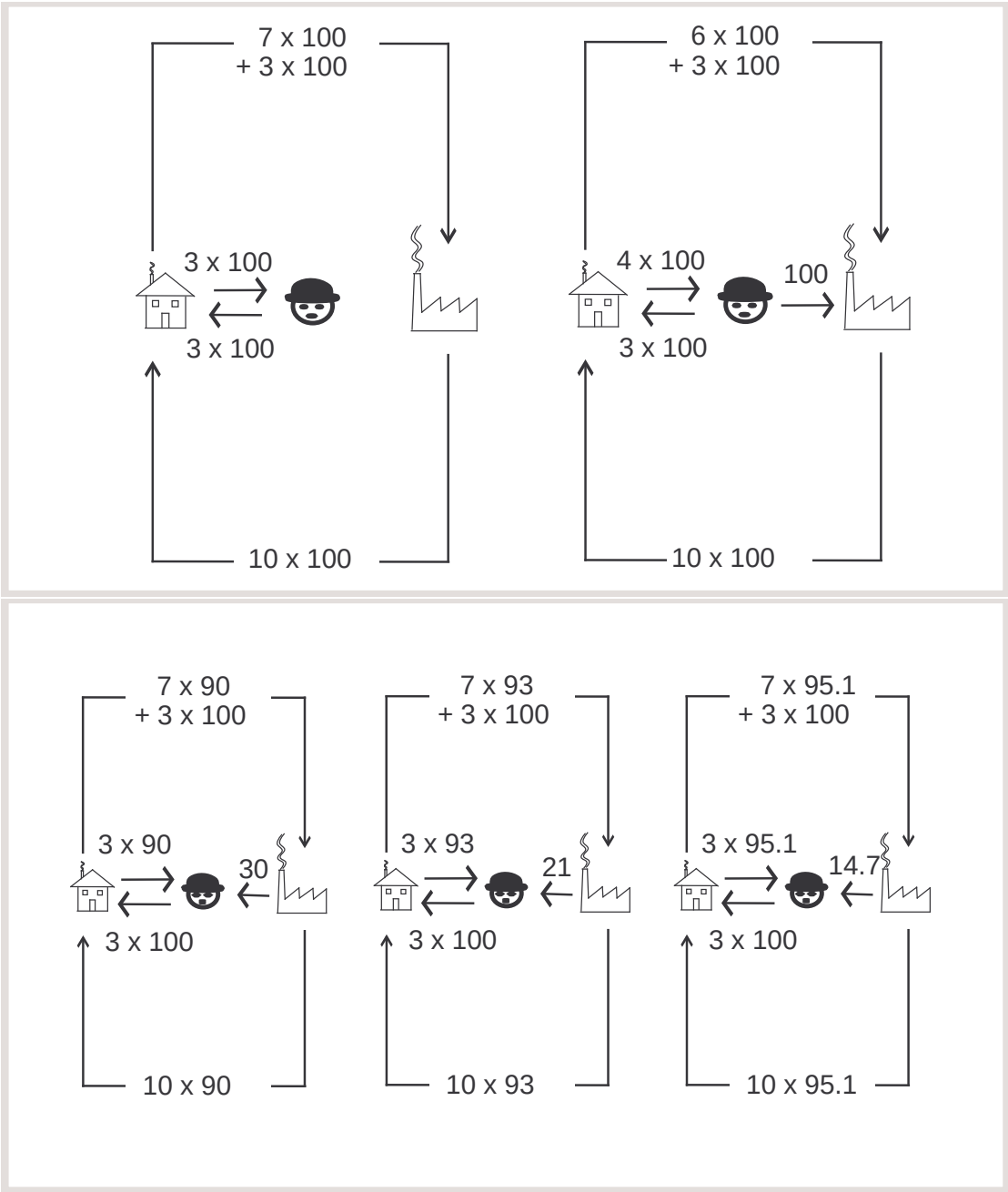


FIGURE 7.3. The circular flow on Monday and Tuesday (upper panel), and Wednesday to Friday (lower panel).

of this cut in production? Recall, from above that

$$\text{Multiplier} = \frac{1}{1 - \text{MPC}}. \tag{1}$$

The lower is the marginal propensity to consume, the lower is the multiplier; and as MPC approaches zero, the multiplier approaches 1.

- When MPC = 0 then the effect of an income shock on consumption is zero: consumption continues unchanged regardless of income. The result of this is that if household income drops, household consumption continues unabated. This causes firms to regret their decision to cut production, and they immediately raise production back to the long-run equilibrium level. Thus the effect of the shock lasts for one period only, and the total effect on GDP of the shock is simply the shock itself; there is no knock-on effect.
- On the other hand, when MPC = 1 then all income is consumed, and the effect of a shock is permanent; GDP never recovers, unless or until a positive shock arrives. This is what we saw in model economy 7.1.

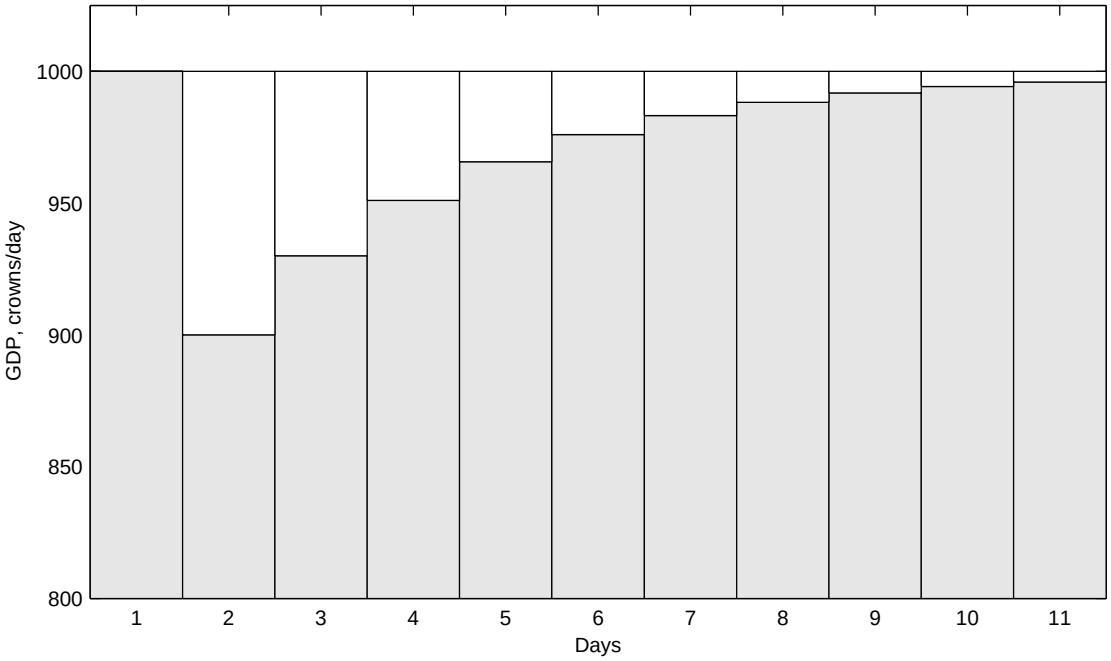


FIGURE 7.4. GDP from day to day in model economy 7.1, continuation 2.

- When MPC is between 0 and 1 then the lower it is, the faster the recovery. A low MPC means that consumption is relatively independent of income, leading to a rapid recovery from shocks.

If the MPC is crucial in determining the economy's response to a shock, what determines the MPC? By definition, the less households consume out of their gross income, the lower is the MPC. Many factors affect this consumption rate, of which we consider the following two: the savings rate, and taxation.

If households save a large proportion of their income, this (by definition) leads to a low MPC. In a closed economy, there must be another side to the 'savings' coin: there must either exist other households with large negative savings (retirees for instance), or the rate of *investment* must be high, or both. In the former case aggregate demand is likely to be stable, hence the economy is likely to recover rapidly from shocks. The latter case is more complex, since (as we shall see below) investment is intricately connected to the business cycle, something we have not accounted for so far.

7.3. The role of the government: Fiscal policy

The next step in the analysis is to introduce a government sector into the model. We do this in two ways. First we introduce a government whose sole object is to parry consumption shocks originating from households in order to eliminate the business cycle. Then we analyse a more realistic model of the government and how it affects the business cycle.

First we return to model economy 7.1, continuation 2, and assume that a government exists. Furthermore, the sole purpose of the government is to parry households volatile consumption decisions through changes in policy on taxation and spending, and thereby dampen or eliminate the business cycle. Such changes in tax and spending are known as *fiscal policy*. Note that government consumption G is then a further component of aggregate demand.

MODEL ECONOMY 7.1, continuation 3. *Recall that we have 100 workers and 100 retirees. The workers earn 10 crowns each per day, of which they spend 7. The retirees spend 3 crowns each per day. One Tuesday, each of the workers decides to spend just 6 crowns, saving 4. Now assume that the government does nothing except monitor consumption decisions and act to smooth out aggregate demand. What should it do?*

Assume that the government detects the drop in consumption on Tuesday evening and is ready to act. Then it should borrow money from the banks and purchase coconuts in order to compensate for the shortfall in consumption. Alternatively, it might choose to borrow money from the banks and transfer it to households as a one-off payment, a sort of windfall benefit to the households, in the hope that the households will use the windfall to purchase coconuts. Assuming that the government chooses the former course of action, the circular flow will be as shown in Figure 7.5.

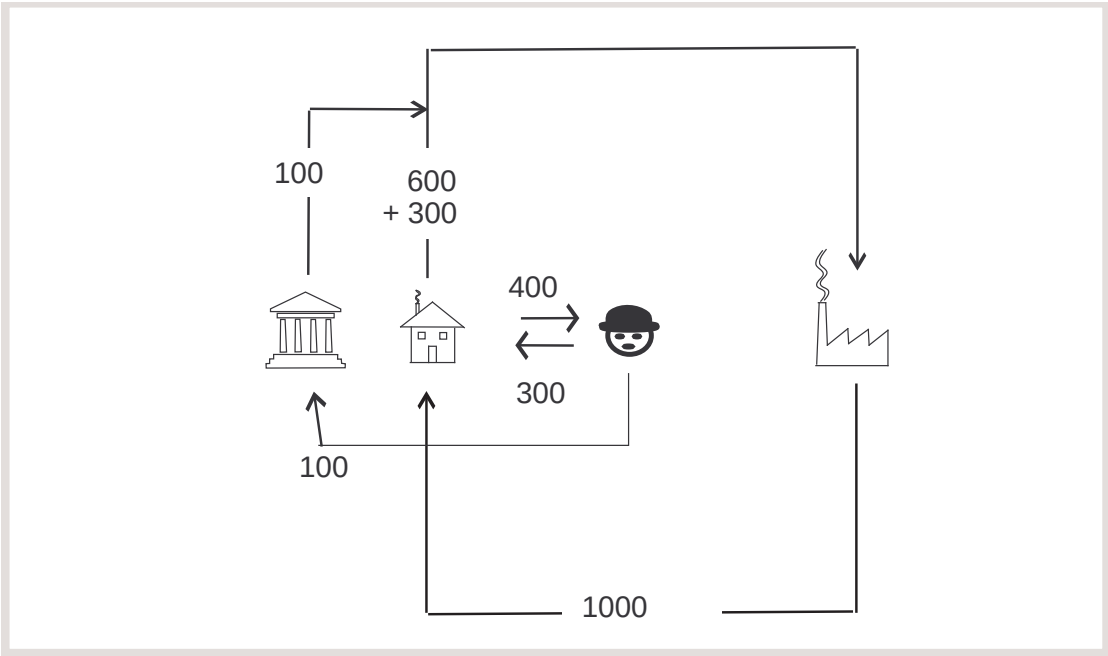


FIGURE 7.5. The government borrows 1000 crowns, and spends the money on consumption.

If the government is able to act on Tuesday then it will buy 100 coconuts. If, on the other hand, the government is unable (for whatever reason) to act until Wednesday, then it should buy 70 coconuts. Otherwise it risks causing firms to overproduce the next day, causing an unsustainable boom. (More on this later.)

Now we turn to a more realistic scenario in which the government collects taxes, consumes, and transfers money. Intuitively, if the government takes a large proportion of (gross) household income as tax, then this will also lead to a low MPC; households do not even get the opportunity to spend that portion of their income! However, the ultimate effect on the business cycle will depend on what the government does with its income: if government expenditure is highly correlated with government income (i.e. if the *government* has a high MPC) then there will be little or no stabilizing effect. If, on the other hand, governments have a strong tendency to borrow money to cover (temporary) income shortfalls then the government sector will have a stabilizing effect.

In our next model we drop the explicit distinction between workers and retirees, and simply assume that a fraction MPC of household income is spent on consumption, whereas the fraction $1 - \text{MPC}$ is saved. Furthermore, we assume that there is also a fixed (basic) level of consumption, denoted by C_0. (This is the retirees' consumption in the model above, 300 crowns/day.) Assume the government collects a proportion τ (tau) of income as tax, and transfers T to households each period. This is illustrated in Figure 7.6. Note that—in the Figure—we distinguish between I_k, capital investment, and I_{inv}, which is *inventory investment*, i.e. the value of unsold produce.

In long-run equilibrium inventory investment must be zero, which implies that (given the rules governing the circular flow)

$$\begin{aligned} Y &= C + G + I_K \\ &= C_0 + \text{MPC} \times [(1-\tau)Y + T] + G + I_K. \end{aligned}$$

We can rearrange this equation to obtain the following equation for Y in terms of known quantities:

$$Y = \frac{C_0 + G + I_K + \text{MPC} \times T}{1 - (1-\tau)\text{MPC}}.$$

Furthermore, the multiplier in this economy is

$$\frac{1}{1 - (1-\tau)\text{MPC}},$$

so the larger is τ, the smaller is the multiplier. So taxation lowers the multiplier and thus helps the economy recover more quickly from shocks. The underlying reason is that the government is assumed not to adjust its expenditure $(G + T)$ in response to the business cycle, and hence the existence of a large government sector tends to stabilize the economy. Government consumption and transfers can therefore be denoted as *automatic stabilizers*. In some cases, transfers may actually increase during recessions;

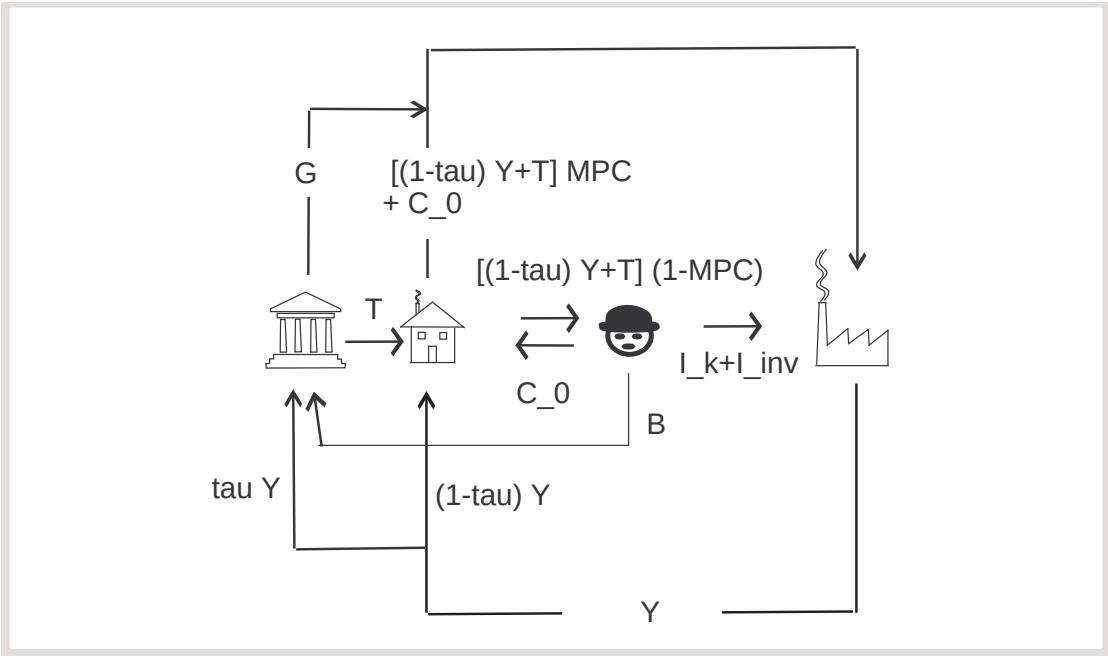


FIGURE 7.6. An economy with autonomous consumption C_0, fixed MPC, income tax, and transfers.

consider for instance benefit payments—such as unemployment benefit—which rise when household income falls. In that case the stabilizing effect of the government sector will be even greater.

Recall that the government may also deliberately adjust its policy on tax and expenditure in order to counter the business cycle, as we saw in model economy 7.1, continuation 3 (fiscal policy). Examples of fiscal policy to counter a recession are raising government spending G, and lowering income taxes τ. The Keynesian model—with its focus on the variability in aggregate demand driven by the variability in consumption—leads naturally to the conclusion that the government should use fiscal policy actively as a tool to counter the business cycle. Indeed, Keynes himself was a strong advocate of active fiscal policy. However, there are a number of problems associated with the use of fiscal policy, some at a rather fundamental (theoretical) level, others of a more practical nature.

In terms of our model, the key problem with the conclusion that fiscal policy should be used to manage the business cycle is that the model treats both household's savings decisions and firm's investment decisions as exogenous: savings are assumed to switch from one level to another due to shocks, whereas investments are assumed to be constant. In reality households change their savings patterns for a reason, and firms decide how much to invest based on their assessment of the future returns to capital.

Assume that households choose to save more because they have all become pessimistic about the future and want to have a bigger economic buffer. Now assume that the government reacts to households' behaviour by borrowing money in order to spend it and thus counteract the households' behaviour. But when the government borrows money, households know that they will have to foot the bill in the end (through higher taxes); effectively, the government is borrowing on households' behalf. But households want to save, not borrow. Therefore a logical response to the fiscal policy is for households to respond by saving even more, thus negating the effect of the government's policy. This problem is known as *Ricardian equivalence*.

Regarding investment, in Section 7.5.2 we discuss how the model may be extended to include firms deciding on their investment rates based on their assessment of future returns.

7.4. The role of the central bank: Monetary Policy

Recall now our final economic agent from Chapter 2, i.e. the central bank. In modern economies the role of the central bank is to control the supply of money in the economy.[6] This is known as *monetary policy*.

A supply curve has price on the y-axis and quantity on the x-axis. A supply curve for paper money is just the same, where the price of money is the interest rate: the higher is the interest rate, the more costly it is (per year) to hold paper money (which does not yield interest) rather than other assets (which do).

[6] In the past this job was often managed jointly by the central bank and the government.

In an economy without paper money—as in our standard model—and in which all bank balances yield interest, there is no cost to holding money. However, there is an opportunity cost of spending money, which is the interest that could have been earned if the money had been saved. This opportunity cost rises when the interest rate rises. Discretionary spending by households is known as *consumption*, whereas discretionary spending by firms is known as *investment*. Thus a high interest rate encourages saving by households (the opportunity cost of consumption rises) and it discourages investment by firms (the opportunity cost of investment rises). Both effects depress aggregate demand, and thus depress the level of economic activity.

MODEL ECONOMY 7.2. *Consider an economy in which there are two hundred people, a hundred who work and a hundred retirees. Those who work earn 70 crowns a day in salary and 15 crowns as the return on their capital. Of these 85 crowns they spend 50 on consumption, and save the rest. Those who have retired also get 15 crowns a day as a return on their capital, and spend 40 crowns a day on consumption. The financial transactions are handled by banks that lend money left over to firms who use it to finance investment in capital. The interest rate—on both deposits and loans from the bank—is* 5 *percent per year. The propensity of households to save increases. What happens next?*

As we now know, when the propensity to save increases, aggregate demand decreases and, therefore, firms cannot sell all of their production at fixed prices. According to Keynes firms therefore adjust their production downwards, laying off workers. We have a recession. (You should be able to analyse this using pictures of the circular flow.)

Above we considered the reaction of the government to such a situation, but here we consider the reaction of the central bank. If the central bank cuts the interest rate, the opportunity cost of spending money declines. Firms therefore increase their investment, while households increase their consumption. Both of these effects tend to drive up aggregate demand and thereby curb the recession.

Note that there is a fundamental difference between the actions of the government (fiscal policy) and those of the central bank (monetary policy). In the former case the government is acting to neutralize the effect of consumer behaviour, whereas in the latter case the central bank is acting to complete the process started by consumers; consumers' saving is a reflection of a desire to build up capital for the future rather than consume today, and the central bank's action helps to ensure that this capital build-up actually takes place.

7.5. Relevance to real economies

7.5.1. Rules of thumb, coconuts, and reality. The model is highly simplified, and has households and firms acting according to simple rules of thumb. Some of these rules make a fair amount of sense, but we would greatly prefer if we could model behaviour as a result of rational thinking. Firms are assumed to adapt their production to the demand which they observed in the previous period. In our toy models the length of a period was typically one day, but in a real economy we should think of a period as being longer, perhaps a quarter (three months) or longer. This behaviour doesn't seem unreasonable as a first approximation, but taken as a whole the model doesn't hold up: if we know (with the help of the model) how the business cycle will develop, firms should be able to work it out too. In which case they will not make the (sub-optimal) choices predicted by the model. Building a model of the business cycle which is internally consistent and matches the data is a huge challenge for macroeconomics.

Another huge simplification of the model is that there is only one product (which we choose to call coconuts, but we could of course have called it something else). What difference might it make if we had many different products, and firms competing to produce them and sell them to households? It turns out that this extension could actually help us to solve one of the problems discussed above, i.e. that firms follow rules of thumb while they ought to know better. If each firm produces a different product then demand for that product is likely to vary greatly due to the state of competition with other firms, depending on the productivities of other firms, consumer preferences, etc. Under these circumstances it is very hard for the firm to predict next-period demand for their particular product, and it may make more sense to follow a rule of thumb.

This is not to say that the models we have are useless; they are not perfect. The simple model developed above gives a sense of how a short-lived shock can have effects which last much longer, and it gives a good idea of what factors may make these long-lasting effects large—e.g. a low savings rate in the economy—and what factors tend to make them smaller, such as a large government sector.

7.5.2. Capital investment. An area where the behaviour assumed of agents in the model is particularly unsatisfactory is capital investment: either we treat such investment as constant, or simply assume that a lower interest rate leads to an increase in investment, while a higher interest rate pushes investment down. In reality, fluctuations in investment make up quite a large share of the fluctuations in the

total GDP, and the causes of these fluctuations are complex. (Remember, we have $Y = C + I$ in our basic model, or $Y = C+G+I$ if we include government consumption separately.) In Figure 6.2 (in the previous chapter) we saw that—in Sweden—investment represents less than 20 percent of total GDP, while the fluctuations in investment account for about 50 percent of the total fluctuations in GDP. Thus, investment is far more volatile (i.e. it varies more) than consumption.

The importance of investment is further underlined when we recall the economy without money (Chapter 1). The analysis there shows that a drop in consumption caused by consumers worrying about the future should not trigger an economic downturn in a perfectly functioning economy; instead, the extra productive capacity released from making consumption goods should be applied to making investment goods. So it is not the drop in consumption that causes the downturn, it is the fact that there is not a corresponding increase in investment. Furthermore, we should also recognize the possibility that downturns could be triggered by firms choosing not to invest rather than by consumers choosing not to consume.

QUESTION 7.1. *Why might investment be more volatile than consumption?*

To analyse investment decisions quantitatively (mathematically) is difficult. However, it is easy to understand intuitively that fear of worse times could easily induce companies to completely abandon planned investments.

MODEL ECONOMY 7.3. *Assume that on 1 March 2014 the typical assessment of firms is that there is an optimal amount of capital K in the economy in relation to GDP. Furthermore, firms plan to increase K in line with GDP, which is expected to rise at a rate of 3 percent per year through 2015 and beyond. Assume further that 7 percent of capital depreciates each year. What is the investment rate as a fraction of the total quantity of capital?*

Since firms want the quantity of capital to rise by 3 percent per year (matching growth in GDP), they must invest 10 percent of the total value of capital each year, in order to counteract the effect of depreciation.

MODEL ECONOMY 7.3, continuation 1. *On 2 March 2014 a wave of pessimism sweeps the economy, and firm now expect GDP to fall by 2 percent in 2015, before resuming its upward path in 2016. What happens to firm investment?*

Now firms want 2 percent less capital in 2015 than they have in 2014. Since depreciation is 7 percent, this suggests that they should cut investment to around 5 percent of the total value of capital, instead of 10 percent. So—according to this analysis—when firms expect GDP to drop by 5 percentage points compared to their previous expectation, their rate of investment halves.

The failure of the simple Keynesian model we developed to analyse investment decisions is obviously a major weakness, not only because changes in investment may be triggered by changes in consumption, but also because changes in the rate of investment may be what triggers consumption changes, rather than vice versa.

7.5.3. Fiscal and monetary policy. The model includes the key policy instruments used to manage the business cycle: fiscal and monetary policy. Recall that, in our discussion of fiscal policy, we explored the idea that the government might deliberately raise spending during a recession in order to counterbalance a drop in consumer spending. In reality government spending does indeed dampen the business cycle, but the main reason is not that it rises during recessions; the reason is that it *does not fall*, or (even) that it does not fall much. Thus economies with a large government sector tend to be significantly less volatile than those with a small government sector (i.e. their GDP fluctuates less).[7] However, in the case of very severe recessions, or in other unusual circumstances, the government may also use 'active' fiscal policy.

Why does government expenditure not fall during downturns? There are several reasons, which could be summed up by the idea that governments typically are not credit-constrained (they are able to borrow large amounts of money cheaply) and that they take the long view. What does a typical high-spending government, say the government of the U.K., spend its money on? Some of the biggest posts are pensions, healthcare, education, and defence. The government does not typically cut pensions, or close schools and hospitals, in response to a temporary drop in its income. Furthermore, the government (or its advisors) typically understand Keynesian economics and thus understand that by maintaining the level of consumption they are actually encouraging economic recovery which will (among other things) lead to a more rapid recovery in government income.

What can we learn from this? Fiscal policy measures are actions that affect the government budget directly, i.e. measures that directly cause changes either in government expenditure or revenue. In most

[7] For evidence see for instance Fatás and Mihov (2001).

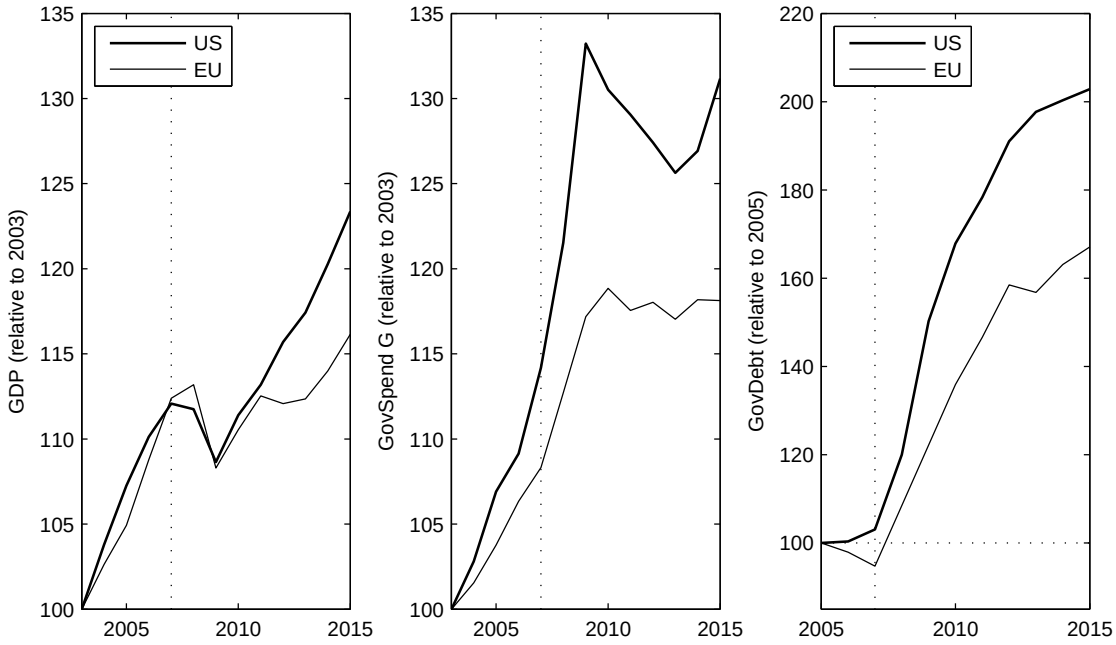


FIGURE 7.7. Comparison of US (thick lines) and EU (normal lines) GDP growth, government spending, and government debt before and after the financial crisis struck in 2007–2008. Data from the IMF.

cases the changes are in tax laws or rates, or changes in government consumption. Fiscal policy currently has a subordinate role in stabilization policy. This is partly because of the fundamental problems discussed above, i.e. that fiscal policy is not getting to grips with the root cause of the problem, which is the mismatch between changes in consumption and changes in investment. It is also partly because of practical problems in the implementation of fiscal policy: it is typically a slow and clumsy instrument, and there is an obvious risk that when fiscal measures such as tax changes finally take effect they will end up boosting an already booming economy rather than helping it out of recession. On the other hand, given a very severe crisis then fiscal policy is very important, partly because there is a strict limit to how far orthodox monetary policy can go: the interest rate cannot be reduced below zero.

Active fiscal policy is likely to be used in a real crisis situation. A good example of this is the Obama stimulus package, i.e. the American Recovery and Reinvestment Act. Lehman Brothers collapsed in September 2008, signalling a new phase in the global financial crisis which had been building since mid-2007. Barack Obama was elected in November 2008, and in February 2009 the Act was approved by Congress, pumping an extra 800 billion US dollars into the economy, corresponding to more than 5 percent of US GDP at the time. Here we see that a strong and rapid fiscal policy response is possible in exceptional circumstances. For an enlightening discussion of the Act see the lecture by Christina Romer (2010), Chair of the Council of Economic Advisers in the Obama administration: Fiscal Policy in the Obama White House: Reasoning, Results, and Challenges Going Forward. It is interesting to note that European governments have pursued a different strategy: fixated by the need to control the size of the government debt they pursued (and continue to pursue) fiscal *contraction* when Keynesian economics demands expansive policy. Europe has recovered much more slowly from the financial crisis than the U.S., and it is tempting to attribute this to the choice to follow contractionary fiscal policy. All of this can be seen in Figure 7.7. The left-hand panel shows the US and EU economies suffering similar slumps in production in 2007–2008, but the US economy recovering much more rapidly. In the right-hand panel we see government expenditure, where the US economy receives a massive fiscal stimulus which peaks in 2009 and tapers down up to and including 2013, whereas the EU economies react to the crisis by making immediate efforts to cut government expenditure (motivated by the fact that they are running substantial deficits due to the fall in GDP and hence revenue).

Turning to monetary policy, in the model the central bank controls the money supply and interest rates by directly setting the base rate, i.e. the interest rate applicable to short-term loans. This is exactly the mechanism described above. Moreover, the bank may *signal* to the market about its plans (or expectations) regarding the future development of the base rate. This is important because consumption and investment decisions by households and firms are typically based not on the interest rate which applies right now, but on the expected interest rate over the medium to long term. The failure to analyse the

medium and long term is therefore another major shortcoming of our analysis so far. It is not obvious how the base rate affects interest rates on long-term loans, as we will see later on.

Nevertheless, it is true—as suggested above—that the control of the base interest rate in the economy is by far the most important single instrument used to control the business cycle. To see just how active the central bank is, we can check how often the bank meets, and how often it adjusts the base rate. In Figure 7.8 we see the Swedish base rate over the last 20 years. Note that rate-setting decisions were announced at varying intervals in the past, and that these intervals were often extremely short. More recently the bank has settled on a policy of meeting 6 times per year. Note also that the committee setting the rate releases a report after each meeting; the report updates the market on the bank's thinking regarding the future development of the economy as a whole and the base rate in particular. Compare this to fiscal policy: how often does the typical government fine-tune its tax or spending policy in order to fine-tune the level of activity in the economy?

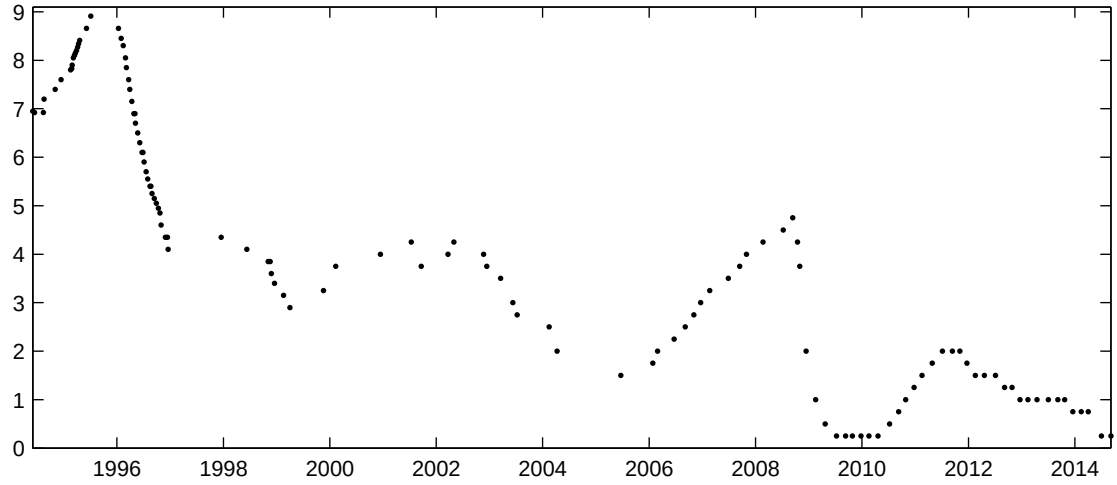


FIGURE 7.8. The Swedish base rate over time. Each point represents an active decision made by the central bank, Riksbanken. Source: Sveriges riksbank.

7.5.4. Inflation. In short-run Keynesian models such as the one developed here we assume constant prices, i.e. zero inflation. We know that in reality inflation is typically not zero, hence this is clearly a simplification. But is it important? It turns out that it is, very important.

To see why it is unreasonable to set inflation to zero, assume a government which is not satisfied with avoiding downturns, it wants to ensure ever faster growth in production. In the model we developed above, it can achieve this simply by spending more! Return to model 7.1, continuation 3, and assume that the government borrows money from the banks every period, using the money to buy coconuts which it then distributes to the population. Firms, finding their coconut inventories running down, respond by raising production, permanently! They do so by employing more people, who thus receive the fixed wage, and start to consume. Over time the economy moves to a new equilibrium with higher employment and higher total production. Flushed by its success, the government borrows even more money ...

This analysis makes no sense because it seems that there is no limit to the production that can be achieved in the economy even without technological progress. But we know from our study of economic growth that there are definite limits: for a given population with given capital and technology there is a maximum rate of production which is reached when all the capital and labour in the economy is fully employed. We can easily incorporate the idea of a limit on production into our Keynesian model. If aggregate demand (in nominal terms) exceeds this limit at the initial price level then the response of producers will not be to produce more at constant prices (which is impossible), rather it will be to continue to produce at the limit, and raise prices.

While our new model with an upper limit on production is an improvement, the problem now is that the limit is too strict: in reality we know that if there is a surge in demand for goods (for whatever reason) the initial reaction of firms will be to raise their production by paying staff to work overtime, hiring extra staff, buying extra capital equipment, etc. However, when many firms do this, it leads to *inflationary pressure* in the economy: fundamentally, because labour is in short supply, firms competing to hire workers must raise their wages, leading to higher costs and therefore also higher prices. Inflation therefore rises after a time lag. Analysis of what happens next will have to wait for the next chapter. Suffice it to say that the overproduction of the boom period is not sustainable, and there is a severe risk that it will be followed by overcompensation and hence 'bust'.

Exercises

Ex. 7.1 Assume a closed economy where the only input into production is labour, and there is no public sector. There are two types of economic agent, workers and retirees.

(a) Draw a picture of the circular flow of money in this economy. Show consumption, saving/investment and wages. What is GDP?
(b) Is there capital in this economy? Is there investment?
(c) One agent-type has positive saving, the second type has negative savings. What type is which?
(d) What happens to firms' inventory investment if one group's savings exceeds the other's negative savings? What could the consequence of this be?
(e) Suggest mechanisms by which this imbalance could be smoothed out.

Ex. 7.2 The year is 1400. Assume an economy with 10 identical producers / consumers, and a single product, milk. There is full employment, 10 liters of milk are produced and consumed per day. The milk costs 10 USD per liter. There is an unlimited amount of money (through credit). Every night the workers get paid, and then buy milk. The company has a stock of milk; it is not necessarily today's production that is consumed.

A certain Monday night one person decides to save his money instead of consuming milk.

(a) Show the circular flow of money; show also the flow of goods and services.
(b) Show the bank's balance sheet on Tuesday morning given that it looks like this on Monday morning.

Assets (USD)		*Liabilities (USD)*	
Monday			
Reserves	100	Deposits (f)	100
Loans	0		
Total	100	Total	100

The firm decides, on Tuesday, to reduce production (and the labour force) in accordance with the lower demand. Those who do not get paid may not borrow money; they have to stop consuming.
(c) Show the new circular flow of money.
(d) How does it look on Wednesday, and beyond?
(e) On his birthday the person who saved money decides to withdraw it and buy an extra liter. What happens?

Ex. 7.3 The year is 1500. Assume an economy with 30 people, of whom 20 are working and 10 have retired. There is one commodity, milk. There is full employment, and 40 liters of milk are produced and consumed per day. Milk costs 5 SEK per liter. There is an unlimited amount of money (through credit). The salary level is 10 SEK per day.

Each day, during the day, the retirees withdraw 6 SEK from their savings and buy milk. Those who work get paid 10 crowns; they save three of them, and use the rest to buy milk. For simplicity, we assume that the interest rate is zero.

(a) Show the circular flow of money and goods / services. What is GDP (SEK per day)?
(b) The balance sheet of the bank on Monday morning is shown below. How does it look on Tuesday morning (after Monday's transactions are completed)?

Assets (SEK)		*Liabilities (SEK)*	
Monday			
Reserves	1000	Deposits (pen)	10 000
Loans (firms)	19 000	Deposits (wkrs)	10 000
Total	20 000	Total	20 000

On Tuesday, all those who work decide to save 4 crowns instead of 3. The company produces as usual.

(c) Show the circular flow of money and goods / services on Tuesday. What is GDP?

The company's milk inventory increases by 4 liters. The company decides, on Wednesday, to reduce production (and the labor force) in accordance with the lower demand. Meanwhile, those who work return to saving 30 per cent of their income. The unemployed spend / save nothing.

(d) Show the new circular flow of money. What is GDP (SEK / day)?
(e) Show the circular flow on Thursday. What is GDP (SEK / day)?
(f) On his birthday (much later) the person who saved extra decides to withdraw the money and buy an extra liter. What happens? Bonus question: What's the overall effect of the savings decision on GDP, in SEK?

Ex. 7.4 Assume that the following applies to the closed economies, Asien and Besien.

Both	Asien	Besien
$C_0 = 400$ tSEK per year	$t = 25$ percent	$t = 50$ percent
$MPC = 0,8$	$T = 625$ tSEK per year	$T = 1250$ tSEK per year
$I = 100$ tSEK per year		
$G = 0$ tSEK per year		

Here C_0 is autonomous consumption, MPC is the marginal propensity to consume, I is the real investment in equilibrium, G is public consumption, t is the rate of income tax, and T are transfers from central government to households.

(a) When GDP = GDP equilibrium (and inventory investments are zero), we know that Y is equal to $MPC\ [(1-t)Y + T] + C_0 + G + I$. Show this with the help of a picture of the circular flow.
(b) Calculate equilibrium GDP for each country.
(c) Calculate the multiplier for each country.

Assume that both countries initially have a GDP level that is equal to GDP equilibrium and then they are affected by a disturbance in aggregate demand such that C_0 decreases temporarily (for one year) by 50 thousand SEK.

(d) What will be the total decline in GDP as a result of the disruption, in each country?
(e) Explain the meaning of automatic stabilizers. Does a large public sector lead to larger or smaller economic fluctuations?

Ex. 7.5 (a) Explain why investment I normally falls more (in percentage terms) than consumption C during a downturn in economic activity.
(b) Compare to what happens in an economy without money when households become worried about the future and reduce their consumption.

Ex. 7.6 Assume an economy with 100 workers. Each worker needs one machine in order to be productive. The workers are employed by competitive firms, each of which owns 10 machines and employs 10 workers. Eight of the firms produce consumption goods, and 2 produce new machines. These two firms, with 10 employees each, produce 5 machines each per year (10 machines per year altogether).

Each year, 10 percent of machines break down irreparably (depreciation). In a normal year that means that 10 machines depreciate, and therefore 10 new machines must be bought, and the economy is in long-run equilibrium. For simplicity we assume that machines used in year n are also made in year n.

Now assume that year 1 was a normal year, but in year 2 consumers reduce their purchases of consumption goods by 2 percent. This means that producers of consumption goods decide to reduce their production in year 3 by 2 percent, and they lay off 2 percent of their workers.

(a) How many machines do the producers of consumption goods buy in year 1? And how many do the producers of machines keep back from their own production?
(b) How many machines do the producers of consumption goods buy in year 2? And how many do the producers of machines keep back from their own production?
(c) How many machines do the producers of consumption goods buy in year 3?
(d) Assume that the producers of machines predict demand in year 3 accurately. How many machines do they make in year 3, and of these how many do they keep?
(e) Use the model to help explain why investment is more volatile than consumption in real economies.

Ex. 7.7 Assume an economy with households, firms, a financial sector, a central bank, and a government. The government taxes income and uses the money to pay for services such as health care and education. The role of the central bank is to determine the interest rate in the economy.

Households become worried about the future and cut their consumption.

(a) Explain how this can lead to an economic downturn.
(b) Discuss what the government and central bank can do to speed up recovery from the downturn.
(c) In real economies, monetary policy is used much more actively than fiscal policy to manage the business cycle. Why?

CHAPTER 8

The business cycle 3: A model of the medium term with inflation

In the simple Keynesian model of the previous chapter we assumed that prices are constant. This might be OK for the very short run (up to a few months, perhaps) but in the medium-run we must consider the possibility that prices (including wages, the price of hiring labour) may go up or down. Including this possibility has a profound effect on the analysis, making it much more general and powerful. Unfortunately, it also becomes a lot more complicated.

8.1. Keynes and the quantity theory

Before proceeding we consider the question of prices and policy in a little more detail. We can summarize the conclusions from the simple Keynesian model (with constant prices) as follows: equilibrium GDP is determined by aggregate demand, and disruptions in aggregate demand lead to temporary variations in GDP. Permanent changes in *AD* instead give permanent changes in GDP.

On the other hand, recall the quantity theory of money (Section 2.1):

$$MV = PY.$$

This states that if demand increases (implying either an increase in the quantity of money M, or an increase in its velocity V) then either prices P or production Y must increase. In the long run we expect production Y to be determined by the productive capacity of the economy, and if more money is injected into the system without the productive capacity of the economy increasing there will be more money chasing the same quantity of goods, so prices rise.

Since long-run production is determined by the productive capacity of the economy, this implies that Keynes' model with constant prices is not realistic in the long term. Suppose, for example that the state borrows money and spends it on consumption, increasing *AD*. We know that this can lead to a temporary increase in GDP (economic boom), but in the longer term, it leads instead to higher prices in the economy, inflation. Keynes was well aware of this, but the question remains of how the adaptation from short-term (higher production) to long-term (higher prices) takes place. What happens in the *medium term*? As we shall see below, the adjustment process itself is not something that happens automatically or mechanically; how fast it goes depends on how economic agents act, and that depends on how they interpret the signals from the government, central bank, the media, etc. regarding future developments in the economy and economic policy.

8.2. The *AD–AS* model

8.2.1. A simple model with inflation. We begin by setting up the simplest possible model which retains the key elements of the analysis of the previous chapter but also allows for the possibility of inflation. Models of this type are known as *AD–AS* models, standing for aggregate demand–aggregate supply. The central element of our first *AD–AS* model is a graph of supply and demand.

Model economy 8.1. *Assume an economy with a single product, widgets, produced using labour alone. There are 100 working-age adults in the economy, each of whom can produce one widget per day, and everyone works in widget production. (All adults are in the labour force, and there is no unemployment.) The price of a widget is 1 crown, and the wage is 1 crown per day. Production is 100 widgets per day. There are also 50 retirees in the economy, and workers save a proportion of their wages to build up savings, while retirees live off their savings. The economy starts in a long-run equilibrium with zero net savings, zero investment, and zero inflation.*

How can we represent supply and demand in Model economy 8.1? Usually when we show supply and demand in economics we put price on the vertical axis and quantity on the horizontal axis. A demand curve always slopes downward in such a figure; the lower the price, the greater the quantity demanded. The partner to the demand curve is the *supply curve*, which shows the amount produced by firms at different prices. This curve typically slopes upwards; the higher the price, the more firms supply.

Now consider Model economy 8.1. Supply is straightforward. If we follow Keynes exactly then we must assume that all prices are fixed, hence the supply curve must be a horizontal line: firms will always

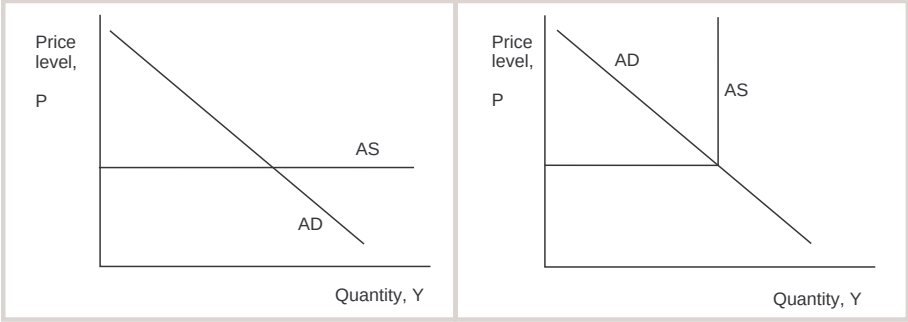


FIGURE 8.1. Keynes' assumption of supply and demand: (a) the pure Keynesian model in which supply is perfectly elastic at all quantities; (b) model 8.1 in which supply cannot increase beyond a fixed limit, the productive capacity of the economy.

supply at the same price whatever is demand. However, here we deviate from Keynes in one simple respect: the fixed-price rule holds, but only up to the point at which there is zero unemployment. It is not possible to produce more than 100 widgets per day at any price, so at this point the supply curve must turn upwards, vertically. The demand curve, on the other hand, should slope downwards as we expect demand curves to do: if the price of widgets rises then (all else equal) fewer widgets will be demanded on the market. We can therefore represent the equilibrium described in Model economy 8.1 as shown in Figure 8.1, right-hand panel. The curves must cross at the corner, because we are told that there is zero unemployment.

MODEL ECONOMY 8.1, continuation 1. *Now assume that, for some reason, the citizens of this economy become more optimistic about the future and decide to save less and consume more. What happens?*

When consumers want to consume more and save less, demand increases, that is the *AD*-curve shifts upwards in the figure. Reading off from the new crossing-point we see that quantity is unchanged (there is full employment from the start), but the price of goods rises. As long as the *wage* remains the same, the result is that firms make profits, which go to their owners. Assume that *AD* moves up by 10 percent, so the price of widgets also rises by 10 percent, while the wage is constant. Consider a firm employing one worker, making one widget per day. That firm will make a profit of 20 cents a day, the difference between revenue and costs.

Now consider an entrepreneur—Briony—who wants to set up a new firm, employing one person. The problem faced by that entrepreneur is of course that the entire labour force is already employed. However, if Briony offers 1.01 crowns per day then she can attract labour away from existing employers while still making a profit. Unfortunately for Briony this wage won't be enough, because (if we assume competitive markets) other entrepreneurs will offer 1.02, and others will then offer 1.03, etc.: the only sustainable wage given the new demand curve is of course 1 crown 20 cents per day, in which case firms just cover their costs and make no profit.

The upshot of all this is that when the demand curve jumps up as in Model economy 8.1, continuation 1, in the medium term the supply curve must follow and the only effect of the increased demand is a jump upwards in prices.[1] On the other hand, note that a permanent negative shock to consumption will (in the model) drive production and consumption down permanently, whereas a temporary negative shock to consumption will have a medium-run negative effect on production and consumption, as the economy takes time to recover from the shock. (To see why, recall the model of the previous chapter.) So in this model there may be a role for policy to counter negative shocks, but there is no benefit at all to driving up demand beyond the level which applies in long-run equilibrium.

8.2.2. A more complex model with booms. The model described above is a lot more powerful than the simple Keynesian model because it allows us to account for both recessions and price increases (albeit in an extremely simple way). However, we would also like to be able to account for *booms* in our model, where we define a boom as a period with an unsustainably high rate of economic activity. According to this definition a boom is both good and bad: it is good because of the high rate of production and high employment during this period, but the downside is that it is unsustainable and the end of the boom may signal the start of a recession rather than a return to normal levels of activity.

In order to incorporate booms we need to allow for the possibility that production may be greater than its 'normal' level. In terms of the Figure, we must relax the assumption that the supply curve switches

[1] If the shift upwards in the supply curve (i.e. the wage increase) occurs after a delay then there is a period during which firm owners reap excess profits.

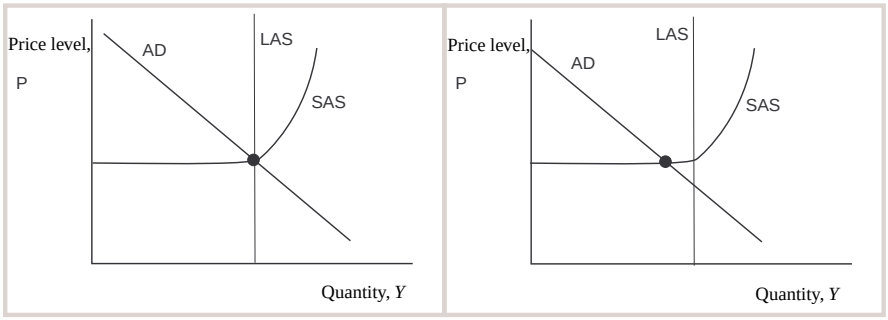


FIGURE 8.2. *AD–AS* model with booms: (a) the economy is in equilibrium; (b) recession. The black dots show the price level and GDP, where *AD* and *SAS* meet.

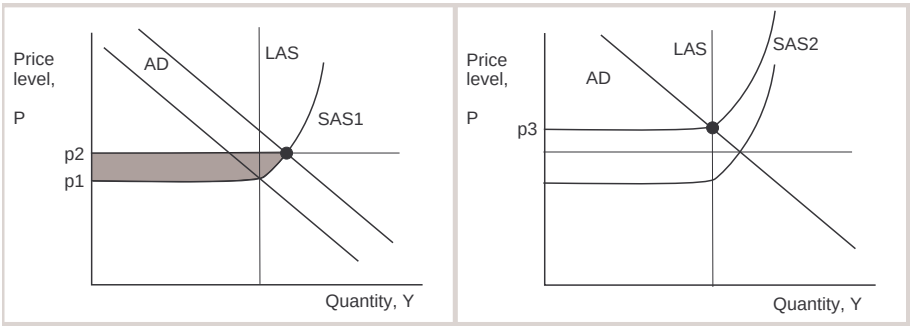


FIGURE 8.3. *AD–AS* model with booms: (a) a boom caused by increased *AD*; (b) A new long-run equilibrium with higher prices only. The black dots show the price level and GDP, where *AD* and *SAS* meet.

suddenly from horizontal to vertical. Instead, we imagine that there is some 'normal' level of supply at which the resources of the economy (labour, capital) are employed at a rate that is sustainable in the long run. Up to this level of supply, the supply curve is horizontal (as in our simple Keynesian model). However, if a greater quantity of production is demanded, then it can be supplied in the short run but only at a higher price. The reason for this price rise is an increase in production costs due to (for instance) the need to pay overtime rates to staff. As quantity increases further, the supply curve steepens, soon reaching a limit beyond which production is impossible given the inputs (primarily labour and capital) available in the economy.

The supply curve described above is now labelled the short-run aggregate supply curve (*SAS*), because it only applies in the short run. What about the long run? Recall that we defined the 'normal' level of supply as the quantity at which the supply curve turns upwards. In the long run this quantity will be supplied irrespective of price, hence the long-run supply curve (*LAS*) is a vertical line through this point. Plotting the *SAS* and *LAS* curves gives us Figure 8.2. In the left-hand panel we have a long-run equilibrium—in which all three curves meet at the same point—and in the right-hand panel we have a recession, which may pass due to the Keynesian mechanism described in the previous chapter, but it could also pass due to a shift down in wages, reducing costs in relation to demand.

MODEL ECONOMY 8.1, continuation 2. *Recall model economy 8.1, with 100 workers and 50 retirees, and zero savings and investment, and constant prices. Now assume that the short-run supply curve is similar to that illustrated in Figure 8.2, and that the citizens of the economy become more optimistic about the future and decide to save less and consume more. What happens?*

When consumers save less and consume more, aggregate demand *AD* moves upwards. Price and quantity are where *SAS* and *AD* meet, implying that both jump upwards when demand jumps up: we have a boom. However, wages are (so far) unchanged, although the owners of firms must pay overtime rates for the extra production. This implies that firm profits increase: recall from microeconomics that revenue is price × quantity, so it is the area under the price line. Variable costs, on the other hand, are equal to the area under the supply curve. The difference between the two shows producer surplus or (assuming no fixed costs) profit to the firms. Assuming that the *SAS* curve is a horizontal line up to the point at which it meets the *LAS* curve then profits are zero in the long-run equilibrium, but are equal to the shaded area in Figure 8.3, left-hand panel, at the height of the boom.

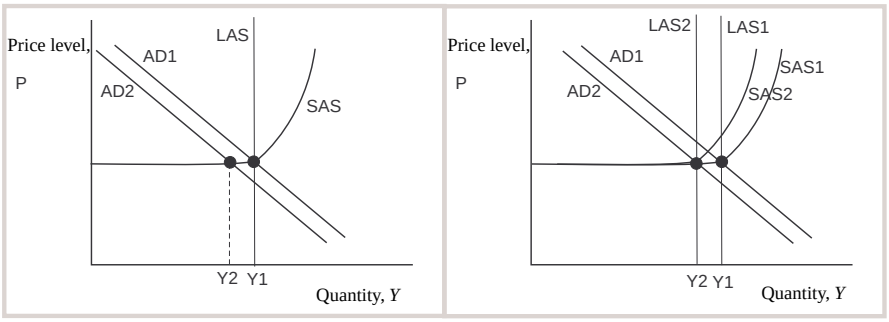


FIGURE 8.4. *AD–AS* model in two cases: (a) worried savers; and (b) productivity drop.

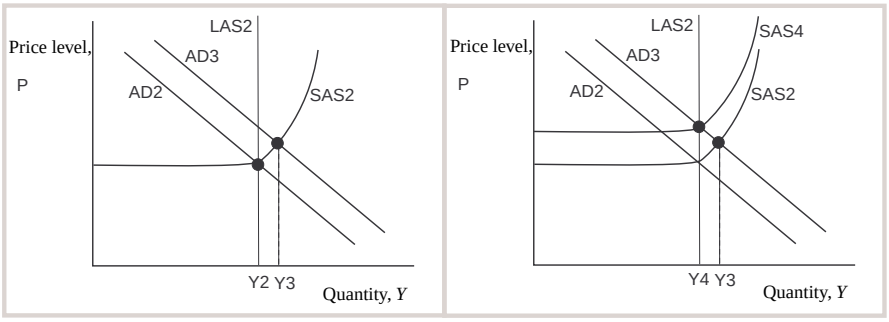


FIGURE 8.5. Expansionary policies after a productivity drop: (a) the economic boom in the beginning (b) only inflation in the long term.

If firms are making excess profits, other firms will want to enter the market, and the existing firms will want to expand. But since there is full employment the only way for firm *A* to expand is to attract workers away from the other firms, and in order to do this firm *A* must pay higher wages. The incentive for firms to pay higher wages will remain as long as profits are positive; in other words, the only possible long-run equilibrium is one in which the *SAS* curve has caught up with the demand curve, and GDP has returned to its long-run level. This is illustrated in the right-hand panel of Figure 8.3.

MODEL ECONOMY 8.1, continuation 3. *For another example, consider the same economy but assume that GDP—which is normally constant—has recently gone down, and the government is not satisfied. However, we do not know whether the problem is due to a lack of demand (i.e. a shift down in AD), or whether it is due to a shift of the LAS curve to the left (i.e. a drop in productivity). What should the government do?*

What the government should do depends on the cause of the drop in GDP. If the cause is a drop in demand (Figure 8.4, left-hand panel) expansionary policy such as a reduction in the interest rate may help return the economy to long-run equilibrium. However, in the latter case (right-hand panel) the new situation with low GDP is the new long-run equilibrium because a real shift in productivity has caused the change. If the government tries to return the economy to the higher (now unsustainable) level of production, the result in the long run will be higher prices but not more production, as shown in Figure 8.5.

8.2.3. Unemployment, inflation, and the Phillips curve. Thus far we have framed the discussion in terms of the price level and the rate of production, and we have not explicitly discussed inflation and unemployment. We have, of course, discussed rises in the price level. In one sense such rises are inflation, however in our analysis so far inflation only seems to occur as an isolated incident triggered (for instance) by mistaken policy, whereas we normally think of inflation as something going on continuously ‘in the background’ so to speak.

Regarding unemployment, we have assumed thus far in our models that in long-run equilibrium there is zero unemployment. Hence in a boom there is no reduction in unemployment, rather an increase in overtime. In reality we know that in long-run equilibrium (or when GDP is equal to its trend level) there is significant unemployment: typically between 2 and 10 percent of those who want to work are unemployed. We come to the explanation of why that is in the next chapter. In this chapter we simply assume that there is some ‘normal’ rate of long-run unemployment which applies when supply is equal

FIGURE 8.6. The relationship between inflation and unemployment between 1913 and 1948 in the U.K., as observed by Phillips.

to long-run aggregate supply, *LAS*. For reasons that will become clear later we denote this 'normal' level of unemployment as *NAI* unemployment, where NAI stands for *non-accelerating inflation*. When unemployment is below the NAI level—implying that the *SAS* curve is 'too low' relative to *AD*—then we assume that competition for workers between firms tends to drive wages up, driving up the *SAS* curve such that (in the long run) *SAS*, *LAS*, and *AD* all meet at the same point.

Let us now consider inflation and unemployment together. Thus far we have assumed that as long as the *AD* and *SAS* curves meet at or to the left of the *LAS* curve then prices are constant, i.e. the inflation rate is zero. Let us stick with this assumption for a while and see where it leads us.

MODEL ECONOMY 8.1, continuation 4. *Continue to assume an economy in which the short-run supply curve is similar to that illustrated in Figures 8.2–8.4, while firms react to price increases by raising wages after a delay, as described above. Furthermore, assume that the delay is* fixed. *Finally, assume that aggregate demand fluctuates unpredictably.*

What do we observe regarding inflation and unemployment in this economy? To answer this question all we need is the above analysis: when demand is low (too low) we see zero inflation and high unemployment, whereas when demand increases the result is a period of positive inflation and low unemployment. If we then show inflation and unemployment in a graph we should see a negative relationship, i.e. a downward-sloping line: when inflation is zero, unemployment should be high, whereas when inflation is positive then unemployment should be low. This is exactly the relationship observed by the New Zealander A.W. Phillips in 1958 when he studied unemployment and inflation in the U.K. between 1861 and 1957: when unemployment was lower, inflation in the economy tended to be higher. Thus the name of the negative sloping curve: the Phillips curve.

Note that Phillips' data suggests a model rather similar to that illustrated in Figure 8.1, right-hand panel: inflation is close to zero when unemployment is above a certain level, but when unemployment is pushed down to that level (around 3 percent in the data) it seems that inflation can rise to almost any level without unemployment going down further.

In the next example economy we add a government to the model and consider how it acts given the existence of the Phillips curve.

MODEL ECONOMY 8.1, continuation 5. *Continue to assume an economy in which the short-run supply curve is similar to that illustrated in Figures 8.2–8.4, while firms react to price increases by raising wages after a delay, as described above. Furthermore, assume that the delay is* fixed. *Finally, assume a government which hates unemployment, loves production of goods and services, and doesn't particularly like inflation. What should the government do?*

To answer this question, consider what happens if the government raises *AD*, either by reducing the interest rate (monetary policy), or through raising spending or cutting taxes (fiscal policy). The first thing that happens is that both production and prices rise, while unemployment falls. The expansionary policy thus leads to a temporary situation with high GDP and low unemployment, at the cost of a rise in prices, i.e. inflation. Since the government hates unemployment, loves production, and isn't too bothered about inflation this seems like a great deal so far.[2]

But what happens next? As we saw earlier, the next step is for *SAS* to catch up with demand, causing a further rise in prices while production (and hence also unemployment) return to normal. So, it seems that a temporary period of high GDP and low unemployment can be achieved at the cost of a rise in the price level. Given what we know about the government's preferences this still looks like a good bargain for the government. Hence in this economy we would expect the government to repeatedly raise demand in order to, repeatedly, enjoy periods of raised GDP and low unemployment, at the cost of a series of price rises, i.e. inflation. It is a small step to think of the government continually raising demand, keeping the *AD* curve ahead of the *SAS* curve and ensuring that production is held above its long-run level permanently, at the cost of inflation.

So given an economy where the government can obtain low unemployment and high GDP at the cost of high inflation, it seems rational for the government to choose high inflation. But the consensus for the last 30 years and more is that government policy should aim for low inflation. Why is that? Does low inflation come at the cost of higher than necessary unemployment? According to our model so far, it does. However, a little more thought shows that our model so far makes no sense and must be extended. Furthermore, study of further data shows that it does not hold in reality either. The key to the extended model is to include *expectations*.

8.3. The model with expectations, or why the government can't outrun the market

The model economy we have built up so far does not include expectations about future prices and wages. If we extend the model by including such expectations it turns out to have a dramatic effect on the behaviour of the economy, and on optimal policy in the model economy.

8.3.1. The effect of expected expansionary policy.

Model economy 8.1, continuation 6. *Return to 8.1, continuation 5, but drop the arbitrary assumption that there must always be a delay between a rise in prices and a rise in wages. Assume that the government manages the economy in such a way that aggregate demand rises by 10 percent each year, while long-run aggregate supply is constant. What happens?*

In the previous section we effectively assumed that each price rise caught firms and workers by surprise, and therefore there was a delay between the price rise and the rise in wages, and this delay was what gave rise to higher production and lower unemployment. But in model economy 8.1, continuation 6 we see that the idea of such a delay is unreasonable. If *AD* always rises by 10 percent per year, then firms and workers will plan for price and wage rises of 10 percent per year too, and furthermore the prices and wages they plan for will be such that $Y = LAS$ and the economy is in long-run equilibrium. So the only effect of the expansionary policy will be to create inflation! The long-run analysis is therefore consistent with our analysis based on the quantity theory of money and the equation

$$MV = PY.$$

When M (the quantity of money) or V (it's velocity) rises, the effect in the long run in not to raise Y (the quantity of goods and services produced) but rather to raise P, the price level. If M rises by 10 percent per year while Y is constant then the inflation rate will be 10 percent.

The key addition to the model is to allow for *expectations*, in particular expectations about inflation. If firms and workers expect inflation at 10 percent per year, then they will plan for price and wages rises of 10 percent per year. These plans may be hard to change, implying that if inflation unexpectedly diverges from 10 percent then this may cause real effects, such as a boom or, potentially, bust.

Model economy 8.1, continuation 7. *Assume that the price level in 2014 is* 100*, that nominal GDP, PY, is* 10 000 *crowns per capita, and that firms and workers confidently expect 10 percent inflation in 2015. They therefore agree wage increases of 10 percent for 2015 (compared to 2014). However, the aggregate demand curve only shifts upwards by* 5 *crowns rather than* 10*, and firms cannot sell all their goods at a price of* 110*. What happens?*

[2] This is reasonable because moderate rates of inflation have little or no social cost; as long as inflation is in line with expectations, economic agents adapt to it without difficulty.

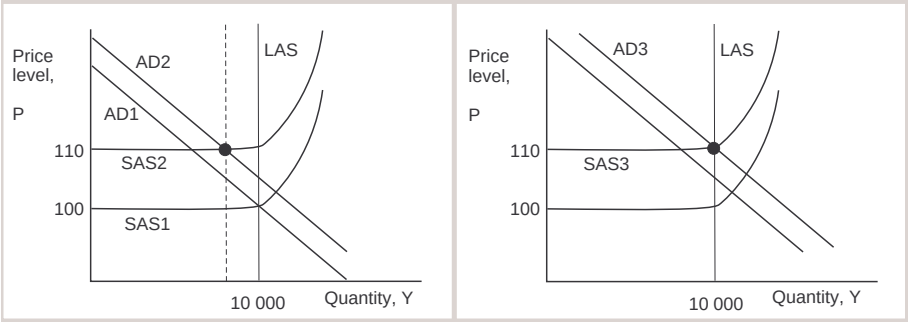


FIGURE 8.7. The effect of an unexpectedly small rise in *AD*: (a) falling production initially (b) return to normal once expectations have adapted.

To answer this question we can use Figure 8.7. Since wages increase by 10 percent, the *SAS* curve shifts up by 10 percent, and the long-run equilibrium price level is 110 crowns. However, the *AD* curve shifts up by just 5 crowns, and it now meets the *SAS* curve to the left of the *LAS* curve (left-hand panel). So according to the model, when demand fails to meet expectations the result is unsold goods: that is, we are back to the Keynesian model of the previous chapter! The difference is the inclusion of expectations. What about the next year, 2016? If we assume that *AD* shifts up by 5 percent that year too, but that this rise is now fully expected, then firms and workers should plan for zero price and wage rises from 2015 to 2016, such that the economy returns to its long-run equilibrium. This is shown in the right-hand panel of Figure 8.7.

According to the simple Phillips curve can buy lower unemployment only by sacrificing low inflation. The fault lies in not having taken into account the *expectations*.

(1) When inflation is *expected*, it has only nominal effects! If everyone knows that inflation will be 10 percent next year, then prepares the price and wage increases in line with this knowledge. Wage increases are agreed to and with. Both *AD* and *AS* curves shown when moving as much and there is no effect on GDP or unemployment. Therefore, only *unexpected* inflation gives real effects.
(2) If a government constantly pursues expansionary policies, then the effect is high inflation, but not high GDP nor low unemployment.
(3) If the government carries on trying to outrun the market by raising demand more than expected the result will be hyperinflation.

A *unexpected* inflation gives real effects because—since they have not anticipated it in advance—agents do not have time to respond in full when it arrives. For example, it may be that you have made investments that provide a predetermined rate of return; this return will be worth less than you hoped for given unexpectedly high inflation.

We are now in a position to explain our name for the 'normal' level of unemployment, i.e. NAI-unemployment.[3] The only way for the government to hold unemployment below the NAI level—through monetary or fiscal policy in a market economy—is to continually outdo market expectations with regard to inflation. So if inflation is 2 percent and the market expects it to stay there, then expansionary policy yielding 10 percent inflation will lead to a period of low (sub-NAI) unemployment. But when expectations have adapted (such that 10 percent inflation is expected) then the government must boost inflation even further in order to stay ahead of expectations and hold unemployment below the NAI level. However, market agents (who are not stupid) will soon learn that the government is trying to stay ahead of their expectations, and will therefore expect runaway (accelerating) inflation. The government (intent on holding unemployment below the NAI level) floods the economy with even *more* money than the market expects. In a rather short time period (perhaps one or two years) a stable economy can be transformed to one with *hyperinflation* where prices rise so fast that the currency becomes useless and agents must either resort to barter or to the use of some other currency such as the US dollar.

8.3.2. Long-and short-run Phillips curves. Can we continue to use the idea of the Phillips curve in our extended model with expectations? It turns out that we can, but that such a curve only ever applies in the short run, when expectations can be taken as fixed; when expectations change the Phillips curve shifts!

MODEL ECONOMY 8.1, continuation 8. *Assume an economy in which inflation has been at around 10 percent per year over a number of years; 10 percent is thus also the expected rate of inflation. Now*

[3] In the literature this is typically denoted NAIRU, the non-accelerating-inflation rate of unemployment.

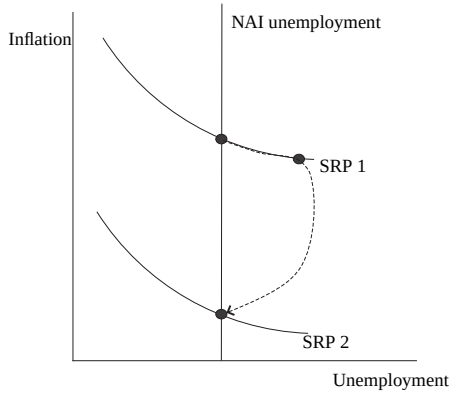


FIGURE 8.8. The short-run Phillips curve (SRP) moves down with time if tight policy is permanent.

assume that the government announces a change of policy: it promises to pursue a tighter fiscal and monetary policy such that the long-run average inflation rate will be just 2 percent per year. Furthermore, it then pursues such a policy. What happens?

According to our model of slow adjustment of wages, the initial effect of the tighter policy will be a shift downwards and to the right along the (short-run) Phillips curve; inflation will decline slightly, and unemployment will increase. However, in the longer run the effect will depend on how expectations adjust. If agents in the economy believe the government then they will expect 2 percent inflation in the long run. The Phillips curve will thus shift downwards, and unemployment will return to the NAI level while inflation drops to 2 percent. So the economy shifts from an equilibrium with high inflation and NAI unemployment to an equilibrium will low inflation and NAI unemployment. The cost of the shift is the period of high inflation and high unemployment which must be endured before the economy adjusts fully to the new policy. The process is illustrated in Figure 8.8.

In our extended model there is no long-run link between inflation and unemployment. But in the short run there is a link. It is then natural to ask how long is the short run? The model does not have a definite answer to this question, except to say: 'It depends!' To see what it depends on, consider the next model economy.

EXAMPLE 8.1. *Consider a country,* Stabbel *which has a long history (over 40 years) of stable policy and inflation close to 2 percent. Consider a second country,* Wobbel, *in which policies—and the rate of inflation—have changed constantly from one year to the next. In both countries the current inflation rate is 2 percent per year. Now assume that both countries embark on a set of expansionary policies that were not anticipated by the market, driving up aggregate demand. How long will it take for the* SAS *curve to catch up?*

The question in the example is of course impossible to answer accurately, however, it is reasonable to suppose that the adaptation will be much faster in Wobbel than in Stabbel. The reason is that in Wobbel all market agents are constantly prepared for changes in economic policies, and prices and wages may begin to adapt within weeks or months. However in Stabbel there has never been any need for such a degree of preparedness, and therefore it takes much longer before prices and wages change and the *SAS* curve shifts upwards.

8.4. Optimal stabilization policy

8.4.1. Expectations and stabilization policy. Recall model economy 8.1, continuation 5, in which the government hates unemployment and isn't too bothered about inflation, and where there are no inflationary expectations. In this case we saw that the optimal government policy was expansionary, yielding high inflation and low unemployment, permanently. But in our extended model (with expectations) we found instead that expansionary policy could, at best, give a temporary period of low unemployment at the cost of permanently higher inflation. What then is the optimal policy in the extended model?

MODEL ECONOMY 8.1, continuation 9. *Assume an economy in which the short-run supply curve is similar to that illustrated in Figures 8.2–8.4. The government can influence aggregate demand (for instance through expansionary policy), whereas short-run shifts in aggregate supply depend on inflationary expectations. (So if for instance inflation is expected to be 10 percent per year then the aggregate supply curve shifts up by 10 percent per year.) The government hates unemployment and isn't too bothered*

about inflation, as long as it is no higher than around 10 percent. Finally, assume that the government discounts the future heavily, i.e. it has a short time horizon, it cares a lot more about what happens next year than about what happens in four years' time. What happens in the long run in such an economy?

To understand what happens in the long run, consider the following scenario. Assume that inflation is at just 2 percent, and the market expects it to remain there. Then if the government launches an unexpected expansionary policy then it can achieve a period of low unemployment before expectations adjust and the economy approaches a new long-run equilibrium with high inflation and NAI unemployment. Alternatively, the government can continue with a tight policy and hold inflation at 2 percent while unemployment is at its normal level. Since the government has a high discount rate it prefers the former option (benefits early, costs later) and therefore launches its expansionary policy. However, the market agents can also do our analysis, and having done so they realize that their expectation of low inflation was not realistic: even though inflation is 2 percent, the market should expect expansionary policy! And since the expansionary policy is now expected, it has no downward effect on unemployment. The choice facing the government is then either to enact expansionary policy and obtain high inflation and NAI unemployment, or to defy expectations and obtain low inflation with high unemployment. The government chooses expansionary policy.

Careful consideration of the above scenario shows that the only long-run stable equilibrium is one with NAI unemployment and 10 percent inflation. At this point the government is sufficiently averse to further inflation to prevent a further loosening of policy. This is despite the fact that the government would prefer NAI unemployment and 2 percent inflation.[4] Using more formal language, we can say that the following policy is *time inconsistent*:

(1) Promise low and stable inflation through tight policy;
(2) Deliver low inflation through tight policy.

A policy is time-consistent if there is no incentive to deviate from it in the future. But if the government succeeds in gaining the market's trust in tight policy then it has a strong incentive to break that trust by delivering expansionary policy and therefore gaining a period of low unemployment.

How then can a government achieve the long-run optimum with low inflation and NAI unemployment? In our model economy there are at least two possible methods to do this. The first is to somehow convince the market agents that the government really will stick to a tight (low-inflation) policy, for instance by convincing them that it actually greatly dislikes inflation, or that it has a very long time horizon. The only way to succeed with the policy is probably through actions rather than words: the government must pursue a tight policy for many years (with consequent high unemployment) until the market adapts its expectations. The second method is to hand over responsibility for monetary policy to a third party (such as the central bank), and to give that third party a clear mandate to control inflation and not to worry about unemployment. In the next section we will discuss historical attempts to apply the first method, with varying degrees of success, and the modern application of the second method, i.e. the creation of an independent central bank.

8.4.2. Time delays and stabilization policy. Even without the problem of managing expectations, the government (and central bank) has a difficult problem managing the business cycle. The difficulties arise because of imperfect information and time delays or *lags*. By lags we mean delays between the time at which it becomes clear that some policy is necessary and the time at which that policy is fully implemented (inside lag), and also the delay between implementation and the policy actually affecting the economy to the full extent (outside lag).

Time delays are a problem for the government as they mean that the government must act in advance in order to curb economic fluctuations completely. But in that case the government must know where the economy is headed, in advance, and this is not easy, because the business cycle is caused by unexpected events. In the worst case, government policy may end up amplifying economic fluctuations rather than dampening them.

MODEL ECONOMY 8.1, continuation 10. *Assume an economy in which there is a 2 year lag between observation of the state of the business cycle and policy to manage the cycle taking effect. Assume furthermore that unexpected events typically cause the business cycle to fluctuate with a period of around 2 years (so 2 years after a recession the economy may well be in a boom, without the application of policy). Finally, assume that the government applies 'stabilization policy' enthusiastically, not accounting for the lag. What happens?*

In this economy it is quite possible that policy may amplify fluctuations rather than dampening them. Assume for instance that the economy is in recession, and the government sets in train expansionary

[4] Note that we did not say that inflation has no cost to the government, only that it is relatively small.

policy. Two years later this policy has reached fruition and affects the economy. However, by this time the business cycles has turned and the economy is in a boom. The expansionary policy thus amplifies the boom rather than dampening it. If the government then sets in train a contractionary policy this may end up deepening the next recession rather than dampening the boom. And so on.

In order to successfully manage the business cycle—despite the problems caused by time delays and imperfect information—the government has two possible strategies: firstly, to choose policies with the smallest possible lags, and secondly to obtain relevant information as early as possible.

Regarding the length of lags, the distinction between fiscal and monetary policy is highly relevant (see Sections 7.3 and 7.4 to revise these concepts). Fiscal policy is policy regarding the government budget. In a recession, expansionary fiscal policy might include reducing taxes, or raising government spending on schools and hospitals. However, such policy changes may typically require parliamentary debates which are not normally organized at short notice; indeed, it may be convenient to debate and plan the government's budget just once per year. Furthermore, even when a decision has been made to (for instance) build new hospitals it may take several more years before the building work begins. So the lags (both inside and outside) on fiscal policy are typically long. Regarding monetary policy, on the other hand, the inside lag is a matter of weeks: recall Figure 7.8 showing how frequently the Swedish central bank meets to (potentially) adjust the base interest rate. Furthermore, a change in the interest rate may have an immediate effect on the economy through its effect on expectations about future long-run interest rates.

Regarding information, our analysis suggests that governments should devote significant effort to monitoring the business cycle in order to know as early as possible where the economy is heading. That is, they should carefully watch the rates of inflation and GDP growth, and the level of unemployment. Furthermore, they should study other indicators—ideally those which are linked to expectations about the future—such as stock prices, house prices, and investment rates. Furthermore, they should perhaps ask economic agents directly about their expectations: do they for instance expect the next year to be better than the last, in economic terms? The heart of Keynes' model of the business cycle is inventories (stocks of unsold goods). So why not keep track of these, too? When inventories are increasing this may be a sign that firms are likely to cut production in the near future. Such measurements should provide the opportunity to explore where the business cycle is likely to be heading in the future, thus allowing policy to be introduced in good time in order to dampen fluctuations. As we will see in the following section (Relevance to real economies) governments perform all of the above measurements, and more, in order to follow and predict the business cycle. The predictions are not very reliable, but they are a lot better than the naive approach of assuming that the economy will always stay in its current state absent policy intervention.

8.5. Relevance to real economies

Here we discuss the relevance of our full *AD–AS* model—with expectations, imperfect information, and policy lags—to real economies. We divide the discussion into three parts: firstly we discuss expectations, the short-run Phillips curve, and the long-run link (if any) between inflation and unemployment; secondly we discuss stabilization policy in the presence of imperfect information and time lags; and thirdly we discuss economic crises such as the recent global crisis which started in 2007/2008.

8.5.1. Expectations, inflation, and unemployment in the data. Can we see changes in expectations, and thus shifts in the short-run Phillips curve, in real data? It turns out that we can! In Figure 8.9 shows data from first Sweden and then Great Britain. In 8.9 (a), we see a stable Phillips curve; expectations of inflation do not seem to have changed much over the period. This is not surprising since the Swedish central bank had a statutory objective of keeping inflation close to 2 percent throughout the period. In 8.9 (b), with a longer time interval, we can clearly see that the short-run Phillips curve moves downwards during the period 1994–1999, and then settles in a new stable position. It is notable that the British central bank (Bank of England) was given independence in 1997; recall the discussion of credibility and expectations above.

The story behind the British data between 1979 and 1993 (the Thatcher era) is fascinating. During a short period in the 1980s—partly because of Margaret Thatcher and Ronald Reagan—Milton Friedman's ideas about a k-percent rule were popular: the rule is that the money supply should grow by a certain percentage k each year. From $MV = PY$, we know that we get constant prices if the increase in MV is the same as the increase in Y, i.e. GDP growth. So if we want inflation to be 2 percent per year then we should instead raise M by the rate of GDP growth plus 2 percent. The idea of following the rule was to guarantee low and stable inflation. As can be seen from Figure 8.9, the policy was a spectacular failure.

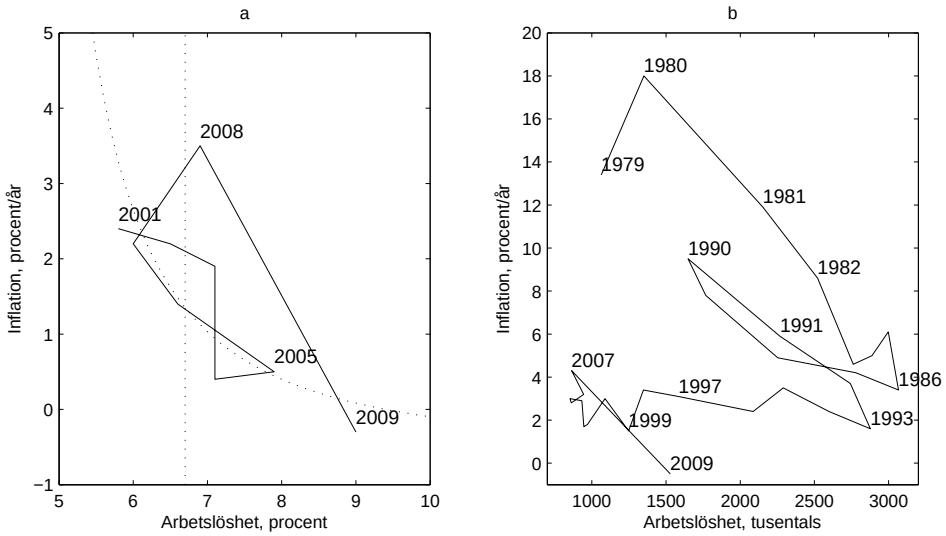


FIGURE 8.9. Phillips Curves (a) Sweden (b) UK

The problem with such a rule is that the money supply is quite elusive, and the velocity of money even more so. And if V rises unexpectedly while M follows the k-percent rule then policy will be too expansionary. Furthermore, neither the money supply nor the velocity of money are easy to control directly. Margaret Thatcher and her "Chancellors of the Exchequer" (finance ministers) played with a money-supply rule during the '80s. The result was—initially—a very deep recession. Then, when the recession was over and the economy started to expand, new forms of credit and payment systems were developed which raised MV beyond what was planned by the government, and led to a huge and unsustainable boom, inevitably followed by a new deep recession in the early '90s.

More broadly, the idea that the government cannot raise the growth rate and reduced unemployment permanently through expansionary policy is almost universally accepted. And there are many examples of hyperinflation and economic collapse which have resulted when governments have tried to do so, a recent one being in Zimbabwe in the first decade of the 21st century.

8.5.2. Stabilization policy in practice. In accordance with our discussions above, the heart of modern stabilization policy is the setting of the base rate (i.e. the short-run interest rate) by the central bank, which is instructed by the government to set the interest rate in order to maintain a low and stable rate of inflation (typically close to 2 percent per year). As discussed above, the interest-rate instrument has a very short inside lag; decisions can be made quickly. Furthermore, the interest rate starts affecting economic agents and their decisions immediately (outside lag). And it affects aggregate demand directly by affecting consumers' incentives with regard to saving and consumption, and firms' incentives with regard to investment.

This is central to the current policy for the euro area, Sweden, and the United Kingdom among many other countries. Stable and low inflation creates a stable foundation for economic activity. This is now considered the main task of government in a market economy. It is difficult or impossible to create growth itself, to ensure that everyone gets a job, and so on. What governments can do is to create the conditions for an effective market economy in which individuals' energy is channelled towards the creation of products and services, rather than being wasted on dealing with an uncertain economic environment.

An inflation target of the central bank (e.g. to keep inflation as close to 2 percent as possible, and at least between 1 and 3 percent) leads to active policy to smooth the business cycle by the central bank, which must continually work to predict where the economy, and the accompanying inflation rate, is headed. For example, if the economy is heading into a boom, inflation is set to rise. If the rate is now 2 percent then the central bank should raise interest rates to 'cool down' the economy in order to keep inflation within the range. Therefore the bank, and the government, perform a wide range of different surveys and measurements of the economy (as well as running computerized economic models) in order to predict where the economy is heading.

Fiscal policy is problematic in an uncertain economy because of long delays: governments do not increase funding for schools as part of stabilization policy, unless it is as part of a generally expansionary policy in the longer term. Nevertheless, some fiscal policy instruments may be used, such as temporary

tax changes. One example that was marketed as economic policy in Sweden is a temporary tax refund for small construction jobs, introduced in order to increase employment in the construction industry during a period of recession in this industry.[5] However, this has now been made permanent, and thus become a permanent subsidy to the construction sector, and therefore has nothing to do with management of the business cycle.[6] One advantage of fiscal policy in difficult times is that it has an effect. In the 1930s it was said that "it is difficult to push on a piece of string", and then it was argued that low interest rates (monetary policy) facilitates economic activity, but does not create it directly, especially if the banks will not lend money anyway.

Regarding long-run fiscal policy, governments typically want to balance their budgets in the long run. Because of the presence of automatic stabilizers, this implies that governments will tend to run a deficit during downturns in the business cycle; in order to compensate, they must therefore run a surplus during the good times. In Sweden, the government has for many years had a stated aim of running a surplus equal to 1 percent of GDP per year, on average. As long as this goal is met, the government gradually pays off its debt to the other agents in the economy (both at home and abroad). As the debt has shrunk, this policy has been questioned more and more, and (at the time of writing) seems likely to be abandoned.

8.5.3. Economic crises. In severe economic crises the rules of the game change. Since in such crises inflation typically becomes zero or even negative, the interest-rate instrument tends to lose its power: even when the base rate is set to zero, firms choose not to invest and consumers not to consume, and GDP remains below trend, while unemployment is above the NAI level. If interest rates are lowered further (below zero) then there is a risk that agents withdraw money from the banks in the form of cash; holding cash gives zero rather than negative interest.

In a crisis instruments other than monetary policy are then called for. The first candidate is fiscal policy. On the one hand, the prospects for fiscal policy look good, because a key drawback with fiscal policy is the long lags, but in a major crisis these are not so important, for two reasons: firstly, in a major crisis the lags can be reduced; secondly, since a major crisis is likely to be long-lasting there is much less risk that the policies end up arriving too late and amplifying a boom. Recall the discussion the Obama stimulus package in the previous chapter: Lehman Brothers collapsed in September 2008, Obama was elected in November 2008, and in February 2009 the Act was approved by Congress, pumping an extra 800 billion US dollars into the economy, corresponding to more than 5 percent of US GDP at the time. Here we see that a strong and rapid fiscal policy response is possible in exceptional circumstances.

On the other hand, there is also a problem with fiscal policy in a major crisis, and this is that expansionary fiscal policy leads to an increase in the government deficit, which is already likely to be large due to the crisis. If the government, and more importantly the markets, are not confident that the crisis will soon be solved, a large deficit and consequent rapidly rising government debt may be a serious problem. In particular, if the markets lose confidence in the ability of the government to pay interest on the debt then agents will be unwilling to lend to the government, and thus the economic system risks collapse. Therefore it is tempting for governments to apply *contractionary* fiscal policy because of fear of a spiralling deficit, even though they know that this will deepen the crisis in the short run. This has been the approach followed in Europe since 2008, contrasting strongly with the expansionary policy followed in the US. The results speak for themselves: US real GDP per capita in 2013 was 0.7 percent higher than in 2007, and growing at a rate of 1.5 percent per year. The corresponding figures for the 15 countries which were in the Euro area in 2007 are that GDP per capita was on average 3.7 percent lower in 2013 than in 2007, with GDP still (very slowly) declining. See Chapter 7, in particular Figure 7.7.

Major crises typically start in the financial sector. The reason that financial crises have such a big effect on the overall economy is that in a financial crisis firms are typically unable to access funds for investment (or to cover temporary losses). This leads to a collapse in the rate of investment, and a very high rate of bankruptcies. When firms go bankrupt then banks make further losses (since the money owed to them by bankrupt firms must be written off, so valuable assets owned by the bank suddenly become worthless). This means that *banks* risk going bankrupt, therefore banks are unwilling to lend to one another (since they know that if they do the lender may never see the money again), and the entire financial system freezes. When firms are no longer able to borrow money to finance investment or tide them over bad times then investment I falls and many firms go bankrupt, directly reducing wages and returns to capital: see Figure 8.10. Meanwhile, the value of assets such as houses and shares plummets, and this reduction in the public's wealth leads to higher savings and lower consumption.

[5] Known as *rotavdraget*.

[6] A similar permanent subsidy was introduced for household services. There are very different interpretations of these. One is that it is about realpolitik, and that thanks to the deduction there has been a dramatic reduction in the black market for such services, and hence an increase in revenue. Another is the desire to make life easier for wealthy households by making cheap labour even cheaper.

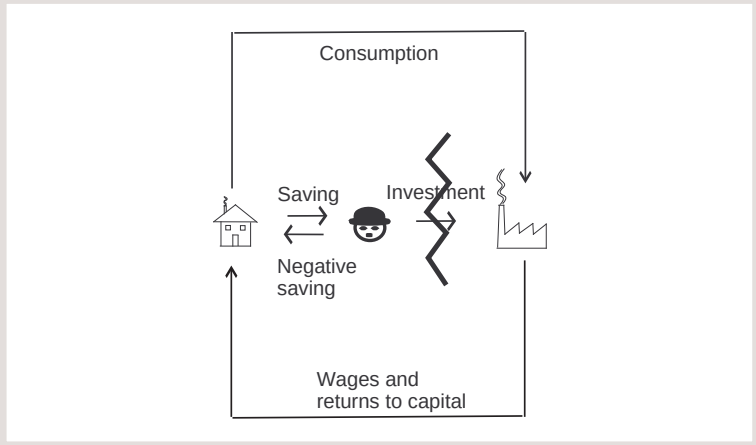


FIGURE 8.10. Due to the confidence crisis, companies difficult to finance investments

MODEL ECONOMY 8.2. *Assume an economy with many banks, and a central bank. The central bank determines the* base rate*, and the banks borrow from and lend to each other at rates close to this rate. There is* uncertainty *in the economy, and banks may make loans to firms or households which they are subsequently unable to recover. Banks make* losses *on such unrepayed loans; on the other hand, the banks make profits in many ways, one if which is that they charge higher interest on loans than they offer on deposits. Nevertheless, if a bank makes too many loans which never get repaid its losses will mount, and eventually it may go bankrupt. When a bank goes bankrupt it is unable—by definition—to pay its debts. Thus all those who have deposits at the bank (including other banks) make losses.*

Now assume that agents in the financial market suddenly realize that several banks have made very large loans which are never likely to be repaid. What happens?

What happens in the model economy is that one or more of the banks is likely to go bust (bankrupt). When one bank goes bankrupt, this causes losses to other banks—all those which have deposits at the first bank—whose position therefore worsens: there may be a domino effect in which many banks go bankrupt. In this situation the *banks are very reluctant to lend money to each other*, fearing that that money will never be repaid. Imagine now a 'business bank' which wishes to lend money to a firm which has a very promising investment plan. If the business bank is to lend money, it must attract the corresponding deposits. The normal way to do this would be by borrowing from other banks. If the other banks are not willing to lend to the business bank, it will be unable to lend money to the firm. And if firms are unable to borrow, they cannot invest. And if investment falls drastically, aggregate demand falls, and we have a recession. Consumer confidence collapses, consumption falls, and we have a crisis.

So, our previous analysis does not match the story of the financial crisis, but we see that our analysis has given us the tools with which to analyse it. The first policy measure which must be taken is to restore confidence in the banks: as long as agents have no confidence in the banks, investment cannot start again, and the economy cannot get moving. One way to restore such confidence is for the government to effectively buy the banks. This is a form of bail-out, but it may give a very good deal to the taxpayer since the (almost bankrupt) banks should be available at a bargain price, and if the government can get the economy moving again, and the banks on their feet again, they can be sold at a profit. Another option —and that which governments chose more often than not—is to give the banks money to cover their losses. Not such a good deal for the taxpayer.

What then should the government do in an economic crisis triggered by problems in the financial sector? And how did governments react in 2007 and 2008? The initial focus was on saving the financial market, so that investment funds could begin to flow again. The hope was for quick results and that recession—let alone a global depression—could be avoided. When it was realized that the crisis was deepening and affecting *AD* dramatically, then governments began to deploy traditional measures to stimulate the economy; first a dramatic lowering of interest rates, and then in some cases expansionary fiscal policy.

As the crisis continued, governments began running out of options. The base rate was near zero, and government deficits were large and increasing, hence the national debts of crisis countries were also increasing rapidly, making it very difficult to further increase state expenditures. Then there is one last tool in the box for the central bank: *QE* or quantitative easing. Through QE central banks pump in money directly to the banks, instead of working through the base rate. They do this by buying interest-bearing assets from the banks. By doing so they hope to push up the price of these assets in the secondary

market, and thus lower the *long* interest rate. (Remember that the bank normally only have control of the *short* rate, while long-term rates is actually more critical to investment decisions.) Thereby hopefully increase banks' willingness to lend to long-term projects because the interest they can earn on alternative investment has fallen. Whether QE actually has the hoped-for effect is a matter of debate. However, there is no doubt that it leads to higher asset prices.

8.5.4. Alternative theories to explain the business cycle. We have developed a theory built on *sticky wages*. Alternative (but very similar theories) can be built on *sticky prices*. If wages are sticky but not prices, then in a boom firm profits should rise while real wages to workers should decline. On the other hand, if prices are sticky but not wages then the reverse should hold (when firms want to raise their production they must pay higher wages to attract labour, but are unable to raise the prices of their products). And if the interest rate (the price of money) is sticky—i.e. if the central bank fails to adjust it in time, or if long-term interest rates fail to adapt—then rising nominal demand will trigger high investment rather than high consumption. In each case the mechanisms are fundamentally similar, and it turns out that any or all of the above may be true at different times. For instance, in the US, real wages were counter-cyclical prior to World War II, but have been procyclical since. This suggests that wages were stickier than prices prior to WWII, whereas the reverse has applied since. The reason for the change could be the increasingly complex networks of supply leading to the production of final goods, where each link in the network may be subject to a long-run contract specifying fixed nominal prices.

A completely different idea is real business-cycle (RBC) theory, according to which business cycles are completely *real*, i.e. there are no sticky prices of any kind, and indeed no other problems connected to how markets function (i.e. no *market failures*). This implies that we would also observe business cycles in economies without money, contrary to our arguments in Chapter 1. The basic idea is that agents deliberately adjust their decisions based on exogenous shocks such as a sudden and unexpected increase in productivity. Such a shock leads agents to supply more labour (and take less leisure) and thus leads to a boom. On the other hand, when there is a negative shock workers withdraw their labour and their is a recession or downturn. Since the business cycle is the result of agents optimizing, according to RBC theory there is actually no need for government intervention (policy) whatsoever! The theory is elegant but many economists view it as irrelevant to understanding how real economies work.

Exercises

Ex. 8.1 Assume an economy with a single product, widgets, produced using labour alone. There are 100 working-age adults in the economy, each of whom can produce one widget per day, and everyone works in widget production. (All adults are in the labour force, and there is no unemployment.) There are also 50 retirees in the economy, and workers save a proportion of their wages to build up savings, while retirees live off their savings. The economy starts in a long-run equilibrium with zero net savings, zero investment, and zero inflation.

Now assume that the short-run supply curve is similar to that illustrated in Figure 8.2, and that the citizens of the economy become more optimistic about the future and decide to save less and consume more. Describe what happens over time according to the *AD–AS* model assuming that wages are *sticky*, that is that they change slowly in response to changed circumstances.

Ex. 8.2 Assume an economy in equilibrium which is suddenly hit by a negative demand shock, such that the demand curve shifts to the left. Use *AD–AS* model to answer the following questions.

(a) Show the short-term impact on GDP (and hence unemployment) and inflation.
(b) Show the effect in the medium term if the state does nothing and the high unemployment leads to a downward pressure on wages.
(c) Show the effect in the medium term if the state tries to neutralize the shock with expansionary policy.

Ex. 8.3 (a) An economy, A, has long had stable inflation at 2 percent per year. Suddenly the government implements a more expansionary policy that leads to a sharp increase in the *AD*. Explain the effect on inflation, GDP and unemployment in the short and medium term.
(b) Another economy, B, has long had high and volatile inflation, which is, however, currently at 2 percent per year. Suddenly the government implements a more expansionary policy that leads to a sharp increase in the *AD*. Explain the effect on inflation, GDP and unemployment in the short and medium term, compared to in economy A.

Ex. 8.4 Assume a country where technological development means that labour productivity rises. Illustrate what happens with *LAS* curve with time. Explain briefly!

Ex. 8.5 Assume an economy with zero growth (there is no technological progress) in which prices and wages both grow at 2 percent per year, while unemployment is stable at 5 percent. The government is not happy; it wants higher GDP and lower unemployment. To achieve this it decides to reduce interest rates and raise spending. Furthermore, it is determined to achieve its goals.

Describe, step-by-step, what is likely to happen. Use economic reasoning (such as a model economy), and cite evidence from real economies.

Ex. 8.6 Assume an economy in which the government controls both monetary policy (the interest rate) and fiscal policy (the government budget). The government claims that it hates inflation, but market agents are not convinced; they think that the government hates unemployment, and isn't too bothered about inflation as long as it is no higher than 10 percent. The inflation rate is currently 10 percent, and the interest rate is 13 percent.

(a) What is likely to happen if the government announces that from now on inflation will be 2 percent, and consequently that it plans to reduce interest rates to 5 percent so that the real interest rate remains at 3 percent? Explain carefully.
(b) What is likely to happen if the government announces that it has created an independent central bank whose sole aim, set down in law, is to keep the rate of inflation as close as possible to 2 percent? Explain the difference.

Ex. 8.7 The central bank controls the short-run interest rate. This question is about how the *long-run* interest rate is determined.

The date is May 29. Assume you hold, among other assets, 10000 bonds giving 50 EUR in payment at the end of each year, in perpetuity. You are happy with your investments at the moment. However, you are suddenly convinced that the central bank is going to lower the short-run interest rate on June 1, and moreover that it will signal a lower interest rate path in the future than the one previously announced. These events are not expected by the financial markets.

(a) What do you do with your bonds, or any of your other assets, when you get your new beliefs? Explain!
(b) Assume instead that you are not alone in your insight: the entire market has the same insight as you, on 29 May. What happens?

Ex. 8.8 Assume that you own a hundredth of a business, and the market believes that the company—if it is well run—will deliver benefits totaling 100 000 SEK annually in perpetuity to their owners. You are thinking of selling your share when you retire and living on it.

(a) What is the value of your share of the company if the interest rate is fixed at 5 percent per year in perpetuity?
(b) What is the value if interest rates rise to 10 percent?
(c) What is the impact of such a rate increase on your prioritization between consumption and saving? Explain!

Ex. 8.9 –We cannot promise spending when there is no money, said Finance Minister Anders.

Prime Minister Fredrik however is confused. Should the government not run a deficit during a recession? Help him sort this out! Is Anders right? Is Fredrik right? What should Fredrik do?

CHAPTER 9

Unemployment: Definitions and Data

In this chapter we define unemployment, and consider data regarding long-run unemployment over time and across countries.

9.1. The definition of unemployment

When is a person unemployed, according to standard methods of gathering labour-market statistics? Presumably when that person has no job. But is that enough? It turns out not to be.

In order to be counted as unemployed a person must be an adult of working age, she must be healthy enough to work, and she *must be actively seeking employment*. Very generally we can divide the adult working-age population into three groups: the employed, the unemployed, and those outside the labour force. Those outside the labour force are thus people who (a) have no job, and (b) are not actively seeking a job. This may be because they are too ill to work, but more likely it is because they have chosen not to seek work, perhaps because they are studying full time (they are students), perhaps because they choose other activities instead of paid work (for instance they could be homemakers), or perhaps because they would like a job but have given up looking because they do not believe that the search is worthwhile (they are *discouraged workers*).

Recall definition 2 from Chapter 1.

Definition 2.

- *The number of unemployed: All the people who do not have a job and are actively seeking work.*
- *The labour force: All those who want to work, i.e. the sum of the unemployed and all those who do have jobs.*
- *The unemployment rate: The number of unemployed as a percentage of the labour force.*

Model economy 9.1. *Suppose an economy with 100 adults, 70 of whom are working. What is the rate of unemployment, in percent?*

This is of course a trick question. We cannot say what the level of unemployment is, all we can say is that it is no more than 30 percent. The reason is that we do not know what the other 30 people are doing: are they looking for the job, or are they outside the labor force?

Model economy 9.1, continuation 1. *Now suppose that of the 30 without a job, 25 are outside the labour force while 5 are looking for a job. What is the rate of unemployment, in percent?*

To answer this question we need another definition.

Definition 3. *The rate of unemployment in an economy is the number of unemployed people in the economy divided by the number of people in the labour force.*

Given this definition, the rate of unemployment in model economy 9.1, continuation 1is $5/75 \times 100$, i.e. 6.7 per cent.

When measuring unemployment, the golden rule is that only those who have no job and are actively seeking a job are counted as unemployed. Despite this apparently clear definition, however, there are gray areas. One such gray area is the classification of people who seem to have jobs, but where the jobs may be seen as artificial, not 'proper' jobs. An example is a job created by local or national government through labor market programs. In some countries (including Sweden) where there are many such jobs then they are counted as a separate category. Another gray area concerns how to count discouraged workers. How 'actively' must one be seeking work to be counted as unemployed? Many discouraged workers may be on the look-out for opportunities even though they are not regularly or frequently applying for advertised positions.

The above is summed up in Figure 9.1, where E, E^*, U, O^*, and O stand for the numbers of working-age adults who are employed, employed in labour-market programs, unemployed, discouraged, and outside the labour force. Note however that the number of discouraged workers is typically not measurable. According to the standard definition the rate of unemployment (in percent) is then $U/(E+E^*+U) \times 100$.

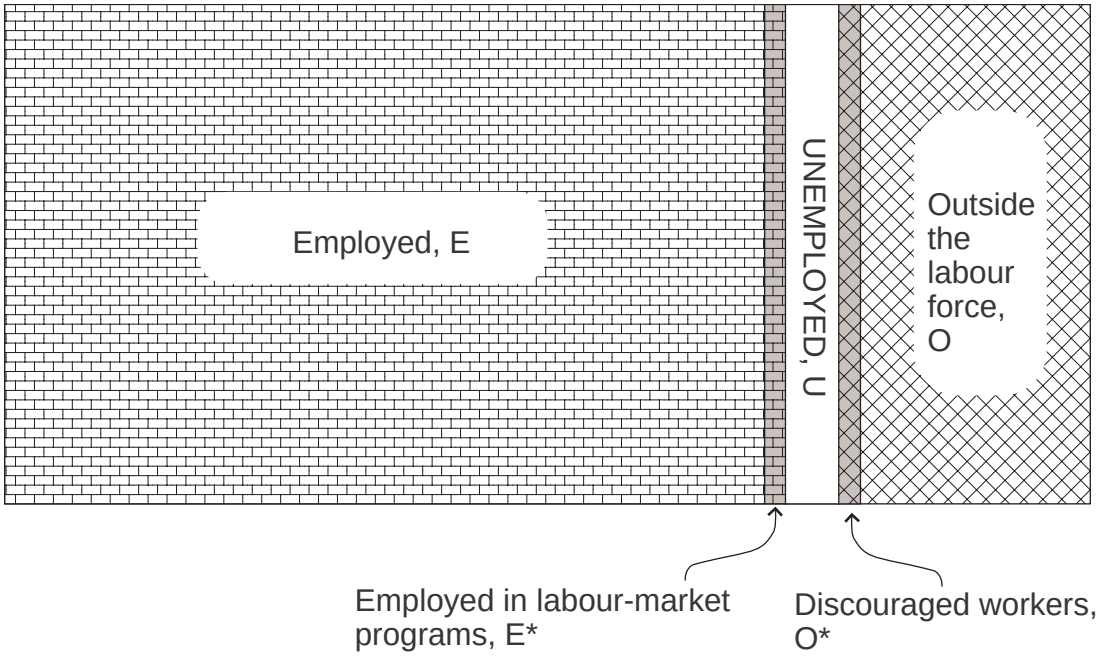


FIGURE 9.1. A categorization of working-age adults according to their current status in the labour market. The proportions of employed, unemployed, and those outside the labour force are very approximately representative for a typical modern economy.

9.2. Different types of unemployment

An important distinction is between long term unemployment and short-term unemployment. Long term unemployment is usually defined as unemployment that persists for longer than 6 months. Most people who experience unemployment never experience long-term unemployment; nevertheless, the majority of the unemployed at any given time are often long-term unemployed. To understand this, study following example.

MODEL ECONOMY 9.2. *Assume an economy with 130 adults of which 30 are outside the labour force, 3 have been unemployed for the past 5 years, 3 have recently come out of high school, and of these two have found jobs (the third has searched for 7 months), and 94 work an average of 98 days of 100; the other two days, they are unemployed. This is because they change jobs occasionally (approximately every three years) and between jobs they are typically unemployed for around three weeks. Right now, 2 of these 94 are unemployed. In this economy, roughly how many people experience unemployment each year? For how long, in most case? Right now, what proportion of the labor force is unemployed? Of the unemployed, what proportion is long-term unemployed?*

The answer is that around 35 or 40 people may experience unemployment in a given year: apart from school leavers and the long-term unemployed, about 30 people switch jobs each year, which often involves a short period of unemployment (about three weeks). Right now, there are 100 people in the labour force, of whom 6 are unemployed. Of these 6, 4 are long-term unemployed, 67 percent.

The example shows that short-term and long-term unemployment are different phenomena with different explanations and different costs. Short-term unemployment is of course not ideal, but not a major social problem. By contrast to long-term unemployment, which is typically a major social problem. Finally, note that countries with high unemployment tend to have a high proportion of long-term unemployed (e.g. that around 50 percent of the unemployed at any given time have been unemployed for more than one year).

9.3. Data on unemployment rates

We now look at long-run and cross-country data on unemployment to get an overall picture of how unemployment has varied over time, how it varies across countries, and how it relates to other variables such as GDP and inflation in the long run.

We start with cross-country data. In Figure 9.2 we see unemployment in 2006 for seven of the world's biggest economies, plotted against GDP per capita (upper panel) and GDP growth (lower panel).[1] Note

[1]The unemployment data comes from the World Bank, GDP data from the IMF.

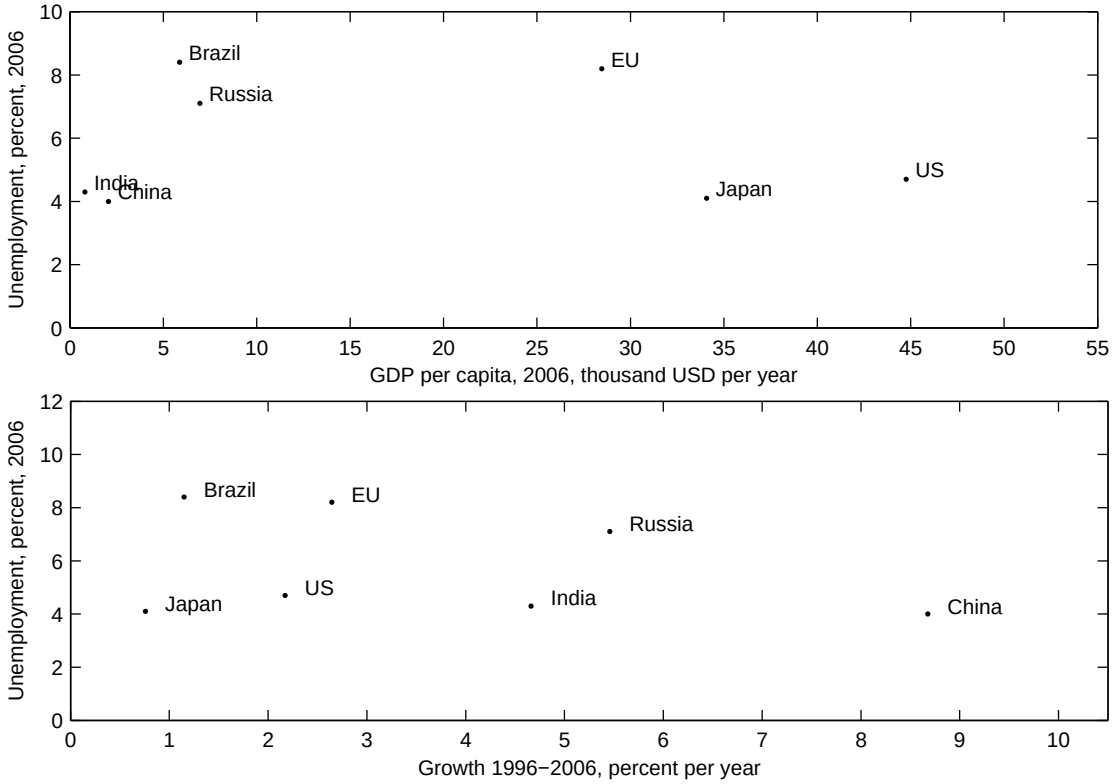


FIGURE 9.2. GDP, GDP growth, and unemployment for some of the world's biggest economies.

first that there is quite a wide variation in the unemployment rate, from around 4 percent (Japan) to over 8 percent (Brazil and the EU). Second, note that there is no obvious correlation between the level of GDP and unemployment; neither is there a strong correlation between the growth rate of GDP and the level of unemployment. So unemployment, the level of GDP, and the growth rates of GDP vary a lot between countries. However, it is not obvious that GDP (its level or growth) is linked to the level of unemployment.

Now we consider time series data, focusing exclusively on unemployment. In Figure 9.3, upper panel, we see a very long time series for the UK, with breaks for the first and second world wars, and a break in 1971 where we switch data source.[2] We see that the unemployment rate varies greatly over time, even in the long run. Short-run periods of high unemployment (such as those starting in 1929, 1980, and 2008) are attributable to the business cycle (i.e. the are caused by severe economic recessions). However, changes in the long run average—which is around 6 percent before WW1, around 2 percent in the decades following WW2, and well over 5 percent from 1980 onwards—must be due to other factors.

In the lower panel of Figure 9.3 we can compare developments in the UK (continuous line), the US (dotted line), and Sweden (bold line) since WW2. Note that detailed data for Sweden is unavailable prior to 1970, but the trend is similar to the U.K., with very low unemployment of around 2 percent. Here we see three contrasting stories, with little or nothing in common except perhaps a slight overall tendency towards higher unemployment over time. (This tendency is strong in the UK and Sweden, but rather weak in the US.) Again we see dramatic shifts in the short run due to the business cycle, but also a major long-run shift in the case of Sweden—similar to that previously observed for the UK, although occurring later—from very low unemployment in the post-war period towards much higher unemployment in recent decades.

A remarkable feature of the data is the reversal of the roles of the US contra the UK and Sweden (which are fairly representative for Europe as a whole) between the post-war period and the present: in the post-war period unemployment was significantly and persistently higher in the US than in Europe; now the reverse is the case. A useful test for any theory we may develop to explain unemployment would be whether it can explain this reversal.

Finally we turn to inflation and unemployment. Recall the previous chapter where we claimed that there exists a short-run link between rising inflation and falling unemployment, but no long-run link between the level of inflation and the level of unemployment. Is this borne out by the data? In Figure

[2] Data...

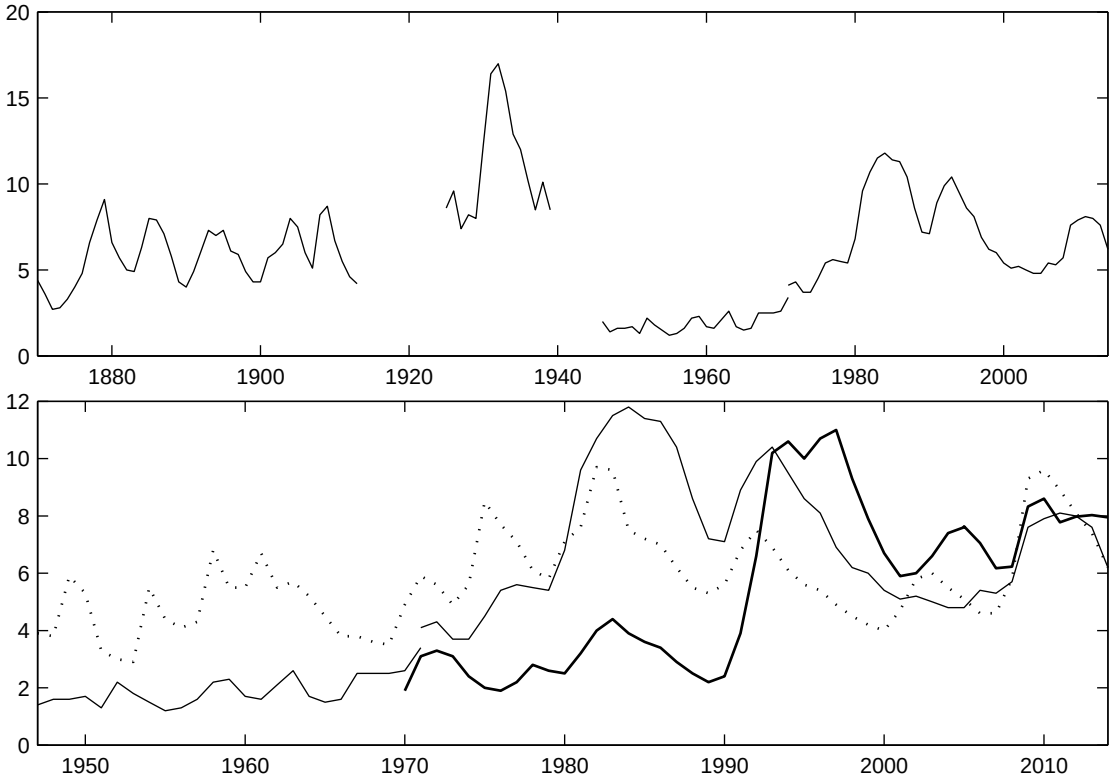


FIGURE 9.3. Unemployment over time in the UK (upper), and in the UK, USA, and Sweden (lower).

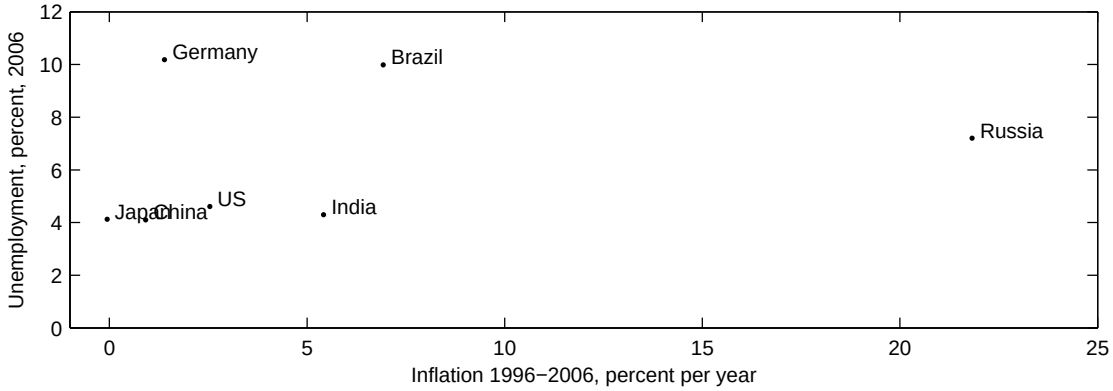


FIGURE 9.4. Inflation and unemployment in major economies.

9.4 we see that it seems to be. Our seven major economies have widely varying long-run average rates of inflation, and widely varying levels of unemployment, but there is no apparent connection between the two variables.

9.4. Data on unemployment, vacancies, and labour-market dynamics

The labour market is not static, with a a fixed group of workers with fixed jobs, and a fixed group of 'workers' who are permanently unemployed. Instead we know that there is a constant interplay between workers and firms, with workers moving from unemployment to jobs, and also from one job to another. Furthermore, firms change in size, and when a firm wants to increase in size there is a period when that firm has a *vacancy*.

In Figure 9.5 we get an idea of the number of unemployed in relation to the number of vacancies in a typical modern economy. Study Figure 9.5 carefully. What is the rate of unemployment in percent? And what is the vacancy rate in percent (i.e. the number of vacancies divided by the number of people in the labour market, $\times 100$).[3]

[3]You should find that the unemployment rate is 6 percent, and the vacancy rate is 2 percent.

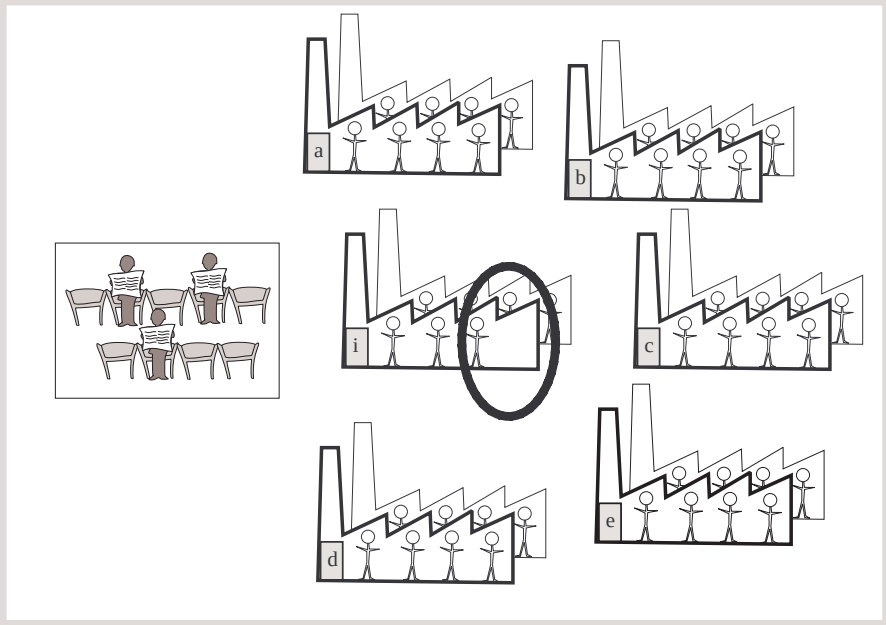


FIGURE 9.5. A picture of a labour market in which firm *i* has a vacancy.

Over the business cycle we would expect the number of vacancies in relation to the number of unemployed to change in a predictable way: we know that unemployment goes up when there is a downturn, and we would expect the number of vacancies to go down, since we have a greater number of unemployed searching for jobs, and also we might expect the rate of job creation to be lower in a downturn. That is exactly what we see, and the relationship is illustrated in a *Beveridge curve*. Note that the curve confirms that our snapshot picture of unemployment and vacancies in a typical modern economy fits the recent data from the US.

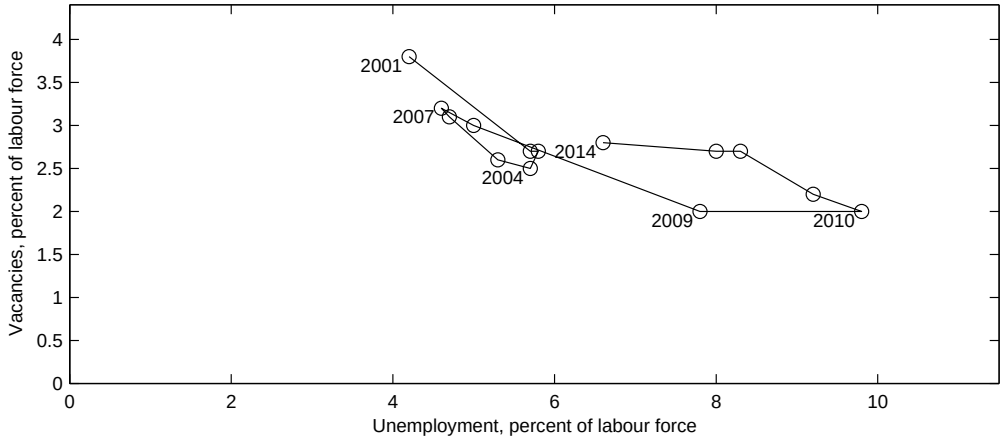


FIGURE 9.6. A Beveridge curve for the US. Data from the Federal Reserve Bank of St. Louis.

We still do not know much about the dynamics of the labour market. How fast are vacancies filled, how often do workers switch jobs, etc? A rough idea about this, again for a typical modern economy, can be gained from Figure 9.7, which shows four snapshots of our 'typical economy' taken at 2-week intervals. In the first 2-week period, the job vacancy is filled, but not by someone from the waiting room, rather it is filled by someone moving from another job. In the second period, someone from the waiting room fills the new vacancy, but someone else loses their job. And in the third period there is a switch between jobs, as in the first. The important point here is that the labour market is very dynamic: typically, the number of 'hires' in a two-month period is approximately equal to or greater than the total number of unemployed. (In the figure we have 3 hires in 6 weeks, and 3 unemployed.) However, there are two problems: firstly, the rate of separation is equally large, so unemployment does not change; and secondly, most of the hires come from other firms rather than the waiting room, and many of those in the waiting room are left there for a long period, i.e. they are long-term unemployed.

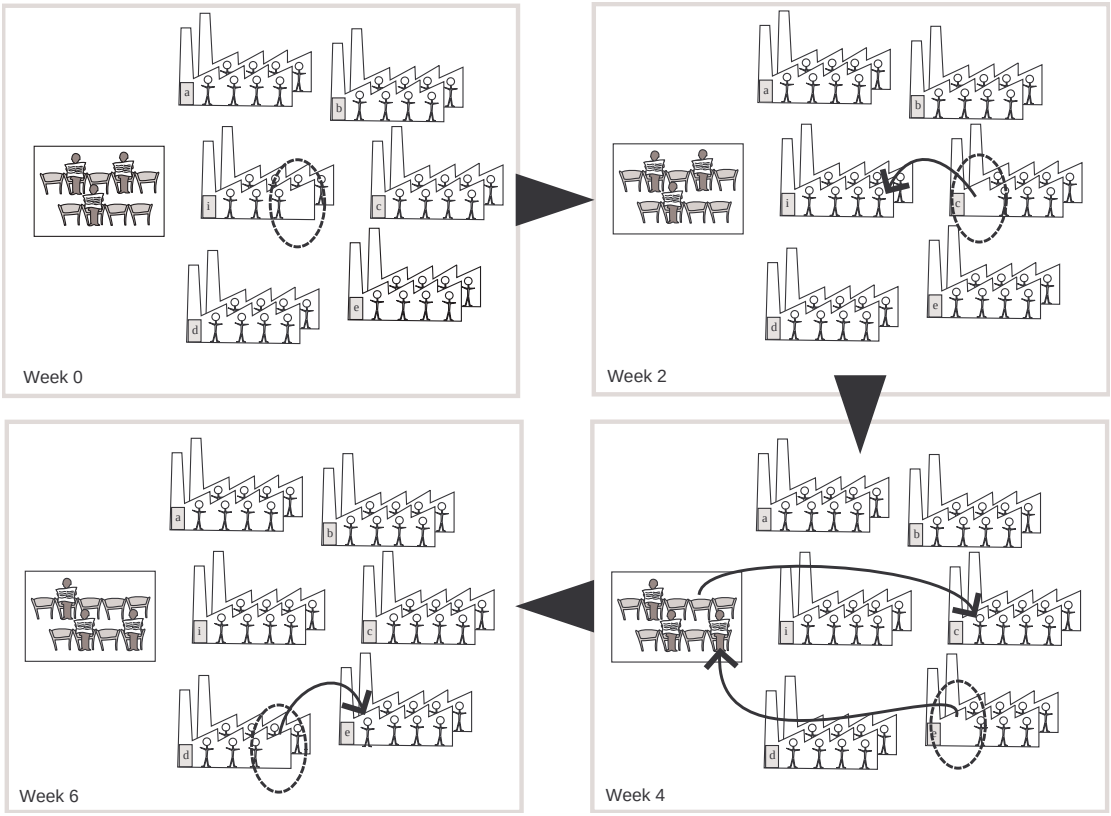
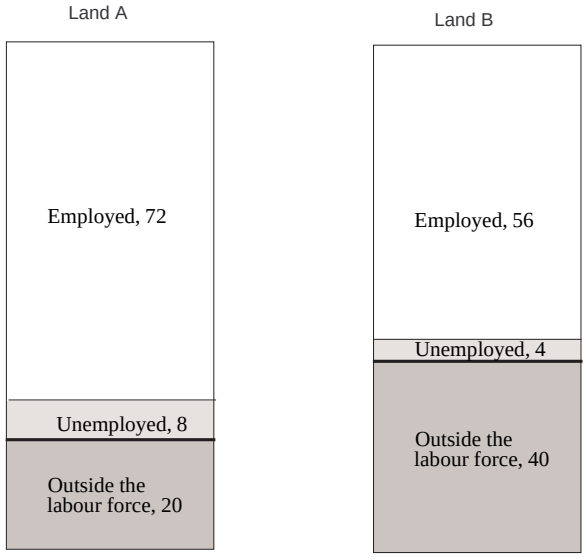


FIGURE 9.7. Snapshots of a labour market taken at 2-week intervals, showing movements between jobs, and into and out of unemployment.

Exercises

Ex. 9.1 Two countries, A and B, have 100 working-age adults each. Their economies are in long-run equilibrium, and the occupations of the working-age adults are distributed as below.



(a) (i) What is the level of unemployment in each country, as a percentage?
(ii) Every person who is employed produces goods with a value of 1000 SEK per year. What is the level of GDP per capita in each country?

(b) Discuss briefly the following statement: 'The labour market in Country A works better than in Country B, because more jobs are created in A than in B.'

CHAPTER 10

Unemployment: Explanations and Policy

Unemployment. Why does it exist? Why is it a problem? In this chapter we will learn that there are different types of unemployment, and a variety of reasons behind unemployment. Keep in mind that this chapter is not about cyclical unemployment, it is about the long-run average level of unemployment, or (recalling the analysis of Chapter 8) *NAI*-unemployment; that is, the lowest rate of unemployment that is consistent with non-accelerating inflation. The state can always boost growth and reduce unemployment in the short run by relaxing fiscal or monetary policy (e.g. by borrowing money and using it to buy goods and services), but if this leads to accelerating inflation then it will not be sustainable. The NAI level of unemployment can also be called 'the natural rate' or structural unemployment.

10.1. The riddle of unemployment

We begin by returning to the economy without money that we considered at the start of the book, and in particular model economy 1.2. The analysis there is so fundamental that we revisit it here.

Model economy 10.1. *Assume an island economy with 150 working-age adults, of whom 100 belong to the workforce and 50 are outside the workforce. Each individual in the workforce is allocated a role. Everything is done as it always has been, and children follow in their parents' footsteps. Of the 100 who belong to the workforce, 90 have jobs and 10 are unemployed. Given the description above, those 10 must be the children of unemployed parents. Right?*

Somehow this picture just doesn't add up. Surely in such an economy everyone should be able to find something to do, some way in which to contribute? Clearly there may be people who do not want to work, and even people who can not work because of such as age or illness. But these people are outside the labour force, not unemployed.

Now we consider in more detail the idea that there are 'too few jobs' in the economy and hence that a proportion of the workforce must be unemployed. There are various reasons why there might be too few jobs, with perhaps the most obvious and popular reason being that demand for goods is given, and that this demand is not sufficient to create jobs for all who want them.

Model economy 10.1, continuation 1. *Return to the island economy, and assume now that there is a fixed demand for food, housing, clothing, etc. Furthermore, assume that this demand can be met—given the technology available to the islanders—by production from 90 people. Since 100 want to work, 10 must be unemployed.*

There are many problems with this idea. Firstly, the idea of demand being fixed or satiated does not fit with our experience and observations of real economies, where the demand for more and more goods and services seems to be unlimited. Secondly, if demand really were fixed then technological progress would lead to ever-increasing unemployment, rather than ever-increasing production (GDP). As we saw in Figure 9.2, high-tech economies do not generally have higher unemployment than low-tech economies, but they do have higher GDP. Based on these observations we can conclude that the idea that long-run unemployment is due to a long-run shortfall in demand for goods and services due to satiation is completely wrong.[1]

If the problem is not a shortfall in demand, maybe it is simply a lack of firms, or an inability on the part of firms to expand.

Model economy 10.1, continuation 2. *Return to the island economy, and assume that there are 9 firms in the economy, each of which employs 10 people. Clearly, then, this is one too few firms, and policy should be directed towards encouraging entrepreneurial activity such that the necessary tenth firm can be created.*

This story fits well with the picture painted by many politicians: in order to reduce unemployment we need to create more jobs, encourage entrepreneurial activity, cut red tape which hinders firm expansion, etc. However, there are many problems here too. Perhaps most fundamentally, why in this story does

[1] But note that, as Keynes showed, unemployment in the short run can be caused by fluctuations in aggregate demand.

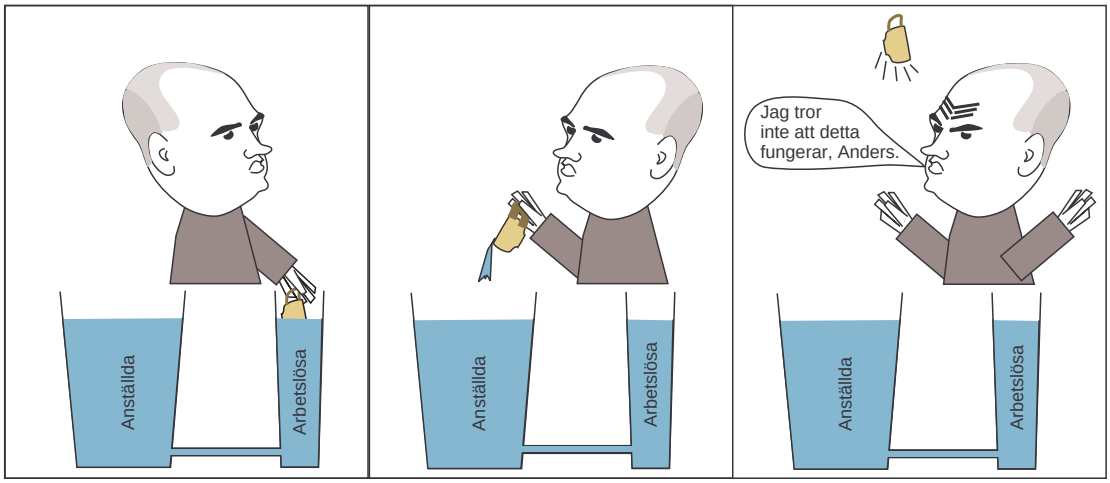


FIGURE 10.1. Trying to reduce unemployment by creating more jobs.

job creation stop at 90? Is it just coincidence that in economies across the world long-run unemployment lies between 2 and 10 percent? Another problem with the story is that jobs are in fact being created at a remarkably high rate all the time in modern economies. We can see this most easily by looking at the long-run rate of job *destruction*: if overall employment is stable and *x* jobs are being destroyed each year, then *x* jobs must also be *created* each year. In US manufacturing, around 20 percent of jobs are destroyed each year. That is, around 20 percent of manufacturing workers are laid off. So the idea of 'too few firms' or 'too few jobs' is misleading: new firms are appearing all the time, the problem is that old ones disappear at the same rate.

MODEL ECONOMY 10.1, continuation 3. *Assume an economy with 150 working-age adults, of whom 100 belong to the workforce and 50 are outside the workforce. Of those hundred, 90 have jobs and 10 are unemployed. There are 9 firms in the economy, each of which employs 10 people. Each year, one firm goes bankrupt, and another firm is created. Clearly, then, the rate of generation of new firms is too low, and policy should be directed towards encouraging entrepreneurial activity such that in the coming year two firms can be created rather than just one.*

This idea also falls foul of the 'coincidence' argument. Why are the rates of firm creation and destruction equal when there are 10 people unemployed? Is it just a coincidence? It clearly is not. Rather, the rate of unemployment is the result of a dynamic equilibrium in which jobs are continually created and destroyed. Furthermore, job destruction is in some way linked to job creation, so that (for instance) simply raising the rate of job creation may not reduce unemployment in the long run. In order to know what measures will—and which will not—reduce unemployment we need to understand how the dynamic equilibrium operates. In the meantime, Figure 10.1 gives us a picture to help capture the idea that employment and unemployment are linked.

To round off the discussion of the 'too few jobs' idea we return to looking at data. Recall that we have seen that there seems to be no link between GDP and unemployment in the data, neither is there any obvious link between GDP growth and unemployment (Figure 9.2). This is in accordance with our theoretical arguments that the long-run level of unemployment should depend on how the labour market operates rather than on variables such as growth or GDP. We now consider the idea that economies are such that the number of jobs is in some way fixed as a proportion of the total population, and that the excess number of job seekers is then unemployed. If this proportion is fixed across countries then we would expect to see a positive correlation between labour-force participation (the size of the labour force as a proportion of the adult population) and unemployment: in countries where a large proportion of adults want to work, the rate of unemployment should be higher. Furthermore, if the proportion is fixed over time then when more people enter the job market, the rate of unemployment should go up. In Figure 10.2 we show data for the seven largest EU economies regarding unemployment and labour-force participation for a given year. We choose these economies because they are comparable in many ways, but there is nevertheless substantial variation in the rate of labour-force participation across the seven. The figure shows that the correlation between labour-force participation and unemployment is *negative*: countries where few people want to work tend to have *higher* rates of unemployment! This is easy to interpret in terms of the functioning of the labour market: in countries where the labour market does not work well, we have both few people seeking jobs and high unemployment. Regarding the

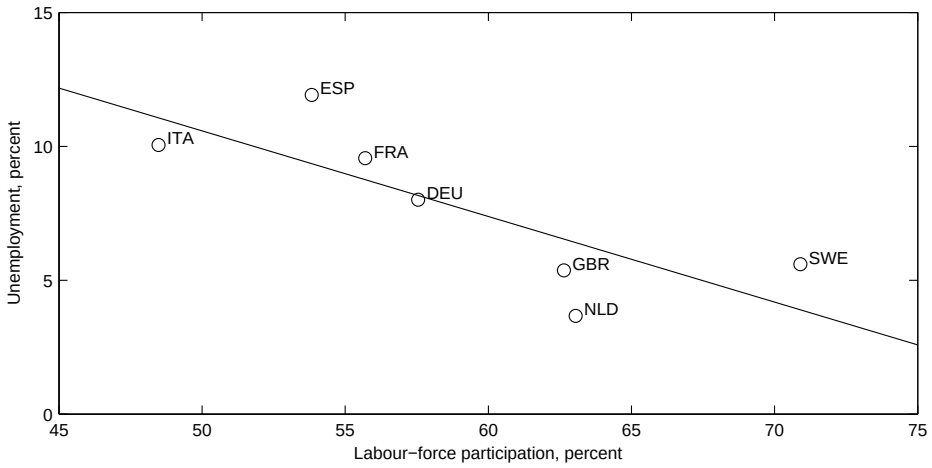


FIGURE 10.2. The relationship between unemployment and labour-force participation in the seven largest EU economies, in the year 2000. Data from OECD.

effect of changes over time we do not have data over a sufficiently long time period to be meaningful. However, what evidence we have suggests strongly that encouraging workers to leave the labour force (for instance through promoting the option of early retirement) is a completely useless strategy for tackling unemployment.[2]

Summing up, unemployment is not caused by a lack of jobs in relation to the number of potential workers, rather it is a result of a dynamic equilibrium in the labour market. The long-run rate of unemployment depends on how the labour market operates, not other aspects of the economy such as the growth rate, the inflation rate, etc. Note that this conclusion leads more or less directly to several further conclusions. For example, the following:

- Immigration does not create unemployment;
- Reducing working hours such that "jobs are shared by more" does not reduce unemployment;
- Persuading workers to take early retirement does not reduce unemployment.

Finally, recall that in Chapter 8 we defined the 'normal' rate of unemployment as NAI-unemployment, or non-accelerating-inflation unemployment. This level of unemployment was defined as the lowest level at which the inflation rate does not tend to accelerate; in terms of the *AD–AS* model it is the level of unemployment corresponding to the point at which the short-run aggregate supply curve turns upwards. Given this definition, we can rephrase the question about unemployment: instead of asking why unemployment exists, or why it settles at some particular level, we can ask why inflation accelerates when unemployment is pushed 'too low', below the NAI level. The main part of our analysis from now on will be framed by this question.

10.2. Inflation, the central bank, and the reserve army of labour

In this section we return to the analysis of Chapter 8, placing special emphasis on its relevance for the analysis of long-run equilibrium unemployment. (Recall that in Chapter 8 the emphasis was on the business cycle.) In Chapter 8 we assumed that there is some 'normal' rate of long-run unemployment —denoted *NAI* or *non-accelerating inflation* unemployment—which applies when supply is equal to long-run aggregate supply, *LAS*. When unemployment is below the NAI level then we assumed that competition for workers between firms tends to drive wages up 'too fast' such that the inflation rate increases. On the other hand, if unemployment is too high (above the NAI level) then the lack of competition for workers allows firms to reduce wages over time relative to the benchmark rate, such the inflation slows or even goes into reverse (decreasing prices or *deflation*). So the size of the 'reserve army of labour' (i.e. the number of unemployed) is an important factor determining inflationary pressure in the economy: when the reserve army is large, inflation tends to slow down, whereas when it is small it tends to accelerate.[3]

[2] See for instance Nickell... ??

[3] The 'reserve army of labour' is a phrase coined in the 19th century and used by social scientists such as Friedrich Engels and Karl Marx in a related context. See for instance *Capital: A Critique of Political Economy – The Process of Capitalist Production*, Karl Marx, p.699 of the Cosimo edition, 2007: "the general movements of wages are exclusively regulated by the expansion and contraction of the industrial reserve army".

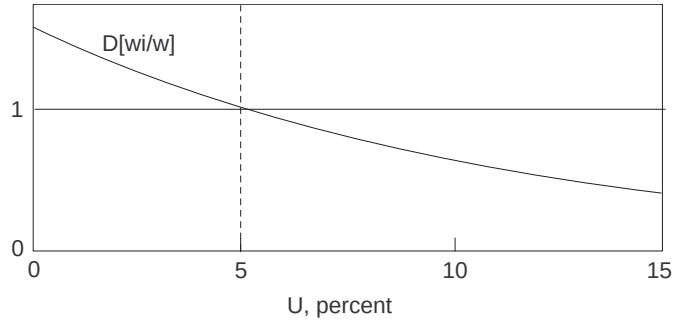


FIGURE 10.3. The relationship between the relative wage which each firm would like to pay, and the rate of unemployment, in an economy in which the NAI level of unemployment is 5 percent.

In this section we reframe this argument in terms of the choices of an individual firm, which we denote firm *i*. First, two definitions.

DEFINITION 4. *A simple labour market. In a simple labour market firms compete for labour, and firms' attractiveness to labour depends on the* relative wages *offered by the different firms; a firm offering lower wages than other firms is relatively unattractive. All labour is of the same quality, and is equally keen to work. Unemployed workers can instantly be matched with firms seeking extra staff. And wages and prices can be adjusted instantly.*

DEFINITION 5. *A complex labour market. In a complex labour market market firms compete for labour, and firms' attractiveness to labour depends on the* relative wages *offered by the different firms; a firm offering lower wages than other firms is relatively unattractive. Labour varies in quality in ways that may be difficult for employers to detect, and the willingness of individuals to work for a given wage also varies. The quality of applicants to a given firm, and their motivation to work hard, are an increasing function of the wage offered by that firm, and are also an increasing function of the rate of unemployment. Firms expend significant effort in recruiting suitable workers, and this effort is a decreasing function of both the relative wage and the rate of unemployment. Wages and prices are adjusted at intervals.*

In a simple labour market (as defined above) all firms pay identical wages, unemployment is zero, and an increase in (nominal) aggregate demand instantly drives up prices and wages, without affecting the allocation of labour. However, in a complex labour market the situation is significantly more ... complex.

MODEL ECONOMY 10.2. *Assume an economy with a complex labour market (as described above) and consider firm i, which is in the process of agreeing wages for the following year. Assume that firm i starts by calculating a benchmark wage w which is the current average wage within the economy or sector, raised in order to account for current inflation and increasing worker productivity.*[4] *What wage w_i will it agree with its employees, relative to the benchmark wage w?*

The answer to the above question is simple: it depends on the level of unemployment. If unemployment is very low then firm *i* will offer wages w_i which are higher than *w*, as the extra cost is well worth paying in order to attract, motivate, and retain high-quality workers. On the other hand, if unemployment is very high then it will offer wages w_i which are lower than *w*, since the high rate of unemployment means that it is easy for the firm to attract, motivate, and retain high-quality workers even if it pays less than other firms. And somewhere in between there will be a level of unemployment such that firm *i* sets $w_i = w$. The form of the relationship is illustrated in Figure 10.3.[5]

MODEL ECONOMY 10.2, continuation 1. *Assume that firm i's choice of next-period wage relative to the benchmark, w_i/w, is described accurately by Figure 10.3, and that all the other firms in the economy are similar. What happens if the current rate of unemployment in the economy is (a) 2 percent; (b) 10 percent; (c) 5 percent?*

If unemployment is 2 percent then each firm chooses to pay more than *w* (the benchmark wage), so wages rise faster than current inflation (after allowing for productivity increases). This implies that

[4] So if the current wage is w^*, current inflation is 2 percent per year, and productivity increases by 1 percent per year, and *w* is the benchmark wage for the following year, then $w = w^* \times (1 + 0.02 + 0.01) = 1.03w^*$.

[5] Note that the firm's choice will also depend on what it expects other firms to do. For instance, if firm *i* wants to pay more than other firms since *U* is very low, then if it expects other firms to pay more than *w*, then it should raise wages by even more. Since all firms are likely to think the same way this leads to even greater wage pressure when unemployment is low.

prices must also rise faster than current inflation, hence inflation must accelerate. On the other hand, if unemployment is 10 percent then each firm will pay less than w in the next period, and inflation will decelerate (the inflation rate will decline). Finally, if unemployment is 5 percent then firms will set next-period wages equal to the benchmark, and the inflation rate will remain constant.

MODEL ECONOMY 10.2, continuation 2. *Now assume that there is a central bank in the economy, whose job it is to keep the inflation rate as close as possible to 2 percent per year. Furthermore, assume that the current inflation rate in the economy is exactly 2 percent per year, while the base rate of interest is (and has long been) 6 percent per year. What happens if the current rate of unemployment in the economy is (a) 2 percent; (b) 10 percent; (c) 5 percent?*

If current unemployment is 2 percent then Figure 10.3 shows that this creates inflationary pressure, i.e. the inflation rate tends to increase. Knowing this, the central bank will immediately raise the base rate of interest, increasing the opportunity cost of investment (firms) and consumption (households), reducing aggregate demand and putting some firms out of business. This may seem paradoxical—why would the central bank want to put firms out of business?—but it is necessary because the state of the economy in which unemployment is just 2 percent is unsustainable whatever the central bank does: if it tries to sustain the unsustainable by holding the base rate down then inflation will accelerate, pushing the *real* interest rate lower still; before long the bank will face a choice between hyperinflation or an economic crash. If current unemployment is 10 percent then we know from Figure 10.3 that inflation is likely to fall steeply, and indeed there is a serious risk of deflation (declining prices) given that inflation starts at just 2 percent per year and the unemployment rate is far above its NAI level. The central bank it therefore likely to act immediately and strongly, drastically cutting the base rate in order to stimulate aggregate demand and therefore encourage existing firms to expand and new firms to enter. When they do so, unemployment falls and the tendency for inflation to fall is countered. Finally, if current unemployment is 5 percent then the bank knows from Figure 10.3 that inflation is likely to remain at its current level (2 percent per year), and it therefore leaves the base rate at its current level of 6 percent per year.

10.3. Determinants of the NAI rate of unemployment

In this section we turn to the analysis of the NAI or equilibrium rate of unemployment. What determines whether this rate is 2 percent, or 10 percent? What if anything can the government of a given country due to reduce the rate? We analyse the determinants under the following three headings.

- Voluntary unemployment and the reserve army:
  - How motivated is each member of the reserve army?
  - How attractive are the members of the reserve army to potential employers?
- Frictional unemployment and the reserve army:
  - How easy is it for employers and job-seekers to find one another?
  - How dynamic is the economy? What proportion of jobs are created and destroyed each year?
  - How stable is the relationship between employee and employer, once established?
- Wage bargaining and the reserve army:
  - How strong is the pressure from existing employees to raise wages?

Recall that the NAI rate can be interpreted as the size of the reserve army needed to keep inflationary pressure under control. How big an 'army' is needed? If the motivation of each member of the army to find a job rises, then the size of the army needed falls; if the ability of each member of the army to find and fill the vacancies rises, and if there are fewer vacancies created each year, then a smaller army is needed; and if existing employees are less concerned about raising their wages relative to others, then a smaller army is needed.

10.3.1. Voluntary unemployment and the reserve army. The first determinant of the NAI rate is very simple, and regards the characteristics of the individual members of the reserve army, with regard to their effectiveness in keeping inflationary pressure under control. In the limiting case, some members of the army may be completely ineffective since they demand a higher real wage than the value of their production to firms. That is, they are *voluntarily* unemployed. More generally, the effectiveness of each member of the reserve army is likely to vary depending on how keenly they seek work for which they are suitably qualified. To understand how this might work in practice, we begin by returning to coconut island.

MODEL ECONOMY 10.3. *Assume an island with 10 workers on it, who all work picking coconuts in a cooperative enterprize. There is no capital. Every day each worker picks 2 coconuts, and gets paid 10 crowns. In the morning they each buy two coconuts from the cooperative (they cost 5 crowns each),*

eat them for breakfast, and set off to work again. This situation—with zero unemployment—continues for many years. However, after a crisis in connection with a lost coin, the people decide to establish an unemployment insurance fund. The rules are that if a worker becomes unemployed, she will get half the regular salary. One of the ten workers—Brian—retires, and his daughter—Briony—joins the workforce. However, Briony wants to become a train driver, and refuses to take a job as a coconut picker. What happens (assuming that Briony is granted unemployment payments)? What is the new level of GDP in coconut economy? Is there a market failure in the economy?

Since there is no capital, we know that the remaining workers pick 18 nuts per day in total, worth 90 crowns. So total GDP is 90 crowns per day. This total income must be divided between the 9 workers (who get a full salary) and the one unemployed worker (who gets a half salary). So the 9 workers with jobs each get a salary of 9 crowns 47 cents per day, and the unemployed worker gets half of that ($9.5 \times 9.47 = 90$). Unemployment is 10 percent. Note that there is no market that does not work perfectly; unemployment can be interpreted as voluntary.

It is straightforward to link the idea of voluntary unemployment to the *AD–AS* model developed in Chapter 8. To see how, we return to Figure 8.2 and Model economy 8.1, continuation 2. In that model we have 100 workers and 50 retirees, zero savings and investment, and constant prices. Furthermore, the short-run supply curve is as illustrated in Figure 10.4. We assume that firms compete to hire labour, so in the long run workers are paid their marginal product; however, wages do not adapt instantly. In Model economy 10.4 we build on the above foundation.

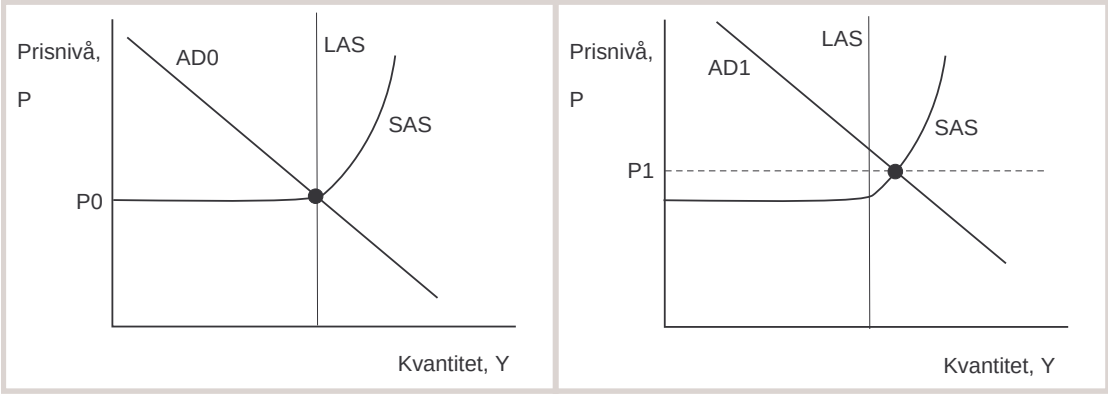


FIGURE 10.4. *AD–AS* model with booms when the economy is in long-run equilibrium. The black dots show the price level and GDP, where *AD* and *SAS* meet. Left-hand panel, long-run equilibrium; right-hand panel, start of a boom.

MODEL ECONOMY 10.4. *Assume an economy similar to 8.1, continuation 2, with 100 workers. Add the assumption that 90 of the workers are of 'high' productivity, whereas 10 of them are somewhat less productive, and that these characteristics are observable to employers. Furthermore, assume that all the workers have the same reservation wage (the lowest wage they are prepared to accept in order to work), and that this reservation wage is higher than the marginal product of the low-productivity workers in long-run equilibrium. It is therefore easy to see that the 10 low-productivity workers will be unemployed in long-run equilibrium. The task now is to explain why these 10 can be employed in a boom, and why the boom leads to accelerating inflation.*

In order to explain the boom and subsequent inflation in Model economy 10.4 we need to consider the owners of the firms. In long-run equilibrium the owners of the firms make zero profits, after they have paid for all their inputs (typically assumed to be labour and capital). Now assume that *AD* shifts upwards, as in Figure 10.4, and we have a boom. However, *SAS* does not shift in the short run, implying that the wage is unchanged. Why then do the marginal production costs increase (*SAS* turns upwards)? The reason is that in order to raise production firms hire low-productivity workers, and pay them the same wage as the high-productivity workers. Since the new workers produce less at the same cost, the marginal cost of production goes up. Nevertheless, the firms now make positive profits because the price of the good goes up from P_0 to P_1 (it is equal to the marginal cost of the last unit produced) and firms' profits rise by the area between the price line (dashed) and the *SAS* curve.

The situation above is not a long-run equilibrium, because firms are making positive (excess) profits. Furthermore, a firm with only high-productivity workers would make even higher profits than firms employing both types of worker. Firms thus compete with each other to hire the high-productivity workers,

driving both the wage and the *SAS* curve upwards. Long-run equilibrium is restored—at a higher price level—when the *SAS*, *LAS*, and *AD* curves all meet at the same point, and the low-productivity workers are again unemployed. On the other hand, as discussed in Chapter 8, if a regulator aims to keep the low-productivity workers in jobs then she must raise *AD* in ever-larger jumps, thus outrunning market expectations and leading to accelerating inflation (and, in the long-run, hyperinflation).

10.3.2. Frictional unemployment and the reserve army. Voluntary unemployment is an extreme case; more generally, it is reasonable to suppose that unemployed individuals vary in the urgency with which they approach the search for work. Furthermore, they may vary range of jobs that they are willing to accept. Assume for instance that a worker's productivity (in value terms) varies depending on the employer. Denote the productivity of individual j assuming a perfect match between the worker and the employer as w_j^*. If that individual is only willing to work for a wage at least equal to w_j^* then technically we might say that they are not voluntarily unemployed; nevertheless, the chances of them finding a job are likely to be very low. At the opposite extreme we can imagine an unemployed person who is willing to accept absolutely any job offered, irrespective of the wage, and who searches for work full-time. The more urgently the members of the reserve army seek work, the broader the range of jobs each individual is willing to accept, and the lower the reservation wage of each individual in comparison to their productivity, the smaller will be the reserve army needed to keep a lid on inflation.

A simple factor making the reserve army less effective is if it is hard for employers to find the right workers, due to frictions such as a reluctance among workers to relocate geographically. If few unemployed workers are willing to move, then the effective size of the reserve army available to any given firm is diminished, hence the firm is likely to have more difficulty recruiting, and the temptation to raise wages is increased. More generally, anything that reduces the effectiveness with which each individual can identify and take up suitable jobs—sometimes known as *frictions*—is likely to increase the size of the reserve army needed to keep inflation in check.

Model economy 10.5. *Assume an economy in which the link between low unemployment and inflationary pressure arises from firms' need to recruit and retain staff. All workers are willing to work for a wage equal to or less than their productivity, assuming that they can find the right match, i.e. the right firm for which to work. Compare the following cases.*

(1) Workers are extremely reluctant to change jobs, and employers are extremely reluctant to employ workers other than recent graduates. The economy is dominated by a small number of large firms which never go out of business; if a firm gets into difficulty the state may—in the last resort—support it until it gets back into profitability.

(2) The economy is highly dynamic and there is cut-throat competition between firms. Around 4 percent of workers lose their jobs each month, while other firms expand and seek new staff. The labour force is highly diverse, as are the jobs on offer; workers and firms spend considerable effort finding good matches between the job requirements and worker skills.

Based on the ideas discussed above, it seems reasonable to suppose that in Case (1) only a very small reserve army is required in order to keep inflation under control. Since employers only employ recent graduates, there is no pressure on employers to pay their workers high wages in order to motivate them to stay at the firm. And since there is minimal turnover in the labour market, the rate at which firms hire new workers is very low. For the few recruitments that firms do carry out, they can afford to take their time; there is little need for them to attract applicants by competing over wages, since applicants are likely to pay attention to their long-run prospects within the firm rather than any small differential in current wages. And both the firm and the applicants know that in the long run the wages paid by the firm will reflect the average productivity of its workers. In Case (2) on the other hand we would expect a much higher NAI rate of unemployment.

The formal (mathematical) analysis of frictional unemployment based on microeconomic foundations is far beyond the scope of this book. Nevertheless, in Appendix 10.6.2 we try to get a flavour of the analysis which is possible.

Returning to the metaphor of the reserve army, we can say that the more there is for the army to do, the bigger it needs to be! When turnover in the labour market increases then firms are likely to spend more resources on recruiting, and the costs caused by the loss of trained staff to other jobs are also likely to increase. Therefore firms firms are—ceteris paribus—keener to raise wages w_i above the benchmark, w. A bigger reserve army is needed to keep this tendency in check. On the other hand, we must bear in mind that a high rate of turnover in the economy may in itself be a symptom of low frictions in the labour market, rather than a symptom of rapid fundamental change in the structure of the economy. When it is cheap and easy for firms to hire and fire then they are likely to hire and fire a lot, without this leading to higher (or lower) unemployment.

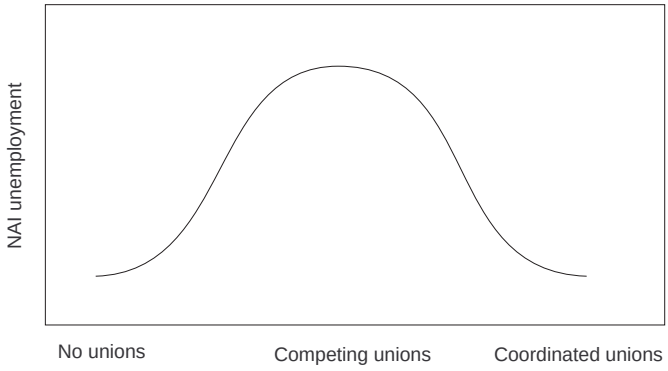


FIGURE 10.5. The hump hypothesis.

10.3.3. Wage bargaining and the reserve army. In bargaining models, workers—typically through trade unions—have a direct influence on the wage rate.

MODEL ECONOMY 10.6. *Assume an economy in which, other things being equal, workers who have jobs always try to force the wage up at a rate faster than inflation (thus raising the real wage and effectively reducing payments to capital owners).*[6] *However, their ability to do so is limited by the level of unemployment: the higher the level of unemployment, the greater the ability of employers (capital owners) to resist wage pressure. The reason could be that the employers' outside option in the wage bargaining process—i.e. the threat of sacking the existing workers and recruiting new ones from the reserve army—becomes more realistic and credible. What happens in the long run in such an economy?*

In this economy we can illustrate the relationship between unemployment and wages with a figure similar to Figure 10.3; however, now the interpretation of the downward-sloping curve is different. In efficiency-wage models this curve shows the wage that a given firm would like to pay, relative to other firms; in bargaining models, it represents the wage that will be agreed upon in the bargaining process (w_i) relative to the wage that would be consistent with constant inflation (w). So when $w_i > w$ inflation tends to accelerate.

A natural question to ask is then why trade unions drive the wage upwards when they should know that their wage pressure leads to unemployment. Here we consider two explanations: the hump hypothesis, and the insider–outsider model. According to the hump hypothesis unemployment is low if there are no unions and employers set the wage unilaterally, but it is also low if there is a unified or coordinated trade union movement that agrees on the bargaining position vis-à-vis the employers. In the first case workers have no bargaining power and therefore cannot push up wages; in the second case unions have bargaining power on workers' behalf, but their desire to push up wages is moderated by their unwillingness to drive up unemployment. In the intermediate case, however, there are many trade unions competing for members, and no one union cares about overall unemployment. In this case each union simply strives for the highest possible wages for its members, and employers need a higher level of unemployment in order to hold wage demands in check. Therefore the NAI level of unemployment is higher in the intermediate case: see Figure 10.5.

Even when unions coordinate their behaviour, it is possible that they do not work in the best interests of the whole population. This is the key idea behind the insider–outsider model.

MODEL ECONOMY 10.7. *Assume an economy in which trade unions coordinate their wage demands in the best interests of their members, who are denoted* insiders. *Furthermore, assume that insiders are those who are employed or who have only recently become unemployed. People who are long-term unemployed are denoted* outsiders, *and the unions do not take their interests into account when negotiating wages. In this economy unemployment has been high for a long time due to a severe economic crisis. Now the crisis is over and the central bank keeps the interest rate low, expecting this to lead firms to invest and expand, and unemployment to decline. What might happen instead, according to the insider–outsider model?*

According to the model, what might happen instead is that the unions, seeing the higher profits made by firms when interest rates are low, negotiate higher wages for their members, pushing profits back down and preventing firms from expanding. Note however that unions only have this power to the extent that they monopolize the supply of labour; to the extent that firms are able to recruit non-union labour (or if non-unionized firms can replaced unionized firms) then the mechanism is weaker.

[6]Note that when labour productivity is growing then the wage can grow at a rate which is the sum of the rate of inflation and the growth rate of labour productivity, without causing inflation to increase.

10.4. Predictions and policy implications

We now look at the predictions and policy implications of the above analysis. First note that the model predicts that it will be very hard to find evidence that it is a true description of the economy, as shown by the following model economy.

Model economy 10.8. *Assume two economies, each with 1000 workers and a central bank which holds inflation to 2 percent per year. Everything about the economies—the skills of the workers, the level of unemployment benefits, the institutions (how the economy is managed), etc.—is identical, except in one respect: in economy 1, agents' preferences are such that workers are terrified of unemployment, whereas in economy 2 workers are much more relaxed about the risk of losing their jobs. What differences can be observed between the economies according to the 'reserve army' model?*

According to the model, the only observable difference between the economies should be the rate of unemployment. Both economies should have the same inflation rate (2 percent), the same interest rate, the same real wage, etc. The only difference is the level of unemployment required to maintain an NAI equilibrium, which is of course higher in Economy 2.

10.4.1. Voluntary unemployment and friction. The basic prediction of the voluntary-unemployment model is well illustrated by the following extension to the model.

Model economy 10.3, continuation 1. *Return to model 10.4 and assume that the alternative to employment is starvation. What is the level of unemployment according to the 'voluntary' theory?*

If long-run unemployment is voluntary, caused by some workers withholding their labour because of the low wage, then unemployment should of course be zero if the alternative to unemployment is starvation. More generally, the harder life is for the unemployed, the lower the level of NAI unemployment will be. Similarly, the higher are the rewards for working, the lower the level of NAI unemployment will be. Note however that this does not imply that rich economies should have lower unemployment, because the labour-supply decision is likely to depend on the *relative* level of the wage rather than its absolute level. Potential workers are likely to compare wages potentially on offer to wages offered to other workers in the economy (fairness), and also on income when unemployed which is likely to be directly related to GDP per capita.

So according to the model we should expect that the following measures, among others, should lead to lower NAI unemployment:

(1) Lower unemployment benefits;
(2) Lower income taxes, thus increasing the gap between the level of unemployment benefits and the take-home wage;
(3) Stricter conditions for entitlement to unemployment benefits;
(4) A shorter time period during which unemployment benefits may be paid out.

However, not all measures need to have this 'tough-love' character. Consider the following model economy.

Model economy 10.4. *Assume an economy in which all workers are entitled to unemployment benefits of 100 crowns per day for 2 years from the time at which the period of unemployment starts. Further, assume that an individual's decision to supply labour is simply a function of the wage that individual can command, relative to the level of unemployment benefit: if an individual cannot raise their income by at least 20 percent by choosing to work then he or she chooses voluntary unemployment. Finally, assume that pre-tax wages of each individual are equal to the individual's marginal product, and that 5 percent of workers have a marginal product of less than 120 crowns per day. Income taxes for the lowest paid are 10 percent. Comment on the effect of the measures above. Can you suggest other measures?*

Clearly the four measures suggested above should all reduce unemployment in Model economy 10.4. (Although we do not know how large the effects will be in all cases, as this depends on details that we have not specified.) However, another rather different measure—which might have a large effect in the long run—would be as follows:

(5) Raise (or modernize) the skills of the workers with the lowest marginal product through for instance better education or training 'from the start', or active policies to help long-term unemployed.

Raising the productivity of the least skilled workers would—if it got their after-tax earning capacity above the 120-crown threshold—lead to a fall in unemployment.

We now consider predictions of the model again. From the above bullet points we know that if the benefit of working compared to being unemployed increases for an individual in the model then that

individual is more likely to supply her labour and thus get a job. This may be achieved by making life harder for the unemployed, making life better for the employed (all those with jobs), and raising the earning power of low-skilled workers specifically. So the model predicts that the measures suggested above should all reduce unemployment. However, it also suggests that the level of unemployment will vary depending on psycho-social factors, such as the social stigma (if any) attached to unemployment. If the social cost of unemployment is high then more people should choose to supply their labour even though the financial benefits are small. Furthermore, the model suggests that rising wage inequality should raise unemployment, assuming that workers are paid their marginal product. When workers are paid their marginal product then rising wage inequality must be due to widening differences in the productivity of workers, and as these differences widen more workers are likely to end up below the wage at which they choose to work.

A variant of the voluntary unemployment model arises when governments set a *minimum wage* below which no employer is allowed to offer work. Given the existence of such a minimum wage then workers whose productivity is below that wage will be unemployed, in the same way that a worker whose productivity is below her reservation wage will be unemployed.

Finally, the model of frictional unemployment suggests that there could be a *positive* correlation between growth and unemployment, if we assume that high growth is associated with a dynamic economy with high rates of entry and exit of firms. The latter idea is linked to the concept of *creative destruction* which we discussed in Chapter 5, according to which an essential part of the growth process is the destruction of old technologies by the entry of the new. In a dynamic economy the rate of creation of job vacancies is high, growing firms spend a lot of time recruiting, and existing firms face the constant threat of their employees leaving to join other firms. Thus we expect the w_i/w curve to be further to the right than in a more static economy, leading to a high rate of NAI unemployment.

10.4.2. Wage bargaining. The third factor we analysed was that wage-bargaining processes may lead to inflationary pressure which is eased by higher unemployment; this may either be due to solidarity with the unemployed, or a purely selfish calculation on the part of the workers who know that the risk of losing their jobs is higher if they demand higher wages. This gives us a sixth measure that should lead to lower NAI unemployment.

(6) Encourage trade unions to bargain for wages in a coordinated manner, rather than competing with one another. Or weaken union power such that wages are set unilaterally by employers.

An important feature of the insider–outsider model is that unemployment may get stuck at different levels. For instance, if unemployment has long been low, but then rises due to an short-run economic crisis, it may be difficult to push unemployment back down to its original level if the unemployed have become outsiders. This effect is known as *hysteresis*, a term borrowed from physics. However, hysteresis may also arise when unemployment is purely voluntary, the reason being that unemployed workers tend to lose skills over time, i.e. their marginal product if employed tends to fall. Since their earning capacity also falls this makes them more likely to choose unemployment; so a temporary increase in unemployment caused by (for instance) an economic crisis may turn into an increase in the NAI level of unemployment if the unemployed workers lose skills to such an extent that they choose to remain unemployed once the crisis is over.

10.5. Relevance to real economies

We have outlined three alternative models to explain unemployment: one based on *voluntary* unemployment, the second based on *frictions* in the labour market, and the third based on *bargaining* between employers and workers. The mechanisms in the models are quite different, but the models based on voluntary and frictional unemployment lead to identical policy conclusions for reducing unemployment, whereas the bargaining model adds a completely new (additional) conclusion. We now turn to consideration of evidence. What policies actually work in reducing unemployment, and why?

Return to Chapter 9, and recall that our theories are consistent with the evidence presented there that unemployment does not seem to be strongly related to other macroeconomic variables such as the growth rate, the level of GDP, and the long-run inflation rate. So far so good, but to find positive evidence for our theories we need to find evidence that unemployment is related to labour-market variables such as taxes on labour income and the size of the income gap between employed and unemployed. In general there are two ways to search for such evidence in the macroeconomic data: either we can look at many countries in the same year and compare their policies and their unemployment rates, or we can look at one country at a time, and study the development over time in that country. Given the striking nature of the data in Figure 9.3, which shows that long-run unemployment has shifted dramatically over time within the same country, we focus mainly on looking for explanations for these shifts.

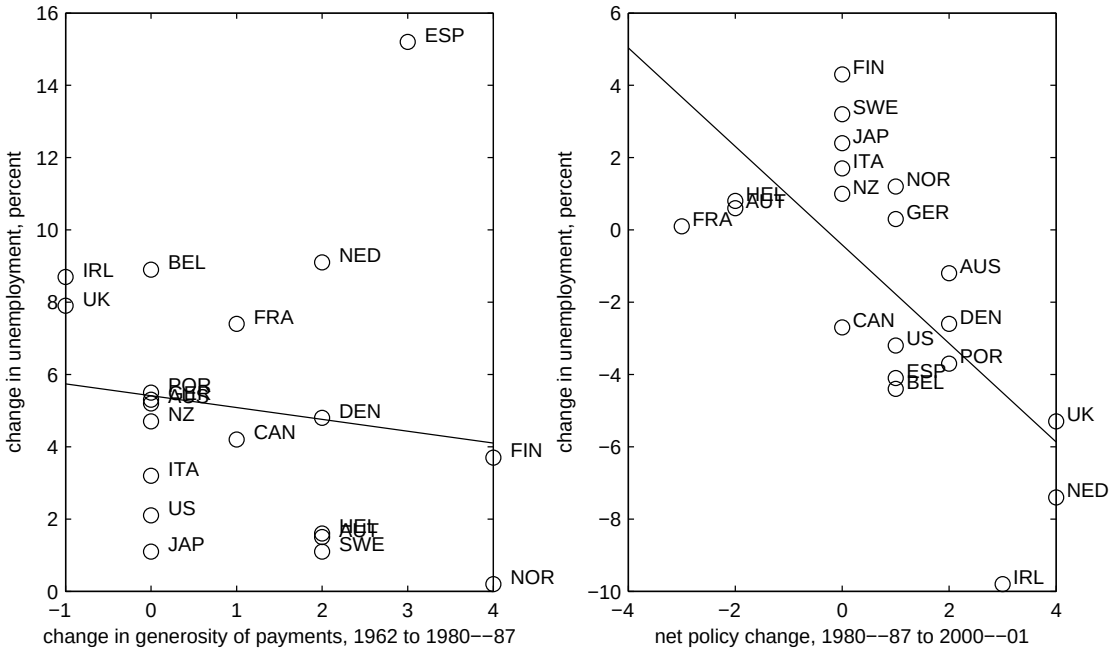


FIGURE 10.6. Explaining changes in unemployment. Left-hand panel: the change in unemployment between 1962 and 1980–87, plotted against the change in the generosity of unemployment insurance. Right-hand panel: the change in unemployment between 1980–87 and 2001, plotted against the net sum of all Nickell's indicators for policy leading to low unemployment.

We build on work presented by Stephen Nickell (2002) in the form of a lecture, *A Picture of European Unemployment: Success and Failure*. We begin by testing the idea, using Nickell's data, that the big rise in unemployment in many European countries between the 1960s and the 1980s—discussed in Chapter 9—was mainly caused by a big increase in the generosity of insurance payments to the unemployed. To check this we plot—for a range of countries, mostly in Europe—the change in average unemployment between 1962 and the period 1980–87 against the change in the generosity of unemployment insurance, using Nickel's data.[7] The results are shown in the left-hand panel of Figure 10.6. We see that there are significant rises in unemployment in all of the countries, and significant increases in the generosity of unemployment insurance systems in many of them, yet there is no positive correlation evident in the data between the two.

Figure 10.6 shows that the link between unemployment benefits and the rate of unemployment is either very weak, or it is masked by other changes in the countries studied. So, we find no positive evidence for our ideas about the causes of unemployment in Figure 10.6. However, it is important to understand that the Figure does not contradict our ideas either. The reason is that according to the models discussed above, a whole host of factors affect the level of unemployment in both the short and the long run. Since short-run fluctuations can be very large they may also be affecting our ability to see the effect of changes in unemployment benefits: we want to know the NAI level of unemployment, but what we observe is the actual level of unemployment at a given time, which is a combination of the NAI level and the divergence from this level caused by the position of that country in the business cycle. Furthermore, we claimed above that according to the model the NAI level of unemployment should be affected by a large range of factors, not just the level of unemployment benefits.

A more sophisticated analysis is clearly needed. In the right-hand panel of Figure 10.6 we show the changes in unemployment for the same countries between the 1980s and 2000-01, now plotted against changes in a composite measure of policy indicators for low unemployment (see Nickell for full details). This measure includes the generosity of unemployment payments, the strictness of rules for receiving payments, expenditure on active labour-market policies, employment protection legislation, taxes on labour income, and variables related to the degree of unionization and coordination in bargaining. Now we see a very strong correlation between a change towards policies which—in theory—should be conducive to low unemployment, and and shift downwards in the level of unemployment.

[7] We measure the change in generosity on a 9-point scale, from −4 (much less generous) through 0 (no change) to +4 (much more generous) using Nickel's scores for the generosity and duration of payments, where a rise of 0.1 or more gives +1, and a rise of 0.2 or more gives +2 (and similarly on the minus side).

When we look close-up, at the microeconomic level, we can find different types of evidence regarding the models. For instance, in Sweden unemployment benefits are generous for a limited period, but then cease and the unemployed must move onto other (much less generous) welfare payments. Not surprisingly we find that the chances of an unemployed person finding a job rise as the cut-off date approaches. This is evidence that the degree of motivation of the individual is important in the job-finding process, i.e. it is evidence supporting the idea that unemployment is in a sense voluntary. However, note that it is not evidence that those who are unemployed are different from those who have jobs, which is the core idea of the voluntary-unemployment model.

Nickell's and other studies thus confirm the broad thrust of the theories presented above, at the core of which is the idea that if we raise the incentives to work (rather than be unemployed), the overall rate of unemployment will fall. However, we are no nearer to identifying the quantitative effects of different measures, such as lowering taxes on labour income (popular on the political right) or investing more in education and training to raise the earning power of those with low or nonexistent qualifications (popular on the left). These remain unanswered questions which are the subject of active research.

Finally, we are scarcely any closer to explaining the big rise in average European unemployment —compared to the US—over the last 50 years. Again, there is no consensus within macro- and labour economics about the correct answer to this question. However, a popular conjecture is that it has to do with changes in the marginal product of those with fewest qualifications, relative to the marginal product of the average worker. The idea here is that the technological changes which have swept through the economy over the last 50 years have greatly increased the importance of education for worker productivity. The result is that in modern economies firms are willing to pay a lot more for highly educated staff than less educated staff, even in jobs which previously required little formal education. This is the case both in Europe and North America. However, the result of this change has been different in the two regions: in Europe, the wage differential between low- and high-skilled workers has remained relatively stable, and many low-skilled workers are unable to find work at the going wage; whereas in the US the wage gap has increased significantly, hence low-skilled workers can still find jobs, but only at very low wages. Another, related, explanation is linked to international trade, and is discussed in Chapter 11.

10.6. Appendix

10.6.1. Classical unemployment. The traditional definition of classical unemployment is as follows.

> Classical unemployment occurs when real wages are kept above the market clearing wage rate, leading to a surplus of labour supplied.

This concept makes sense if we assume that there is a fixed quantity of capital in the economy, as shown by the following example.

Model economy 10.5. *Assume an economy with 100 machines and 100 firms, one machine per firm. The machines require no maintenance and last forever. It is impossible to make new machines, and it is impossible to start a firm without a machine. There are 1000 identical workers, who each have a reservation wage of 100 widgets per day. That is, if their pay packet is not sufficient for them to buy 100 widgets then they choose not to work. How many workers does each firm choose to hire?*

To solve the model we must know the *production function*, i.e. the relationship between inputs (including labour and machines) and the output (widgets). We assume that there are no inputs other than labour and machines, and assume that the production function for a single firm is

$$Y = 118L - L^2,$$

where Y is production in widgets/day, and L is the number of workers employed by that firm. The marginal product of labour is then

$$\frac{\partial Y}{\partial L} = 118 - 2L.$$

So the marginal product of labour is declining in the number of workers employed in the firm. This makes sense since the number of machines owned by the firm is fixed: as more and more workers are employed there is less and less for each worker to do.

Each firm will only employ workers up to the point at which the wage it must pay (100 widgets per day) is no greater than the marginal product of the last worker employed. Therefore each firm will employ 9 people, and since there are 100 firms employment will be 900 and unemployment will be 100, i.e. 10 percent.

The problem with this story is that it breaks down as soon as we let capital vary over time. If capital (machines) costs money to build up and then falls apart over time (called depreciation) then someone

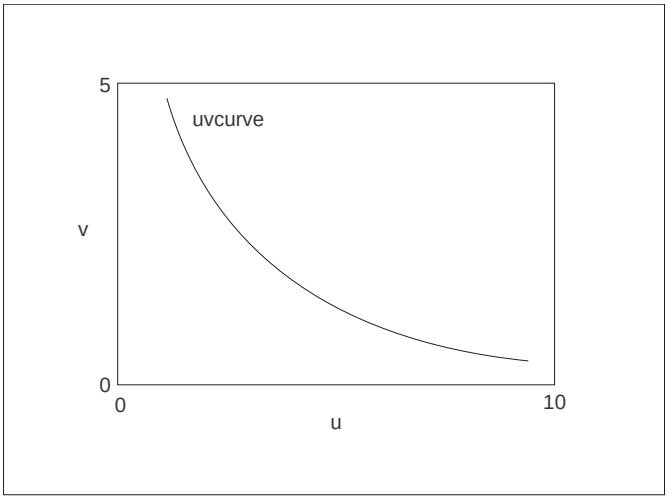


FIGURE 10.7. The relationship between unemployment and vacancies when vacancies are treated as exogenous and fixed.

thinking of investing in capital and starting a firm has a calculation to do based on the cost of the capital and the subsequent flow of profits.

MODEL ECONOMY 10.5, continuation 1. *Take the economy above and assume that new machines can be produced while the old ones tend to depreciate over time. Furthermore, assume (without going into details) that the situation above gave investors a 'good deal', i.e. a good return on their investment. In that case more firms will enter the market until unemployment has gone down to zero. On the other hand, if the situation above gave investors a bad deal then there would be no more investment and over time all the machines would fall apart and* everyone *would be unemployed!*

So when capital is variable the model seems to predict either zero unemployment, or zero employment. The problem is that the model does not link the rate of unemployment to the returns to capital investment. We need a model in which firms lower their rate of investment as unemployment declines, thus slowing down and ultimately stopping the decline. Furthermore, we need to link this process to the acceleration of inflation.

10.6.2. Microeconomics of frictional unemployment. The formal (mathematical) analysis of frictional unemployment based on microeconomic foundations is far beyond the scope of this book. Nevertheless, we try here to get a flavour of the analysis which is possible. Our analysis is based around a graph on which we have unemployment (in percent of the workforce) on the horizontal (x) axis, and vacancies (as a percentage of the workforce) on the vertical (y) axis. So if we have a workforce of 50 million, with 3 million unemployed and 1 million vacancies then $u = 6$ and $v = 2$.

We start by assuming that the number of vacancies is exogenously fixed, and thinking about the resultant level of unemployment. Clearly if there are always are huge number of firms looking for workers (irrespective of u) then we expect u to be low in the long run. On the other hand, if the number of firms looking for workers is very low then (all else equal) we expect u to be high. This gives us our first curve, the u–v curve, as shown in Figure 10.7. A possible mathematical form for this curve is

$$u = \frac{s}{m}\frac{1}{v},$$

where s is the rate at which members of the workforce join the reserve army (i.e. enter unemployment), and m is a measure of how quickly the matching process works. When s is large (lots of firms going bankrupt for instance) and m small (matching process slow) then the u–v curve is far to the right, implying a high rate of unemployment for a given vacancy rate.

To make further progress we need to focus on the number of vacancies. Assume that there is some cost to advertising a vacancy. Then if a firm judges that there is no chance of filling a vacancy, they will not advertise it. And (given many firms of different types) the better the chance that a vacancy is filled within a given time, the more vacancies will be advertised. Finally, it is reasonable to suppose that the chance of a vacancy being filled rises with the rate of unemployment: the bigger the reserve army, the quicker a given firm can find a suitable worker to fill any particular vacancy. However, even when $u = 0$ firms may be able to fill vacancies by attracting workers from other firms. Therefore we can add a

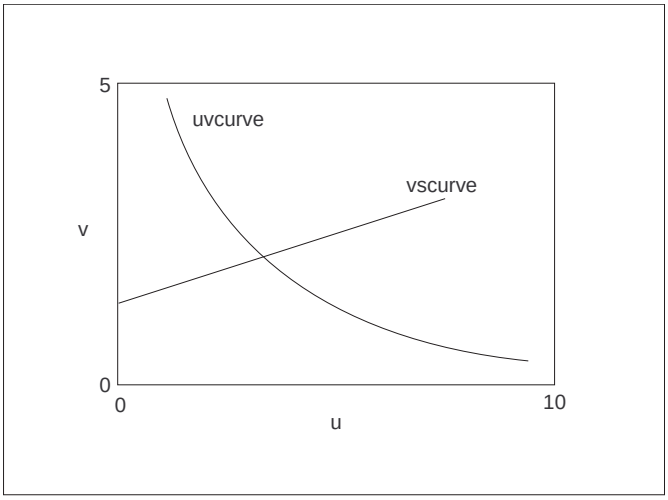


FIGURE 10.8. The two curves, both *u–v* linking the vacancy rate to unemployment, and *vs* linking unemployment to the supply of vacancies.

vacancy-supply or *vs* curve to our graph, as shown in Figure 10.8. A possible equation for this curve is

$$v = (g_j j + g_u u)/c,$$

where j is the percent of the workforce in work, g_j and g_u are measures of the effectiveness with which workers and the unemployed can fill vacancies, while c is a measure of the cost of advertising a vacancy.

Having constructed the graph, we need to interpret it. First note that the crossing point of the two lines shows the long-run equilibrium level of unemployment in the economy. So unemployment may deviate from this level due to shocks, and we know from our earlier analysis that if unemployment is higher than the long-run equilibrium then inflation in the economy should tend to decline, hence the central bank should loosen monetary policy (reduce the base rate), encouraging investment by firms and consumption by households, leading to firm expansion and a fall in unemployment towards the NAI level. On the other hand, if unemployment is lower than the long-run level then there will be inflationary pressure in the economy (inflation will tend to accelerate), and to counter this the bank must raise the base rate, thus raising unemployment and stabilizing the economy.

Now to actually use the graph. Consider efforts to reduce the NAI level of unemployment. To do so we must either shift the *u–v* curve down to the left, or shift the *v–s* curve up to the left. Recall the equation

$$u = \frac{s}{m}\frac{1}{v},$$

where s is the rate of separation (workers into unemployment), and m is the rate of matching (job-seekers into jobs). To shift the *u–v* curve left we need to raise m or reduce s, that is we either need to speed up the process by which unemployed workers are matched up with available vacancies, or reduce the rate of separation s. There are measures—such as strict employment protection rules—which reduce the separation rate, however they are also likely to make employers more careful about hiring, hence they also reduce the matching rate and their overall effect on unemployment is thought to be small.[8] There are many measures to improve matching, as discussed above. For instance, making life harder for the unemployed by reducing their benefits etc., and increasing the incentives for unemployed people to take new jobs by reducing taxes on labour income.

To shift the *v–s* curve upwards we must reduce c—the cost of advertising a vacancy—or raise g_j and g_u, the effectiveness with which workers and the unemployed can fill vacancies. The latter—g_j and g_u—are linked to m, the matching rate. A rise in g_u will also lead to a rise in m, the rate at which the unemployed are matched to jobs, thus also shifting the *u–v* curve to the left. However, a rise in g_j will have the opposite effect on the *u–v* curve, because it will make it harder for the unemployed to compete for vacancies with those who are already employed and switching jobs.

[8] So countries with strict employment laws do not tend to have higher long-run rates of unemployment, however, they may have less dynamic labour markets. A consequence of this may be a higher proportion of long-term unemployed.

Exercises

Ex. 10.1 Assume an economy without money in which the citizens decide collectively what each person should do, to best contribute to the common good.

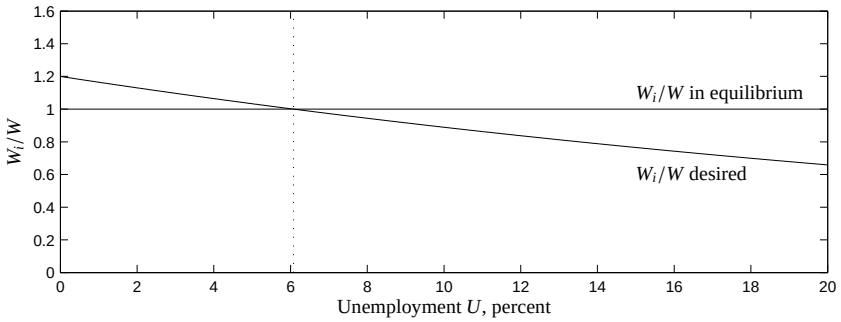
(a) Discuss whether factors such as technological progress and immigration are likely to create unemployment in such an economy.
(b) Are government policies to encourage business activity likely to reduce unemployment in such an economy?
(c) Is there any reason to suppose that these conclusions change in a market economy?

Ex. 10.2 Explain the concept of voluntary unemployment, and use the *AD–AS* model to explain why voluntary unemployment might fall in a boom.

Ex. 10.3 Assume a modern economy with inflation at a steady 2 percent and a central bank whose job it is to keep it that way. There are 10 000 people in the labour market, of whom 9500 have jobs and 500 are unemployed. Of those with jobs, 300 work in what remains of the steel industry, of whom 200 have very specialized skills and high wages. However, the steel industry in this economy is dying due to cheaper competition from abroad, and on 1 January 2015 the last factory closes. The reservation wages of all the former workers in the factory are close to the wages they received before its closure.

Discuss the likely evolution of the economy over the next two years, including the actions of the central bank and changes in the rate of unemployment.

Ex. 10.4 Assume an economy of 100 similar firms, and 100 000 people in the labor force. In an equilibrium with full employment each firm employs 1000 people and pays everyone 10 SEK per day. But if unemployment is zero then each of the firms would like to pay 20 percent higher wages than the other firms, in order to attract and retain staff. The higher the unemployment rate, the less each firm wants to pay in relation to the others. The relationship between the firms' desired relative wage level, W_i/W, and the unemployment rate U, is shown in the figure below.



(a) Why does the curve for "W_i/W desired" slope downwards?
(b) What will the unemployment rate U be in long-run equilibrium? Explain.
(c) What can we say about inflation in such an equilibrium?
(d) Suggest policies which might reduce equilibrium unemployment.

Ex. 10.5 Assume an economy in which trade unions are able to influence wages for everyone in the economy, including non-members. However, the higher the rate of unemployment, the stronger the incentive is for unions to restrain their wages demands. Labour productivity in the economy increases by 2 percent per year, and the central bank has the task of keeping the rate of inflation at or close to 2 percent per year. In 2015 the inflation rate is 2 percent and the rate of unemployment is 4 percent. Meanwhile the unions and employers agree wage increases averaging 6 percent.

Describe what is likely to happen over the next few months and years.

Ex. 10.6 Assume an economy in which trade unions are able to influence wages for everyone in the economy, including non-members. However, the higher the rate of unemployment, the stronger the incentive is for unions to restrain their wages demands.

Compare the likely equilibrium rate of unemployment in the following three cases. Explain carefully.

i The unions only represent a very small proportion of the workforce and have little or no power to set wages.

ii There are many unions which compete for members and bargain separately over wages.
iii The unions get together and bargain collectively over wages.

Ex. 10.7 Assume an economy in which trade unions are able to influence wages for everyone in the economy, including non-members. However, the higher the rate of unemployment, the stronger the incentive is for unions to restrain their wages demands.

(a) Show, using a figure with real wage on the vertical axis and jobs on the horizontal, how a prolonged recession (case of *AD* to the left) can create more outsiders in an economy, i.e. individuals outside the wage bargaining process and the trade unions.
(b) Explain why—when there are many outsiders—inflationary pressure is likely to be higher at any given level of unemployment.
(c) Could this be relevant to Sweden? Is there any evidence for that?

Ex. 10.8 Assume two economies, each with 1000 workers and a central bank which holds inflation to 2 percent per year. Everything about the economies—the skills of the workers, the level of unemployment benefits, the institutions (how the economy is managed), etc.—is identical, except in one respect: in economy 1, agents' preferences are such that workers are terrified of unemployment, whereas in economy 2 workers are much more relaxed about the risk of losing their jobs. What differences can be observed between the economies according to the 'reserve army' model?

Ex. 10.9 In Sweden, around 6000 people are employed in the mining industry in 2015. Imagine an alternative reality in which Swedish minerals ran out in 1965. Which of the following statements is nearest to the truth? Explain your choice.

i There would be approximately 6000 fewer people employed in Sweden in 2015, in total, in the alternative reality, and hence unemployment would be higher by 6000.
ii There would be an even greater shortfall in employment in the alternative reality in 2015, because many of the other workers necessary to support the mining communities (in schools, hospitals, etc.) would also be without jobs.
iii The level of unemployment in 2015 would be the same in the alternative reality as it is in the real Sweden.

CHAPTER 11

Open economies

Almost all of our analysis so far applies only to closed economies, i.e. economies that do not trade with the outside world. A really large and diverse economy—such as the US economy—can in many cases successfully analyzed as if it were closed. The same does not apply to any economy in Europe. In this chapter we extend therefore the analysis to include international trade and how it affects a small, open economy. By 'small' we mean small in relation to the outside world, and by open we mean that the economy has considerable trade with the outside world.

We start by explaining how international trade works, using the circular flow. Then we discuss the business cycle, with either a completely fixed or a floating (*variable*) exchange rate. Then we discuss how unemployment and long-term growth is affected by the outside world in an open economy. Finally, we discuss various currency systems: how do the different systems work, and what the advantages and disadvantages do they have for a country like Sweden?

11.1. The circular flow and national accounts

We start with the circular flow. How does international trade work? Keep in mind that a country imports a lot of goods without exporting anything. Is it possible? If so, how?

11.1.1. GDP and GNP. GDP, gross domestic product, is the value of what is produced within the country's borders. Therefore, it is equal to total payments to firms in the country for their goods (not including payments between firms, but these are not shown in our diagram anyway). GNI, gross national income, is equal to the total revenue that flows to a country's inhabitants. See Figure 11.1.

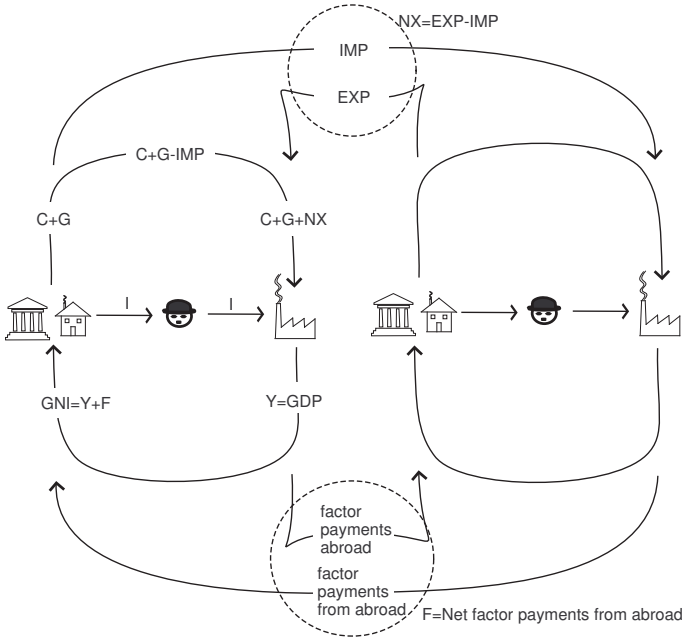


FIGURE 11.1. The circular flow with two open economies.

We can use Figure 11.1 to read off expressions for GNI and GDP, among other quantities:

$$\text{GDP} = Y = C + G + I + NX;$$
$$\text{GNI} = Y + F.$$

MODEL ECONOMY 11.1. *The world economy consists of two countries with GDP equal to 100 USD and 50 USD per year respectively. Country 1 owns everything in the other country, both capital and workers*

(they are slaves). All revenue from country 2 is therefore sent to country 1. There is no investment. Show the circular flow for both countries. What is GNI in each country?

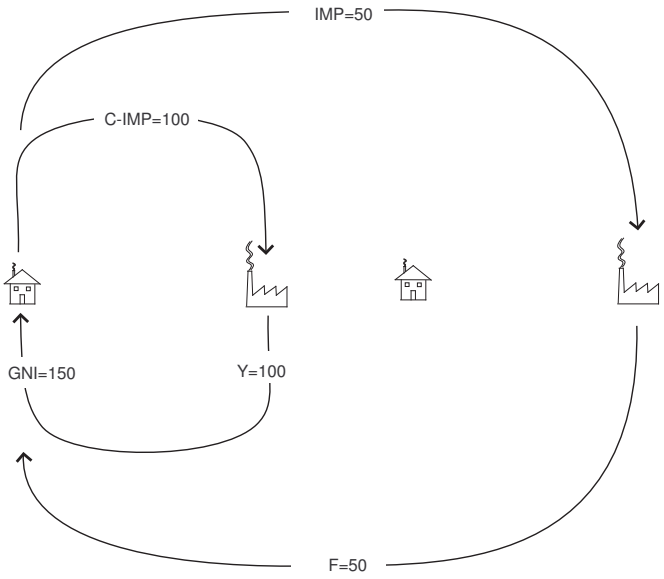


FIGURE 11.2. The circular flow with a 'slave economy'.

As can be seen in Figure 11.2, GNI in land 2 is zero, while it is 150 USD per year in land 1.

11.1.2. The current account. Look again at the circular flow for GDP and GNI. Flows of money between countries must also balance, implying that net imports must be equal to F, or NX should be equal to *minus* F. But if $NX = -F$, this implies a restriction on the amount that can be imported, that a country can import (net) only if it has net income from abroad to pay for the imports with. But this is actually wrong! We need a new entry in the figure, the *current account*.

MODEL ECONOMY 11.2. *Assume an economy, call it Sweden, in which exports are zero and there is no income from abroad, but where imports are worth* 100 *million USD per year. How does this work? What does this country pay for the imports with?*

If the country does not have income from abroad then it must finance the net imports by selling assets. Possibly, these assets could be in the form of money, in which case the foreign producers accept your money as payment. However, it is unlikely that they want to collect a pile of Swedish crowns. It is more likely that they use will use the crowns to buy other *real* assets, such as Swedish companies or (more generally) Swedish capital. Put differently, they invest in Sweden! The current account (in Swedish, bytesbalansen) is then defined as the flow of funds from domestic households to foreign households, and is therefore positive when the domestic country is a net investor in other countries, buying their assets. So if for instance Sweden has a positive current account balance, that means that Swedish households are net buyers of foreign assets, while a negative current account means that the country is selling assets (perhaps to finance imports). See Figure 11.3.

It is important to distinguish the current account from the government budget. Just because the government budget is in the red and the government (or national) debt is rising, that does not imply that the country has a negative current account balance. However, a high level of government consumption G may contribute to negative net exports and thus a negative current account balance.

In some circumstances it may be natural that a country has a negative current account balance. This applies, for example, if the country has suffered great difficulties such as natural disasters or wars that have devastated the country's capital. In this case, the reconstruction is greatly facilitated if foreign agents invest in the stricken country. Their incentive to invest is the high return to investment in the capital-poor country.

11.1.3. The government debt and private debt. Above we saw that an economy can finance net imports by selling capital assets. It is also possible to sell financial assets, such as debt securities, i.e. to borrow money from abroad to finance imports. Households may do so indirectly through their banks acting in international markets. Governments do it more directly. For simplicity, we focus on the government and leaves the banks to one side.

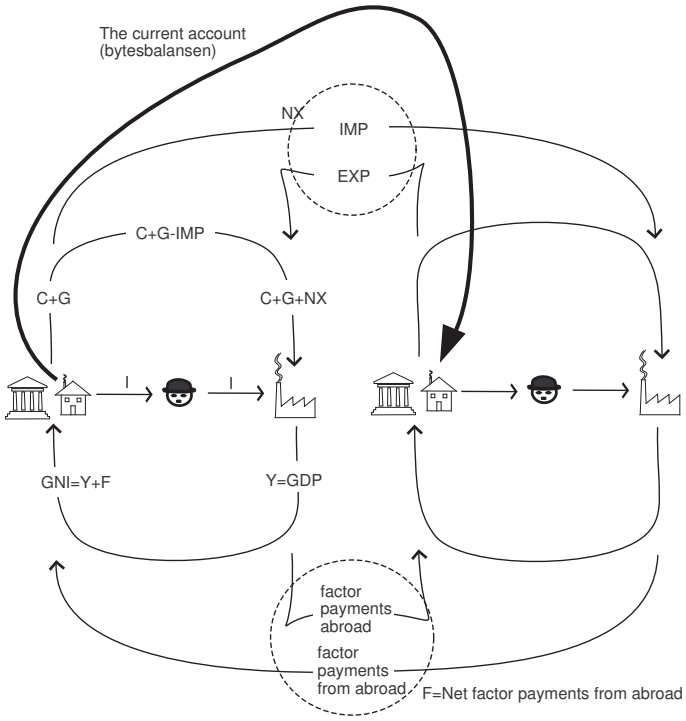


FIGURE 11.3. The circular flow including the current account.

It is common that a government has debts to international financial markets; the government also has huge assets and large streams of revenue and expenditure. Usually we measure the size of government debt in relation to the country's (annual) GDP: a debt equal to less than 50 percent of the country's annual GDP is relatively low, and a debt greater than 100 percent of GDP is high. More important than the size of the debt is what the market thinks about the future: if the debt is expected to increase uncontrollably over the next few years it will not help much if it is 50 percent right now, compared to a government whose debt is 100 percent but is expected to fall in the future. International markets, just like any sensible lenders, are willing to give loans to help the borrower out of a temporary fix, but not to finance unsustainable consumption, since in the latter case they cannot expect to get their money back.

What happens if a government debt begin to rise sufficiently to raise concerns in international markets? Initially, the government can still borrow money, but as the turmoil increases the market demands ever higher interest rates to compensate for the risk taken when lending money to that government. Also note that this applies not only to new money (loans) but also old, as old loans must be renewed. Loans run over a specified time interval, and at the end of the time the loan must be repaid. In order to pay back to old loan the government must typically agree new loans, at a new interest rate.

EXAMPLE 11.1. *Assume a country, in 2007, with GDP of* 100 *million USD per year, and a (relatively large) government debt of* 100 *million USD. The government budget is in balance; it draws in 30 million per year in taxes, and spends the same amount on government consumption and interest on the debt. The real interest rate is 2 per cent, and hence, the interest cost* 2 *million USD per year. The loans are renewed on an annual basis.*

Assume now that the economy enters a crisis in 2008 such that the GDP drops to 80 *million USD that year. Government consumption increases due to the necessary increases in social welfare to 32 million, while income decreases to 24 million. The interest rate (set at the beginning of the year) is still 2 percent. The government budget is 10 million in the red, and debt increases to* 110 *million.*

The crisis continues, and in 2009 GDP is also expected to be 80 million. Assume that the government's income is again 24 million, while public consumption is at 32. What happens next?

What happens is that market agents are not willing to lend money to the country without a large increase in the real interest rate. However, such increases put the country in an even worse position. Assume for instance that the interest rate increases to 10 percent. Since the new rate applies to the entire debt, interest payments are now 11 million per year, and the government is 19 million in the red. The situation is catastrophic.

How can a country get into this kind of situation, and what can be done about it? The answers depend heavily on the currency used in the country, and its exchange rate policy. We will deal with these issues

below, where we discuss the two most important currency systems, which are (i) where countries share the same currency, and (ii) where countries have separate currencies with freely-floating exchange rates between them.

11.2. Short-term and long-term stability in open economies

Here, we analyze the cyclical and long-term stability in open economies. We begin with an economy that is part of a large currency union, then we take the opposite case of a freely floating currency, then we discuss other options.

11.2.1. A common currency. The simplest case to analyze is when a small open economy shares a currency with the rest of the world; all have the same currency. There is of course no such economy, but the situation can be compared to a small economy in the EMU area, or a state in the United States. In addition, lessons learned from this simplified case applied in more contexts.

If everyone has the same currency, it follows directly that the risk free interest rate must be the same everywhere, and therefore there can be no more than a single central bank that determines the short-term (base) interest rate. If there were competing central banks that offered different interest rates on the same currency then all agents would choose to borrow from one (which offered lowest interest) and make deposits at another (which offered the highest interest rate), and the system would collapse immediately. Since the country is small we assume that it cannot influence the central bank, hence its only means of controlling the business cycle is through fiscal policy. Now let's study such an economy, making Keynesian assumptions; that is, we assume that all prices are fixed.

MODEL ECONOMY 11.3. *Assume a Keynesian economy—call it Sweden—with a fixed exchange rate vis-à-vis the outside world. Assume that 50 percent of consumption and investment is domestically produced, and 50 percent is imported. The government budget is in balance, and furthermore the current account balance is zero. Assume that the government is not satisfied with the pace of economic growth, and increases G by 100 million EUR per year. What happens to exports? What happens to imports? Is the multiplier higher or lower than in a closed economy? What happens to the current account?*

To understand what happens, we can draw the circular flow, as in Figure 11.4. Since half of the increase of G goes on imports, the effect on household income before taxes is halved. Thus, the multiplier effect is significantly reduced; the reason is that half of the effect of the expansionary policy is felt abroad rather than at home.[1] At the same time, the government budget and current account are now both in deficit; foreign households buy assets of Swedish households (or the government).

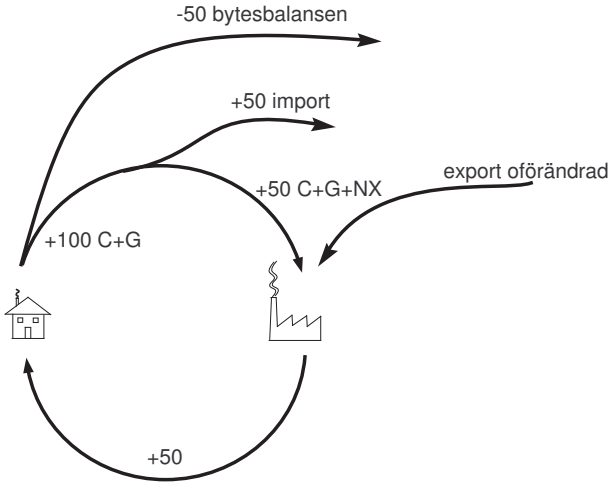


FIGURE 11.4. The circular flow and expansionary policy.

Note that the level of exports from the small economy is unchanged. This is because prices are fixed and the exchange rate is fixed (single currency). Thus the outside world's demand for the small country's products is not affected by the expansionary policy.

[1] Given more information we can easily calculate the multiplier. Assume for instance the $MPC = 0.7$—so households consume 70 percent of their net income—that $G = 0$ and there are no taxes. Then if Y rises by 1 percent, $C + G$ rises by 0.7 percent, and $C + G + NX$ rises by just 0.35 percent (because half of the extra spending goes on imported goods). So the multiplier, which would be $1/(1 - 0.7) = 3.33$ in a closed economy, is just $1/(1 - 0.35) = 1.54$ in the open economy. So the total effect of (for instance) a fiscal stimulus on the home economy is much smaller than in a closed economy.

In Model economy 11.3 the government budget was in balance from the beginning, but after the increase of G there is extra expenditure of 100 million EUR per year in the government budget, which is only partially offset by increased revenue. To finance this, the government can sell assets abroad, or borrow money. We focus on the case where the government borrows from the international market to meet its expenses, and that the government has current loans to be renewed. This is, as we stated earlier, no problem if the market believes the deficit to be temporary. But is it temporary? To answer that question we need to analyze economic development in the longer term.

In the longer term we know from Chapter 8 that the expansionary policy will cause an increase in the rate of inflation. Such an increase will make the situation even worse. Higher prices mean that the small country's products become more expensive compared to the rest of the world's products, and thus exports fall, imports increase, and current account and balance of public finances deteriorate further. This means that the state must borrow even more money to finance its consumption. The situation can soon become unsustainable untenable, as above: the government debt rises, interest rates rise, and soon no one is prepared to lend to the small country at all. The country is bankrupt.

The example shows that a small country sharing a currency with the rest of the world cannot even pursue an independent fiscal policy. If the country drives domestic demand then it drives up prices and wages, and this reduces the country's international competitiveness. As long as there is a single currency the only way to restore competitiveness is to reduce prices and wages relative to the rest of the world. Such a reduction can be achieved through (i) cuts in nominal wages in the small country, (ii) nominal wage increases in the outside world, or (more radically) (iii) if the small country leaves the monetary union and creates its own currency. If the exchange rate between the currencies were set by the market then the new currency would immediately move to a value such that competitiveness would be restored. Finally, a possible short-run solution is that the country's creditors write off some or all of the debt. However, if this is done then the problems are likely to return in the near future.

Model economy 11.4. *Assume that a small municipality in a large country, say Dalsland in Sweden, begins to print its own crowns in order to bring down interest rates in the municipality. What happens? Now assume instead that the municipal leaders in Dalsland borrow a lot of money and invest in construction projects in the municipality. What happens?*

In the first case—quite apart from the fact that this would not be allowed by the central bank—there is no effect on the interest rate in Dalsland, since a single interest rate applies across the whole country. In the second case there will be a short-run economic boom in Dalsland, but many of the jobs will go to those who do not live in the municipality; furthermore, the municipal budget will go deep into deficit.

11.2.2. Freely floating exchange rate. The opposite extreme to a common currency is freely floating exchange rates. That is, each country in the global economy has its own currency, and the market determines the value of each currency relative to the others.

The situation of a country that allows its currency to float freely—thus allowing the market to determine the exchange rate—is completely different from a country sharing a currency with its trading partners. The reason is that the floating exchange rate acts as a valve or automatic adjustment mechanism which (at best) completely eliminates the risk of a country losing competitiveness relative to the outside world due to poorly managed economic policy. So if, for instance, expansionary domestic policy leads to inflation, this will cause the value of the domestic currency to decline (the currency depreciates), and export performance is not affected.

Model economy 11.5. *Assume that there are two countries in the world economy, Sweden and the USA, with currencies SEK and USD. In Sweden they produce Volvos (alone), in the US they produce Fords (alone). In 2010, a Volvo costs* 100 000 *SEK, and a Ford costs* 10 000 *USD. The cars are equivalent, and tradable, hence the exchange rate is 1 USD: 10 SEK. In Sweden, the inflation of 4 percent per year, while inflation in the US is 2 percent per year. There is no uncertainty; everyone knows that these numbers are valid in perpetuity. What happens to the exchange rate over time? What will happen to interest rates? (What interest rate will agents demand if they are to be indifferent between holding assets in one country or the other?)*

The example demonstrates the adjustment mechanism provided by the floating exchange rate. The Swedish crown will fall in value by 2 percent per year compared to the dollar, and thus keep prices for Swedish goods constant in dollar terms. To see this mathematically, note that the price of a Volvo will be 104 000 SEK in 2011, and the price of a Ford will be 10 200 USD. Since the cars are equivalent and tradable, it must be possible to exchange 104 000 SEK for 10 200 USD, implying that the exchange rate must be 1 USD:10.196 SEK, and the Swedish crown has decline in value by (almost exactly) 2 percent. As for the real interest rate, it must be the same in both countries, otherwise everyone would save in the

country with the higher interest rate, and borrow in the other country. That means that if the (nominal) interest rate in Sweden is 6 percent per year, then the nominal interest rate in the US must be 4 percent per year.

In Model economy 11.5 the exchange rate is determined by the purchasing-power parity rule, PPP. The rule is that the prices of goods traded on international markets should be the same on all markets, when measured in the same currency. So if 10 000 USD can buy you are Ford in the US, it should also be just enough to buy you a Ford in Sweden, after exchanging the dollars for crowns. If this rule always applied exactly than exchange rates would be very stable in the short run, since prices of most goods only change infrequently. But the situation is, of course, more complicated than that: the PPP exchange rate actually works more like an *anchor* for the true exchange rate, which we can think of as the boat. A boat does not necessarily float neatly above where the anchor is on the sea bottom; winds and currents can pull the boat away from this position. In the same way, economic forces may pull the exchange rate away from the rate that would give PPP. These forces are—guess what—all connected to *expectations*.

Model economy 11.6. *Assume that you are an economic agent in an economy—Swinden—with a floating exchange rate, and that you own a lot of Swindish financial assets. What to do if you believe that the exchange rate will soon fall by 1 percent compared to the US dollar? What might make you change your mind?*

If you think that the value of the Swindish crown is about to fall, you do not want to keep your assets in Swinden since their value (measured in dollars) will fall when the crown falls in value. You therefore sell your Swindish assets and buy American assets instead. After the crown has fallen in value you can (if you choose) sell your American assets and buy back Swindish ones, but now you can buy 1 percent more Swindish assets than you had before!

What might make you change your mind is if the interest you earn on your Swindish assets is higher than the interest on the US assets. Mathematically, we have the *international interest rate parity condition*:

$$i = i^* + e + \text{risk premium}.$$

Here i is the domestic interest rate in a small economy, i^* is the interest rate in a large neighbour, and e is the expected rate of *depreciation* of the domestic currency. So if the domestic currency is expected to depreciate at 2 percent per year then—ignoring risk for now—the domestic interest rate (per year) must be 2 percent higher than the foreign interest rate. If the domestic inflation rate is 2 percent higher than the foreign rate then this closes the circle: the exchange rate shifts over time to compensate for the difference in inflation, and the real interest rates in the two economies are equal.

The analysis becomes more interesting when we include *risk*.

Model economy 11.6, continuation 1. *You are still an economic agent in Swinden, with a floating exchange rate. Assume that you consider the Swindish crown to be a risky currency; because Swinden is a small and erratically governed economy you think that there is a relatively large chance that the value of the currency may vary drastically over time. On the other hand, you have no expectation that it will appreciate or depreciate in the near future: the exchange rate is at the PPP level. If other agents think like you, what does the interest rate parity condition predict?*

We are told that the risk premium is positive, but that e is zero. This implies that $i > i^*$, i.e. investors who choose Swindish assets must be compensated for the risk they take through a higher interest rate. Furthermore, since e is zero the inflation rates in Swinden and the rest of the world must be equal, so the *real* interest rate in Swinden must be higher! The lesson is straightforward and intuitive: a country which is judged by international markets to be risky must offer higher expected rates of return if it is to attract international investors.

Model economy 11.6, continuation 2. *Now assume that a crisis hits both Swinden and its trading partners. All the central banks choose to reduce their base rates to zero in order to stimulate the economies. Therefore we have $i = i^*$. However, Swinden is still perceived as particularly risky by international investors, especially in a time of crisis. What happens?*

The interest rate parity condition must still hold. Since $i = i^* = 0$ we can rewrite the condition as

$$-e = \text{risk premium}.$$

Since e is expected depreciation, $-e$ is the expected rate of *appreciation* of the Swindish currency. Since the risk premium is positive, this implies that in equilibrium investors must be compensated for holding Swindish assets by an expectation that the currency will appreciate over time.

This might seem paradoxical. Why should the currency of the risky, erratically run economy be expected to appreciate in value? However, the answer is simple: because its current value is below the

PPP value. But we were told that—prior to the crisis—the currency was at the PPP level. Therefore when the crisis hits *we expect the currency to suddenly drop in value*. When the crisis hits, all investors want to sell their risky Swindish assets, and no one wants to buy; therefore the value of the currency plummets below PPP to the point at which its expected appreciation compensates for the perceived risk of complete collapse.

Model economy 11.6, continuation 3. *Now assume that, years later, the Swindish economy is no longer thought of as risky, and the exchange rate is back at PPP. However, the Swindish central bank thinks the economy is in trouble, and it therefore lowers the base rate, unexpectedly, to get the economy moving. Swinden's trading partners have higher base rates. Assume that international markets believe that the bank will keep the low interest rate for a period. What happens next?*

When the interest rate falls, what do investors do with their Swindish securities? They want to get rid of them, but nobody wants to buy! When the supply of these securities exceeds demand the price drops, and therefore Swindish crown drops in value. Again, this is compatible with the interest rate parity condition

$$i = i^* + e + \text{risk premium}.$$

Now we have $i < i^*$, so e must be negative if the risk premium is zero. That is, again, we have an expected appreciation in equilibrium. And this means that the exchange rate must be below PPP. So when the Swindish bank lowers its base rate, the Swindish currency drops in value until it is low enough that its expected appreciation from that low level compensates for the low interest rate. So the expansionary monetary policy causes the currency to fall in value (depreciate) immediately, which actually strengthens the effect of the policy since net exports NX rise.

What about fiscal policy in an open economy? Here the key points are similar to a closed economy. Firstly, note that in a modern economy where the central bank sets the base rate the effects of fiscal policy may be countered by the bank's monetary policy. Secondly, note that in an open economy the effects of fiscal policy will typically be diluted since (for instance) given expansionary fiscal policy, some of the extra government spending will end up paying for goods manufactured abroad, and hence that spending will boost economic actively in the economies trading partners rather than domestically.

11.2.3. A third alternative: 'fixed but not really'. Historically, there is a third option. The government of a small country announces that it intends to maintain a fixed exchange rate relative to one or more of its trading partners, without tying the currencies together fully (as in a monetary union). One reason for doing this may be that the trading partner may be perceived to be economically well-managed, with stable and low inflation. If the small country is to maintain a stable exchange rate then it must also maintain stable and low inflation. The government therefore hopes that the announcement of a fixed exchange rate will act as a credible signal that the government will pursue responsible policy.

Do you think such an announcement will be taken seriously by the markets if (for instance) the small country has a long history of erratic economic policy and periods of high inflation? For historical evidence see the section below on relevance to real economies.

11.3. Unemployment and growth in open economies

11.3.1. International competitiveness. It is common to hear or read that in Sweden we have to do this or that to maintain our international competitiveness, without which we get mass unemployment and economic crisis. These arguments are almost always wrong. Sweden's international competitiveness is kept in balance through the floating exchange rate: if we become more competitive then our exports rise relative to imports; this causes the Swedish crown to be more sought after, hence the currency appreciates and our competitiveness decreases, bringing exports and imports back into balance. In the same way, if nobody wants to buy our export goods because they are too expensive, while we want to import cheap foreign goods, then the crown is overvalued and will fall in value, restoring balance.

On the other hand, we saw above that there may be reasons why the value of a currency diverges from its PPP level, thus affecting competitiveness. If a currency falls in value (because for instance it is thought to be risky to hold it) this actually boosts the competitiveness of the economy, raising net exports and boosting economic activity. This may seem paradoxical, but is in fact logical. When a currency falls in value the real wages of the citizens of that country fall, in international terms. This can be seen in two ways: on the one hand, the citizens have become poorer and can afford fewer imports and fewer foreign holidays; on the other hand, the goods they produce have become cheaper so they are more in demand, which helps to boost the domestic economy and create jobs.

11.3.2. Unemployment. Unemployment in the long run is determined by how the labor market works. Therefore other policy areas, including regarding management of the currency and exchange rate, are fairly irrelevant. However, the labor market may be affected if, for example, a more open economy is a more dynamic economy where the process of creative destruction is faster: new industries arise more frequently and develop faster, and by the same token old industries disappear. In such an economy unemployment may be higher because of the higher friction; to avoid this, it may help to make the workforce more flexible and agile.

This is not true for a country in a currency union. Recall that the floating exchange rate ensures that —for instance—domestic inflation has no effect on competitiveness and net exports. If the exchange rate is fixed, then high domestic inflation leads to high prices of domestic products relative to foreign products, and hence falling exports and rising imports. This will lead to economic crisis and high unemployment until such time as domestic wages are brought into line with the wages of the trading partners.

A floating exchange rate also ensures that domestic unemployment is not created when trading partners have different productivity levels to the home country. The mechanism works in a similar way to the mechanism we discussed in Chapter 1, the economy without money. If a trading partner has a more skilled and productive labour force than the home country then the exchange rate will be such that workers in the trading partner are more highly paid than the workers in the home country, and prices of finished goods will be the same in both countries. Or, more likely, goods in which the hi-tech trading partner has a comparative advantage (such as computers) will be more cheaply made there, whereas simpler goods (such as clothes) will be more cheaply made at home. The exchange rate, rather than keeping all prices the same, will ensure that imports and exports balance. On the other hand, if a trading partner has a *less* skilled workforce then their wages will be lower to compensate for their lower productivity, and again the exchange rate will ensure balanced trade between the countries.

In reality we know that trade between particular countries is not always balanced. However, the reasons for this are not to be found by looking at the relative productivities of the workers in those countries, or relative wages. They are to be found by looking at forces affecting the exchange rate. We consider some examples later on.

MODEL ECONOMY 11.7. *Assume that Sweden closes its borders to trade. What happens with regard to unemployment?*

Since unemployment is determined by the operation of the labour market, the short answer is that there should not be a direct effect. The longer answer is that we don't know, since such a drastic change would have profound consequences for the entire economy, including presumably the operation of the labour market. However, we can build models to test different ideas.

Recall that one important cause of unemployment is *voluntary* unemployment, which builds on the idea that the wage that some workers can command (related to their productivity for employers) is lower than their reservation wage, hence they can never find employment. The reservation wage is determined by many factors, including wages in previous jobs and the level of income when unemployed. With regard to productivity, the key variable is *marginal revenue product*, which is the extra revenue a firm can earn by employing one extra worker. This may be affected by international trade.

MODEL ECONOMY 11.8. *Assume a country—Youessay—with* 91 *skilled workers and* 9 *unskilled workers. Every firm in this economy needs (must have) one telephone operator for every 9 production workers. Skilled workers can do either job, while unskilled workers can only work as telephone operators. Firms produce goods worth 1 USD per worker per day. Describe the allocation of workers in the economy, and wages.*

The allocation of workers in this economy will be 90 production workers, all skilled, and 10 telephone operators, 1 skilled and 9 unskilled. Since there are skilled workers in both sectors, wages must be identical for skilled and unskilled workers. And since there is no capital, wages will account for the entire GDP of 100 USD per day, hence wages will be 1 USD per day.

MODEL ECONOMY 11.8, continuation 1. *Now assume that Youessay starts to trade with the another large country which has lots of unskilled workers who are only paid* 0.5 *USD per day. Firms are now able—at no extra cost—to outsource telephone services abroad. What happens?*

Now the wage to unskilled workers at home must be equal to the wage abroad, 0.5 USD per day. The result is that firms in Youessay will employ all 91 skilled workers in production, and of the 10.1 telephone operators needed, 1.1 will be employed abroad. Total production will be 101.1 (the number of workers employed), worth 101.1 USD. Of this sum, 0.55 will go abroad (to pay for the foreign telephone operators), and 100.55 will remain at home. So Youessay's GDP will rise by 0.55 percent.

Despite the rise in total GDP, the change is clearly to the detriment of the unskilled workers at home, whose wages are halved. However, it is to the benefit of the skilled workers since their wages—given that they take the residual after paying the unskilled workers—rise to $(101.1 - 10.1 \times 0.5)/91 = 1.055$ USD per day.

MODEL ECONOMY 11.8, continuation 2. *Now assume that unemployment payments are set at* 0.6 *USD per day, and that anyone without a job is entitled to say payments unconditionally. Furthermore, there is no utility nor disutility associated with working.*

Now all of the unskilled workers will refuse jobs as telephone operators and choose unemployment instead. The unemployment payments must come from the employed workers (via taxation), and their net wage after tax is now $(101.1 - 10.1 \times 0.5 - 9 \times 0.6)/91 = 0.996$ USD per day. So now trade causes unemployment, and furthermore it makes everyone worse off!

The above example shows how opening up for trade may affect the distribution of income in a country, in particular it shows how low-skilled workers in high-tech economies may lose out when firms in such economies find it easier to source low-tech products from abroad. Furthermore, in the presence of generous payments to the unemployed this might lead to higher unemployment rather than lower wages. The model thus ties in with the discussion in Chapter 10, at the end of Section 10.5. There we discussed briefly why unemployment has risen in Europe but not in the US over recent decades. The idea was that the value of low-skilled workers to firms has declined, and that in the US this is reflected in lower wages without higher unemployment, whereas in Europe wages to low skilled workers have remained relatively high, but they find it increasingly hard to find jobs.

11.3.3. Growth. The driving force for economic growth is the development and adoption of new technologies. In less developed countries we know that the key is adoption; in the leading economies, both innovation and adoption are necessary. How are these processes affected by openness to trade?

MODEL ECONOMY 11.9. *Assume that Sweden closes its borders to trade. What happens with regard to growth? Now assume that Thailand closes its borders. What happens here?*

The first thing that will happen in Sweden is a rather dramatic *level effect*: the level of GDP in Sweden will decline quite suddenly. The reason is that we must reorganize our production to produce smaller quantities of a larger range of products, including products in which we have a comparative disadvantage such as clothing. Thus we lose the benefits of large scale and comparative advantage. In the longer run there will also be a growth effect: since our connections to the outside world are weakened, our ability to learn from and use the technologies discovered and developed in the outside world will diminish. Furthermore, the very many producers of various kinds will have difficulty making technological advances because they are too small and different from each other, and moreover, they are subject to weak competition. The Swedish growth rate will therefore be low even after the initial adjustment period. In an economy further from the technological frontier the effect of isolation will be to prevent the continuation of rapid growth.

Even more broadly, it can be argued that the driving force of growth is the urge to improve, to do things better. And one thing that pushes firms to do better is competition. And opening up to trade increases competition. These ideas can be linked to the discussion above about trade and unemployment (Model economy 11.8). Opening up to trade puts unskilled workers in Youessay into competition with workers abroad, competition which leads to a drop in wages for the Youessay workers. However, this competition may also stimulate individuals in Youessay to raise their skills and thus to raise their wages again.

11.4. Optimal currency areas: What currency system fits best?

Define a 'currency area' as the area within which a given currency—controlled by a single central bank—is the official means of exchange. How large should such currency areas be? Is one currency per country always best, or might it be advantageous for many countries to share the same currency. The theory of optimal currency areas addresses these questions.

MODEL ECONOMY 11.10. *Assume two countries planning to share a single currency. What factors might suggest this would be a good idea? What factors might suggest it would be a bad idea?*

A single currency will lead to savings of *transaction costs*, i.e. the costs associated with the need to change money in order to do business. Furthermore, doing business is easier becomes firms no longer face the risk of the exchange rate changing over time and affecting their competitiveness. Since export contracts may run over several years the risk of shifts in exchange rates is very important, and exporting and importing firms typically choose to insure or hedge against such risks. With a single currency they

don't need to worry. The Calmfors Commission in Sweden estimated that Sweden would save transaction costs amounting to 0.2 percent of GDP if it joined the euro.

The disadvantage of a single currency is that the countries lose the 'safety valve' that a floating exchange rate provides. If one of the countries gets into a cost crisis, this cannot be solved through a simple drop in the value of the currency. Instead, nominal wages must decline in the crisis country, or they must increase rapidly in the partner country.

Model economy 11.11. *Compare two countries in which wages have risen rapidly, more rapidly than in their trading partners. One has a floating exchange rate, the other is in a currency union with its partners. In which country is the readjustment more painful? Why?*

If a country with a floating exchange rate gets into a cost crisis, all that needs to happen is for the market to wake up and reduce the value of the currency. If the currency value drops by 10 percent, the citizens have effectively become 10 percent poorer. However, they scarcely notice as their nominal wage has not been affected. On the other hand, to achieve a similar effect in the country which is part of a currency union, nominal wages in that country must drop by 10 percent. A much harder sell for the politicians of that country, and likely to involve a lengthy period of high unemployment . . .

Given the above, what countries are well suited to sharing a currency? Presumably, countries where the upside is large and the downside small. The upside is simple: since it is reduced transaction costs associated with trade, the upside is large when the countries trade a lot with each other. The downside is more complex: the downside is small when the risk of the economies getting out of step with one another is small. This should be the case when the economies are similar (they make similar products, for instance), and when they are highly integrated. Ideally both capital and labour (and not just final goods) should be highly mobile across the border between the countries. In that case, wage and price differences will tend to even out rapidly due to labour and capital moving across the border. Furthermore, the risks will be much smaller if the governments of the two countries communicate with each other and coordinate their fiscal policies.

11.5. Relevance to real economies

To what extent can the ideas discussed above explain phenomena observed in real economies? We now address this question for the last time.

11.5.1. The euro. First, a brief note about the euro. Despite all the talk about costs and benefits, it is clear that the euro was and is primarily a political, not an economic project. That is why countries skeptical to tighter union—such as Sweden and the UK—chose to stay out.

11.5.2. Sweden during the recent crisis. Sweden fared incredibly well during the crisis years 2008–2010. Why? In Figure 11.5 we see that the value of the Swedish crown declined by 20 percent compared to the euro in the second half of 2008. This is as if Swedish wages declined by 20 percent compared to German wages, and those of other countries in the eurozone. Clearly this gave a massive boost to Swedish firms, raising their ability to export, and their ability to outcompete importers in the domestic market. But why did the crown's value decline so steeply? Remember the interest rate parity condition?

Model economy 11.12. *(1) Assume that the year is 2008. You are American, and hold both Swedish and other European assets in your portfolio. During September, Lehman Brothers goes bankrupt and the global crisis is a fact. What happens to the risk premium on the Swedish currency relative to the euro? What happens to interest rates? What do you do, all things being equal? What happens to the value of the crown against the euro?*

(2) It is now 2010. It is now clear that the Swedish economy can handle the crisis very well, while the eurozone crisis is about to flare up. What happens to the risk premium on the Swedish currency relative to the euro? What do you do, all things being equal? What happens to the value of the crown against the euro?

The data in Figure 11.5 strongly suggest that the interest rate parity condition as explained above does actually describe how exchange rates are determined in reality.

11.5.3. Greece during the crisis. Greece fared extremely poorly in the crisis years after 2008. Why? What happened? The Greek crisis shows the role of imperfect information in allowing problems to build up, and of course the role of a single currency in preventing markets from solving such problems.

The Greek government ran a deficit most years from the mid-1970s through to 2007, and at this stage the government debt was equal to 100 percent of GDP. This is a high level, but on the other hand

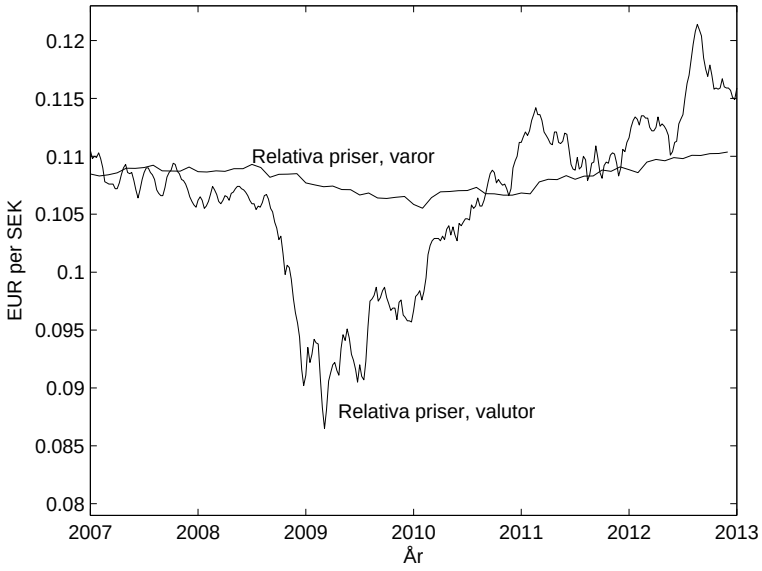


FIGURE 11.5. The exchange rate EUR per USD, and the development of relative prices in Sweden and the euro area. When the latter curve rises means that nominal prices have risen in the euro area compared to the prices in Sweden.

the government was more-or-less balancing its budget so the debt level was stable. In 2007–2009, however, the Greek economy got into trouble, reducing government revenue while government expenditure increased dramatically: the deficit ballooned. However, it seems that the Greek statistical agencies were not doing their job properly, and in 2010 the already high estimated deficits for this period were revised dramatically upwards. This news shocked the market. The first effect was that market agents demanded high interest rates in order to be willing to buy bonds from the Greek government, in order to compensate for the risk of default. However, high interest rates increase the risk of default, and soon there was no interest rate at which the market was willing to lend; other governments then chose to step in and lend directly to the Greek government, while at the same time negotiating reforms to the Greek system of governance and management of the economy to try to ensure that the government would be able to repay.

If Greece had retained its own currency (the Drachma), the effect when the false accounts were revealed in 2010 would have been that the value of that currency would have fallen very dramatically, perhaps by 20 percent, perhaps by a lot more. This would instantly have made Greece 20 percent poorer, but it would also—instantly—have raised the competitiveness of Greek firms. Furthermore, the value of debts denominated in Drachmas would have fallen by 20 percent, easing repayment problems. But because Greece had switched to the euro, there was instead a need for *nominal* wages in Greece to fall by perhaps 20 percent in order to restore competitiveness, an extremely difficult process. On the other hand, by going through this process it is possible that Greece will develop better economic institutions in order to manage the economy in a more predictable and rational manner in the future.

There were at least two alternatives to deflation and painful adjustment in Greece (and to some extent in other euro-area economies such as Spain). One of these was to leave the euro and resurrect the Drachma: in practice only a very desperate last resort as it would be enormously costly and create huge conflicts with Greece's trading partners and creditors. How would Greece pay back its creditors? In euro? Or in (almost worthless) Drachma? The other alternative was for the *other* countries in the eurozone to create positive inflation domestically, allowing Greece to regain competitiveness by holding its own wage inflation around zero. Such a solution was completely ruled out by the dominant force in the eurozone, Germany, for two reasons: first, it would allow Greece to continue its economic mismanagement, with the obvious risk of a new similar crisis in the future; and second, the German government has a long and powerful tradition of careful management of monetary policy and low inflation, a tradition that it was not prepared to give up.

11.5.4. Currency policies in Sweden and the UK until 1992. A very different story was played out in the 1970s, '80s and early '90s in some European countries, including Sweden and the UK. In this period both countries followed the strategy 'fixed but not really', as described in Section 11.2.3. We take the case of the UK here, but the reasoning is identical for Sweden.

The idea was to announce to the market that the government and central bank would maintain a fixed exchange rate with the German mark. Since it was well known that Germany always maintained stable

and low inflation, this announcement would convince the market that the UK government would also maintain stable and low inflation, since that would be the only way of maintaining the fixed rate in the long run. In practice this meant that the UK central bank promised to exchange DM and GBP (German marks and British pounds) at the given rate, for ever. So market agents wanting to convert pounds to marks could always do so, at the fixed rate, through the UK central bank.

Unfortunately, however, it is scarcely more difficult for a government to break a promise of a fixed exchange rate than it is for a government to break a promise of low inflation; the strategy failed. The UK allowed its domestic inflation to rise above German inflation, leading to a crisis of competitiveness for domestic producers at the (temporarily fixed) exchange rate. Exports fell and imports rose. Quite apart from the adverse economic effect of the policy, practical problems arose. The excess of imports over exports led to an excess of importers wanting to change pounds to marks to pay for imports, compared to the number of exporters wanting to change marks into pounds. Soon the British central bank started to run out of marks. For a while it could sell gold to the German central bank in exchange for marks, but not for long. As the crisis became too severe the currency was *devalued*, i.e. the government and central bank set a new, lower exchange rate for the pound against the mark. And *this time they really meant it*! Did they? Of course not. Inflation carried on above the German level, and soon another devaluation was on the cards. So the result was high inflation and a series of devaluations, with the resultant instability favouring neither growth nor employment.

In the early '90s the governments of Sweden and the UK decided that this time they *really did mean it*! This time they would really be disciplined and not allow more devaluations. However, the inflation rate rose and they lost competitiveness. Market pressure for devaluation increased. But this time they really meant it! What to do? The UK simply fought against the market by selling assets (such as gold) in order to buy marks, to satisfy market demand to exchange pounds for marks. But the more marks the UK government bought using gold, the more the market wanted to buy them back in exchange for pounds. Why?

EXAMPLE 11.2. *Assume your name is George Soros, and that you own assets worth 5 billion British pounds. You think that the pound is significantly overvalued against the German mark (DM), while the British finance minister believes that the value should absolutely be kept as it is, and promises to defend this value by all means available. What do you do?*

Soros's solution is simple. He sells all his UK assets, and switches the pounds he's realized to DM. The British central bank, which has vowed to defend the exchange rate, sells him DM at the fixed rate. Soon many more market agents follow Soros's example, and the central bank runs out of DM. For a while it can sell gold to obtain DM, but soon the gold starts running out too. The UK government admits defeat and devalues the currency by 20 percent. And Soros buys back his old assets; the difference is that now he has 1 billion pounds over!

The Swedish government chose an even more drastic strategy to try to defend the fixed exchange rate: the central bank raised its base rate to try to compensate investors holding Swedish crowns for the risk of devaluation. Remember the interest rate parity condition? Ignoring the risk premium we have

$$i = i^* + e,$$

where i is the Swedish interest rate, i^* is the German rate, and e is the expected rate of depreciation of the crown. So if investors expect the crown to depreciate, they can nevertheless be persuaded to hold crowns if they are given a high enough interest rate. The Swedish government raised the base rate to 500 percent per year in 1992! This is equivalent to 0.5 percent per day.[2] So a 500 percent annual interest rate will compensate investors for an expectation that the crown will depreciate by 0.5 percent per day. This will of course be totally insufficient if investors expect the crown to drop in value by 20 percent, imminently.

11.5.5. Economic policy in Sweden and the crisis of the early '90s. A lot happened in Swedish economic policy through to 1992, much more than just devaluations of the currency. In the 1970s the Swedish economy was much less open than today's economies. The main difference was that *capital* could not be taken out of the country freely.[3] This made it easier to maintain high taxes on capital and profits in Sweden without investors shifting their capital to foreign markets; the investors had no choice! Additionally, this meant that the Swedish government was free to choose the base rate of interest, unlike the situation in a currency union with the free movement of capital.

In the 1980s the economy was deregulated and opened up to the outside world. For instance, in 1985 Sweden deregulated its domestic credit market: commercial banks were allowed to lend money as they

[2] 500 percent per year is equivalent to ×6 per year. And $6^{(1/365)} = 1.005$, i.e. 0.5 percent per day.

[3] These capital restrictions are crucial to the plot of the Swedish film *Sällskapsresan*, where the baddies hatch a plot to smuggle money (capital) out of the country in order to buy a plot of land in Spain.

wanted, rather than as the central bank decided. This led to increased borrowing and hence increased aggregate demand, and raised asset prices. Deregulation created a party mood where both the supply of and demand for loan funds grew. Levels of private debt increased sharply, while the value of assets such as shares rose. Households felt wealthier and consumed more. Everything looked good on the surface, but private savings were low or negative, inflation was high and the current account was deteriorating.

In 1989 foreign exchange controls were abolished. Meanwhile, however, monetary policy was tightened in order to bring inflation under control and defend the currency (prevent a devaluation); real interest rates rose. With high interest rates, invest fell steeply, especially as confidence regarding long-run returns to investment fell. Given the removal of exchange controls of loss of confidence, market agents chose to invest in other currencies, other markets; as usual, the markets proved to be right, since the value of Swedish assets collapsed. However, part of the reason is that the market's expectations of the future are self-fulfilling.

The flight of capital led to the collapse of banks and real-estate firms. Households reacted by increasing their savings and reducing consumption; aggregate demand fell steeply and unemployment rose sharply. Exports failed to rise despite the fall in inflation, and devaluation of the currency was inevitable. The Swedish crown was allowed to float freely on 19 November 1992, and the immediate crisis was over!

11.5.6. Growth and openness. There is plenty of evidence about long-run growth and openness to trade. Completely closed economies can grow at very different rates from one another, whereas countries which trade intensely with one another tend to grow at equal rates in the long run, with long-run differences in the *level* of GDP across such countries attributable to specific factors.

Regarding closed economies, compare, for example, the average GDP per capita in 1500 at the following locations: Flinders Island; Tasmania; Australia; the Americas; Eurasia / Africa. These areas are very different large and had by then developed independently of each other for a very long time. The larger the area, the opener is each society in the field of ideas from afar; thus, the growth rate higher. After many years of distinct growth rates, GDP levels are very different: lowest on Flinders Island, and the highest in Eurasia / Africa.

Today, all world economies are open to each other in different degrees, and it creates a force that tends to keep their GDP levels close to each other. Yet differences in history, geography, culture, and luck (among other things) also play a big role. For Sweden, this means that the economy will grow at about the same rate *completely independent of the growth policy*, as long as we do not mismanage the economy so that stability deteriorates rapidly and the system fails. This is due to the high degree of openness to the other European economies. If we reduce our investments in new technology then progress in neighbouring economies will tend to spill over to us, and the long-run effect may not be very great. However, if we reduce our investments in 'social infrastructure' such as education then the effect might be much more serious.

Exercises

Ex. 11.1 On April 27, 2002, The Economist published its "Big Mac Index" and noted that the US dollar was overvalued. Among other things, it presented the following figures.

Country	Price	Price (USD)	Implied PPP rate	Actual exchange rate 2002-04-23	Overvaluation percent
USA	2.49 USD	2.49	-	-	-
Euro area	2.67 EUR	2.37	0.93 USD / EUR	0.89 USD / EUR	-5
Sweden	26 SEK	2.52		10.3 SEK / USD	+ 1

(a) What is the PPP exchange rate between the SEK and the USD is implied by the prices?
(b) What was the exchange rate between the SEK and the EUR?
(c) Was the Swedish crown, on this basis, over- or undervalued against the euro? By how much?

Ex. 11.2 The year is 1980. The souvenir donkey industry in Spain is on its knees. You make a plan to import donkeys redesigned to Dala Horses. You buy donkeys with pesetas and sell them in Sweden for crowns.

(a) How are your profits affected by the changes below?
  (i) The nominal exchange rate is unchanged, but prices are rising faster in Sweden than in Spain.
  (ii) The nominal exchange rate is unchanged, but prices rise more slowly in Sweden than in Spain.

(iii) The crown depreciates (more per ESP), and the prices are unchanged both in Sweden and in Spain.

(b) When foreign goods become cheaper, and import business benefits, is that called a real *appreciation* or *depreciation* of the currency?

Ex. 11.3 (a) If the government has a budget deficit while private net lending is zero, what can you say about the current account?

(b) The US has a negative current account balance, while China has a positive balance and large net exports to the US. Explain in terms of the countries' net financial savings, with the help of a picture of the circular flow.

Ex. 11.4 Assume that the global economy consists of two countries with identical GDP of 2000 SEK per year. However, there are net exports from country A to country B worth 200 SEK per year. Explain by using an image of the circular flow how this can be possible.

Ex. 11.5 Assume an open economy with a floating exchange rate that is heading into a recession caused by a sharp reduction in real investment in the private sector. The government responds by lowering short-term interest rates in the economy, as well as signalling that interest rates will remain low for a significant period of time.

(a) Explain the effect on the exchange rate according to simple theory.
(b) Explain the effect on net exports in this case.
(c) Is the effect of interest rate change is greater or less than it would have been if the economy had been closed? [Is multiplier is higher or lower than if the economy had been closed?]

Ex. 11.6 Assume a country, in 2007, with GDP of 100 million EUR per year, and a government debt of 100 million EUR. The government budget is in balance; it draws in 40 million EUR per year in taxes and spend them on government consumption (38 million) and interest on the government debt, which is 2 million EUR per year since the interest rate is 2 per cent per year. The loans on the government debt are renewed on an annual basis.

Assume now that the economy enters a major crisis in 2008 such that the GDP drops to 80 million EUR per year. Government consumption increases due to the necessary increases in social welfare to 43 million, while revenue drops to 35 million. The interest rate (set at the beginning of the year) is still 2 percent, and the interest cost is 2 million.

The crisis continues, and in 2009 GDP is again 80 million, while government revenue is again 35 million and public consumption is 43 million. Market agents are concerned, and no one is willing to lend money to the country without real interest rate increases to 10 percent. The new rate applies to the entire government debt.

(a) What is the government deficit in 2008?
(b) What is the government debt at the beginning of 2009?
(c) What is the government deficit in 2009?
(d) What is the government debt at the beginning of 2010?
(e) What solutions are available if the country is in the common European currency, the euro? What are the options if the country is *not* in the euro, or if it is able to withdraw?

Ex. 11.7 Households in the UK owns assets worth 7×10^9 GBP net, while the total return on assets within the UK economy is about 0.4×10^9 GBP per year.

(a) Assume that all UK assets owned by UK households. What is the yield in percent per year in that case?
(b) Who might own the assets if not households?

Ex. 11.8 Assume a small country—GDP = 2000 million EUR per year—which is part of a monetary union with several major countries. Assume that 30 percent of consumption and investment is domestically produced, and 70 percent is imported. The government budget is in balance, and the current account balance is zero.

(a) The government is not satisfied with the pace of economic growth, and increases G to 100 million EUR per year. What happens in the short term with the following quantities, according to Keynes: (i) imports; (ii) exports; (iii) aggregate demand; and (iv) the current account balance?
(b) What happens in the medium term, in this economy, because of the expansionary fiscal policy?

(c) Assume the country decides to leave the union and allow the exchange rate to float freely. The government continues to pursue expansionary policies, and inflation is 6 percent per year, while inflation in the RoW[4] is 2 percent per year. What happens as a result of this policy?

Ex. 11.9 Assume a small island economy (3 million inhabitants) whose GDP per capita is 50 percent of USA's GDP per capita. The country exports agricultural products, and imports some hi-tech products. Imports are strictly controlled, and the rules ensure that most products (including cars and computers) are assembled at home from imported parts. There are restrictions on taking capital out of the country, and the exchange rate is fixed relative to the dollar. Unemployment is 2 percent.

Discuss possible short and long-run effects on (a) GDP and (b) unemployment if the country removes all barriers to trade and lets the exchange rate float freely.

Ex. 11.10 Assume a country with 60 million inhabitants whose GDP per capita is 50 percent of USA's GDP per capita. Unemployment is 8 percent and the growth rate of GDP per capita has averaged 2.0 percent over the last 10 years. The exchange rate floats freely.

A new government comes in and introduces a range of measures which it says will increase competitiveness and therefore lead to a fall in unemployment. These measures include weakening rules regarding environmental protection, removing barriers to trade, and funding research.

Discuss the likely effect of these measures.

[4] RoW = rest of the world.

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