PART I. INTRODUCTION

Preface

■ The **main challenges for macroeconomic theory** are:

1. to explain the **long-term economic growth**,
2. the **short-term business fluctuations** observed in the real world and,
3. to deal with the **macroeconomic policy issues**.

■ This course offers an **introduction to advanced economic analysis** of these issues.

■ To give students a feel for the methodology of modern macroeconomics, **the course uses formal mathematical analysis** throughout, supplemented by graphical illustrations. However, the **mathematics used are simple**, and students are only required to have some training in basic calculus and some familiarity with first-order difference equations and with the concept of a stochastic variable.

■ Rather than offering a superficial coverage of a wide range of topics and different model types, **an in-depth treatment of a limited number of workhorse macro models** will be provided.

■ Let us begin with the brief history of modern macro.

The history of modern macroeconomics

Keynes and the Great Depression

■ The **history of modern macroeconomics starts in 1936**, with the publication of **Keynes's *General Theory of Employment, Interest, and Money***. As he was writing the General Theory, Keynes confided to a friend: "I believe myself to be writing a book on economic theory which will largely revolutionize—not, I suppose at once but in the course of the next ten years—the way the world thinks about economic problems."

■ Keynes was right. The book's timing was one of the reasons for its immediate success. The **Great Depression was not only an economic catastrophe but also an intellectual failure for the economists working on business cycle theory** – as macroeconomics was then called.

Few economists had a coherent explanation for the Depression, either for its depth or for its length. The **economic measures** taken by the governments had been **based on instinct rather than on economic theory**. The *General Theory* offered an interpretation of events, an intellectual framework, and a clear argument for government intervention.

■ The *General Theory* emphasized **effective demand** – what we **now call aggregate demand**. **In the short run, Keynes argued, effective demand determines output**. Even if **output eventually returns to its natural level**, the **process is slow at best**. One of Keynes' most famous quotes is "In the long run, we are all dead."

■ In the process of deriving effective demand, **Keynes introduced many of the building blocks of modern macroeconomics**:

- The **relation of consumption to income**, and the **multiplier**, which explains how shocks to demand can be amplified and lead to larger shifts in output.
- **Liquidity preference** (the term Keynes gave to the demand for money), which explains **how monetary policy can affect interest rates and aggregate demand**.
- The **importance of expectations** in affecting consumption and investment, and the idea that **animal spirits** (shifts in expectations) are a major factor behind shifts in demand and output.

■ The *General Theory* was more than a treatise for economists. It **offered clear policy implications**, and they were in tune with the times: waiting for the economy to recover by itself was irresponsible. **In the midst of a depression, trying to balance the budget was not only stupid, it was dangerous**. Active use of fiscal policy was essential to return the country to high employment.

The neoclassical synthesis

■ Within a few years, the *General **Theory*** **had transformed macroeconomics**. Not everybody was converted, and few agreed with it all. But **most discussions became organized around it**.

■ **By the early 1950s, a large consensus had emerged**, based on an integration of many of Keynes' ideas and the ideas of earlier economists. This consensus was called the **neoclassical synthesis**. To quote from Paul Samuelson, in the 1955 edition of his textbook Economics – the first modern economics textbook:

> In recent years, 90 per cent of American economists have stopped being "Keynesian economists" or "Anti-Keynesian economists." Instead, they have worked toward a

> synthesis of whatever is valuable in older economics and in modern theories of income determination. The result might be called neo-classical economics and is accepted, in its broad outlines, by all but about five per cent of extreme left-wing and right-wing writers.

■ The neoclassical synthesis was to remain the dominant view for another 20 years. Progress was astonishing, leading many to call the period from the early 1940s to the early 1970s the golden age of macroeconomics.

Progress on all fronts

■ The first order of business after the publication of the *General Theory* was to **formalize mathematically what Keynes meant**. While Keynes knew mathematics, he had avoided using it in the *General Theory*. One result was endless controversies about what Keynes meant and whether there were logical flaws in some of his arguments.

■ **The IS-LM model.** A number of formalizations of Keynes' ideas were offered. The most influential one was the **IS-LM model**, developed by John Hicks and Alvin Hansen in the 1930s and early 1940s. The initial version of the IS-LM model was criticized for

emasculating many of Keynes' insights: **expectations played no role, and the adjustment of prices and wages was altogether absent**.

■ Yet the **IS-LM model provided a basis from which to start building**, and as such it was immensely successful. **Discussions became organized around the slopes of the IS and LM curves**, what variables were missing from the two relations, what equations for prices and wages should be added to the model, and so on.

■ **Theories of consumption, investment, and money demand.** Keynes had emphasized the importance of consumption and investment behavior and of the choice between money and other financial assets. Major progress was soon made along all three fronts.

■ In the 1950s, Franco **Modigliani** (then at Carnegie Mellon, later at MIT) and Milton **Friedman** (at the University of Chicago) independently developed the **theory of consumption**. Both insisted on the **importance of expectations in determining current consumption decisions**.

■ James **Tobin**, from Yale, developed the **theory of investment**, based on the **relation between the present value of profits and investment**. The theory was further developed and tested by Dale Jorgenson, from Harvard.

■ Tobin also developed the **theory of the demand for money**, and more generally, the **theory of the choice between different assets based on liquidity, return, and risk**. His work has become the basis not only for an improved treatment of financial markets in macroecomics, but also for the theory of finance in general.

■ **Growth theory.** In parallel with the work on fluctuations, there was a **renewed focus on growth**. In contrast to the stagnation in the pre-World War II era, **most countries were growing fast in the 1950s and 1960s**. Even if they experienced fluctuations, their standard of living was increasing rapidly.

■ The **growth model** developed by MIT's Robert **Solow** in 1956 provided a framework to think about the **determinants of growth**. It was followed by an **explosion of work on the roles saving and technological progress** play in determining growth.

■ **Macroeconometric models.** All these **contributions were integrated in** larger and larger **macroeconometric models**. The first U.S. macroeconometric model, developed by Lawrence **Klein** from the University of Pennsylvania in the early 1950s, was **an extended IS relation, with 16 equations**.

■ With the development of the **National Income and Product Accounts** (making available better data) and the development of econometrics and computers, the **models quickly grew in size**. The most impressive effort was the construction of the MPS model, developed during the 1960s by a group led by **Modigliani**. Its structure was an **expanded version of the IS-LM model, plus a Phillips curve mechanism**. But its components – consumption, investment, and money demand – all reflected the tremendous theoretical and empirical progress made since Keynes.

Keynesians versus Monetarists

■ With such rapid progress, **many macroeconomists** – those who defined themselves as Keynesians – **came to believe that the future was bright**. The nature of **fluctuations was becoming increasingly well understood**; the development of **models allowed policy**

decisions to be made more effectively. The time when the **economy could be fine-tuned**, and **recessions all but eliminated**, seemed not far in the future.

■ This optimism was met with **skepticism by a small but influential minority, the monetarists**. The intellectual leader of the monetarists was Milton **Friedman**. Although Friedman saw much progress being made – and was himself the father of one of the major contributions to macroeconomics, the theory of consumption – he did not share in the general enthusiasm.

■ He **believed that the understanding of the economy remained very limited**. He **questioned the motives of governments** as well as the **notion that they actually knew enough to improve macroeconomic outcomes**.

■ In the 1960s, **debates between Keynesians and monetarists** dominated the economic headlines. The **debates centered around three issues**:

- the effectiveness of monetary policy versus fiscal policy,
- the Phillips curve,
- the role of policy.

■ **Monetary policy versus fiscal policy. Keynes had emphasized fiscal rather than monetary policy** as the key to fighting recessions – and this had remained the prevailing wisdom. The **IS curve**, many argued, was **quite steep**: **changes in the interest rate had little effect on demand and output**. Thus, monetary policy did not work very well. **Fiscal policy, which affects demand directly**, could affect output **faster and more reliably**.

■ **Friedman** strongly **challenged** this conclusion. In their 1963 book *A Monetary History of the United States*, 1867-1960, Friedman and Anna Schwartz painstakingly **reviewed the evidence on monetary policy**, and the relation between money and output in the United States over a century. Their conclusion was not only that **monetary policy was very powerful**, but that **movements in money explained most of the fluctuations in output**.

■ They interpreted the **Great Depression as the result of a major mistake in monetary policy**, a decrease in the money supply due to bank failures – a decrease that the Fed could have avoided by increasing the monetary base but had not.

■ Friedman and Schwartz's challenge was followed by a vigorous debate and by intense research on the respective effects of fiscal policy and monetary policy. In the end, a **consensus** was reached. **Both fiscal policy and monetary policy clearly affected the**

economy. And if policymakers cared about not only the level but also the composition of output, the **best policy was typically a mix of the two**.

■ **The Phillips curve.** The **second debate focused on the Phillips curve**. The Phillips curve was **not part of the initial Keynesian model**. But because it **provided such a convenient (and apparently reliable) way of explaining the movement of wages and prices over time**, it had become **part of the neoclassical synthesis**. In the 1960s, based on the empirical evidence up until then, **many Keynesian economists believed that there was a reliable trade-off between unemployment and inflation, even in the long run**.

■ Milton **Friedman** and Edmund **Phelps** (from Columbia University) strongly disagreed. They argued that the existence of such a long-run trade-off flew in the face of basic economic theory. They argued that the apparent trade-off would quickly vanish if policymakers actually tried to exploit it—that is, if they tried to achieve low unemployment by accepting higher inflation. As you saw in Chapter 8 when we studied the evolution of the Phillips curve, Friedman and Phelps were definitely right. By the mid-1970s, the consensus was indeed that there was no long-run trade-off between inflation and unemployment.

■ **The role of policy.** The **third debate** centered on the **role of policy**. **Skeptical that economists knew enough to stabilize output and that policymakers could be trusted** to do the right thing, **Friedman argued for the use of simple rules**, such as **steady money growth**. Here is what he said in 1958[1]:

> A steady rate of growth in the money supply will not mean perfect stability even though it would prevent the kind of wide fluctuations that we have experienced from time to time in the past. It is tempting to try to go farther and to use monetary changes to offset other factors making for expansion and contraction... The available **evidence casts grave doubts on the possibility of producing any fine adjustments in economic activity by fine adjustments in monetary policy** – at least in the present state of knowledge. There are thus serious limitations to the possibility of a discretionary monetary policy and much danger that **such a policy may make matters worse** rather than better.
>
> **Political pressures to "do something"** in the face of either relatively mild price rises or relatively mild price and employment declines are clearly **very strong** indeed in the

[1] **"**The Supply of Money and Changes in Prices and Output,**"** Testimony to Congress, 1958.

existing state of public attitudes. The main moral to be drawn from the two preceding points is that **yielding to these pressures may frequently do more harm** than good.

■ This **debate on the role of macroeconomic policy has not been settled**. The nature of the arguments has changed a bit, but the arguments are still with us today.

The rational expectations critique

■ Despite the battles between Keynesians and monetarists, **macroeconomics around 1970 looked like a successful and mature field**. It appeared to **successfully explain events and guide policy choices**. Most debates were framed within a **common intellectual framework**. But within a few years, the field was in crisis. The **crisis had two sources**.

■ One was events. By the mid-1970s, most **countries were experiencing stagflation**, a word created at the time to denote the simultaneous existence of high unemployment and high inflation. **Macroeconomists had not predicted stagflation**. After the fact and after a few years of research, a convincing **explanation was provided, based on the effects of adverse supply shocks on both prices and output**. But it was **too late to undo the damage to the discipline's image**.

■ The other was ideas. In the early 1970s, a small group of economists – Robert **Lucas** from the University of Chicago; Thomas **Sargent**, then from the University of Minnesota and now at New York University; and Robert **Barro**, then from University of Chicago and now at Harvard – led a strong attack against mainstream macroeconomics. They did not mince words. In a 1978 paper, Lucas and Sargent stated:

> That the **predictions [of Keynesian economics] were wildly incorrect**, and that the **doctrine on which they were based was fundamentally flawed**, are now simple matters of fact, involving no subtleties in economic theory. The task which faces contemporary students of the business cycle is that of sorting through the **wreckage**, determining what features of that remarkable intellectual event called the Keynesian Revolution can be salvaged and put to good use, and which others must be discarded.

The three implications of rational expectations

■ Lucas and Sargent's main argument was that **Keynesian economics had ignored the full implications of the effect of expectations on behavior**. The way to proceed, they argued, was to **assume that people formed expectations as rationally as they could**, based on the

information they had. Thinking of people as having rational expectations had **three major implications**, all highly damaging to Keynesian macroeconomics.

■ **The Lucas critique.** The first implication was that **existing macroeconomic models could not be used to help design policy**. Although these models recognized that expectations affect behavior, they **did not incorporate expectations explicitly**. All **variables were assumed to depend on current and past values of other variables, including policy variables**.

■ Thus, what the models captured was the set of **relations between economic variables as they had held in the past, under past policies**. Were these **policies to change**, Lucas argued, the way people formed **expectations would change as well**, making estimated relations – and, by implication, **simulations** generated using existing macroeconometric models – **poor guides to what would happen under these new policies**.

■ This critique of macroeconometric models became known as the **Lucas critique**. To take again the **history of the Phillips curve** as an example, the data up to the early 1970s had suggested a trade-off between unemployment and inflation. **As policymakers tried to exploit that trade-off, it disappeared**.

■ **Rational expectations and the Phillips curve.** The second implication was that **when rational expectations were introduced in Keynesian models**, these models actually **delivered very un-Keynesian conclusions**. For example, the **models implied that deviations of output from its natural level were short-lived**, much more so than Keynesian economists claimed.

■ This argument was based on a **reexamination of the aggregate supply relation**. **In Keynesian models, the slow return of output to the natural level of output came from the slow adjustment of prices and wages through the Phillips curve** mechanism. An **increase in money**, for example, led first to **higher output** and to **lower unemployment**. Lower unemployment then led to **higher nominal** wages and to **higher prices**. The **adjustment continued until wages and prices had increased in the same proportion as nominal money**, until unemployment and output were both back at their natural levels.

■ But this **adjustment**, Lucas pointed out, was **highly dependent on wage setters' backward-looking expectations of inflation**. In the MPS model, for example, wages responded only to current and past inflation and to current unemployment. But **once the**

assumption was made that wage setters had rational expectations, the adjustment was likely to be much faster.

■ **Changes in money, to the extent that they were anticipated, might have no effect on output**: for example, anticipating an increase in money of 5% over the coming year, wage setters would increase the nominal wages set in contracts for the coming year by 5%. Firms would in turn increase prices by 5%. The result would be no change in the real money stock and no change in demand or output.

■ Within the logic of the Keynesian models, **Lucas therefore argued, only unanticipated changes in money should affect output**. Predictable movements in money should have no effect on activity. More generally, if wage setters had rational expectations, **shifts in demand were likely to have effects on output for only as long as nominal wages were set** – a year or so. Even on its own terms, the Keynesian model did not deliver a convincing theory of the long-lasting effects of demand on output.

■ **Optimal control versus game theory.** The third implication was that if people and firms had rational expectations, **it was wrong to think of policy as the control of a complicated**

but passive system. Rather, the **right way** was to think of policy as **a game between policymakers and the economy**. The right tool was **not optimal control but game theory**.

■ And game theory led to a **different vision of policy**. A striking example was the issue of **time inconsistency** discussed by Finn **Kydland** (then at Carnegie Mellon, now at UC Santa Barbara) and Edward **Prescott** (then at Carnegie Mellon, now at Arizona State University): **good intentions on the part of policymakers could actually lead to disaster**.

■ Let's summarize: When rational expectations were introduced, Keynesian models could not be used to determine policy; Keynesian models could not explain long-lasting deviations of output from the natural level of output; the theory of policy had to be redesigned, using the tools of game theory.

The integration of rational expectations

■ As you might have guessed from the tone of Lucas and Sargent's quote, the **intellectual atmosphere in macroeconomics was tense in the early 1970s**. But within a few years, a **process of integration** (of ideas, not people, because tempers remained high) had begun, and it was **to dominate the 1970s and the 1980s**.

■ Fairly quickly, the **idea that rational expectations was the right working assumption gained wide acceptance**. This was **not because macroeconomists believe that people, firms, and participants in financial markets always form expectations rationally**. But rational expectations appears to be a **natural benchmark**, at least until economists have made more progress in understanding **whether, when, and how actual expectations systematically differ from rational expectations**.

■ Work then started on the challenges raised by Lucas and Sargent.

■ **The implications of rational expectations.** There was a **systematic exploration of the role and implications of rational expectations in goods markets, financial markets, and labor markets**. What was discovered? For example:

- Robert **Hall**, then from MIT and now at Stanford, showed that **if consumers are very foresighted, then changes in consumption should be unpredictable**: the best forecast of consumption next year would be consumption this year. Put another way, changes in consumption should be very hard to predict. This result came as a surprise to most macroeconomists at the time, but it is in fact based on a simple intuition: **if consumers are very foresighted, they will change their consumption only when**

they learn something new about the future. But by definition, such **news cannot be predicted**. This consumption behavior, known as the **random walk of consumption**, has served as a benchmark in consumption research ever since.

- Rudiger **Dornbusch** from MIT showed that the **large swings in exchange rates** under flexible exchange rates, which had previously been thought of as the result of speculation by irrational investors, were **fully consistent with rationality**. His argument was that **changes in monetary policy** can lead to long-lasting changes in nominal interest rates; **changes in current and expected nominal interest rates lead in turn to large changes in the exchange rate**. Dornbusch's model, known as the **overshooting model of exchange rates**, has become the benchmark in discussions of exchange rate movements.

■ **Wage and price setting.** There was a systematic **exploration of the determination of wages and prices, going far beyond the Phillips curve** relation. Two important contributions were made by Stanley **Fischer**, then at MIT, now governor of the Central Bank of Israel, and John **Taylor**, then from Columbia University and now at Stanford. Both showed that the **adjustment of prices and wages in response to changes in unemployment can be slow even under rational expectations**.

■ Fischer and Taylor pointed out an important characteristic of both wage and price setting, the **staggering of wage and price decisions**. In contrast to the simple story we told earlier, where all wages and prices increased simultaneously in anticipation of an increase in money, **actual wage and price decisions are staggered over time**. So there is not one sudden synchronized adjustment of all wages and prices to an increase in money. Rather, the **adjustment is likely to be slow, with wages and prices adjusting to the new level of money through a process of leapfrogging over time**. Fischer and Taylor thus showed that the **second issue raised by the rational-expectations critique could be resolved**, that a **slow return of output to the natural level of output can be consistent with rational expectations in the labor market**.

■ **The theory of policy.** Thinking about policy in terms of game theory led to an explosion of **research on the nature of the games being played**, not only between policymakers and the economy, but **also between policymakers** – between political parties, or between the central bank and the government, or between governments of different countries.

■ One of the major achievements of this research was the development of a more rigorous way of thinking about fuzzy notions such as "**credibility**," "**reputation**," and "**commitment**." At the same time, there was a distinct **shift in focus from "what**

governments should do" to "what governments actually do," an increasing **awareness of the political constraints** that economists should take into account when advising policymakers.

■ In short: by the end of the 1980s, the **challenges raised by the rational-expectations critique had led to a complete overhaul of macroeconomics**. The basic structure had been extended **to take into account the implications** of rational expectations or, more generally, **of forward-looking behavior by people and firms**.

Recent developments

■ Since the late 1980s, **three groups** have dominated the research headlines: the **new classicals**, the **new Keynesians**, and the **new growth theorists**.

New classical economics and Real Business Cycle theory

■ The **rational-expectations critique** was more than just a critique of Keynesian economics. It also **offered its own interpretation of fluctuations**. Instead of relying on imperfections in labor markets, on the slow adjustment of wages and prices, and so on, to explain fluctuations,

Lucas argued, macroeconomists should see **how far they could go in explaining fluctuations as the effects of shocks in competitive markets with fully flexible prices and wages**.

■ This research agenda was taken up by the new classicals. The intellectual leader is Edward **Prescott**, and the models he and his followers have developed are known as real **business cycle (RBC) models**. Their approach has been based on **two premises**.

■ The first premise is **methodological**. Lucas had argued that, in order to avoid earlier pitfalls, **macroeconomic models should be constructed from explicit micro-foundations** – that is, **utility maximization by workers, profit maximization by firms, and rational expectations**.

■ **Before the development of computers**, this was hard, if not impossible, to achieve: **models constructed in this way would have been too complex to solve** analytically. Indeed, much of the art of macroeconomics was in **finding simple shortcuts to capture the essence of a model while keeping the model simple enough to solve**.

■ The **development of computing power has made it possible to solve such models numerically**, and an important contribution of RBC theory has been the development of more and more **powerful numerical methods of solution**, allowing for the development of richer and richer models.

■ The second premise is **conceptual**. Until the 1970s, **most fluctuations had been seen as the result of imperfections**, of deviations **of actual output from a slowly moving natural level** of output. Following up on Lucas' suggestion, **Prescott** argued in a series of influential contributions that **fluctuations could indeed be interpreted as coming from the effects of technological shocks in competitive markets with fully flexible prices and wages**.

■ In other words, he argued that **movements in actual output could be seen as movements in – rather than as deviations from – the natural level of output**. As new discoveries are made, he argued, productivity increases, leading to an increase in output. The **increase in productivity leads to an increase in the wage, which makes it more attractive to work, leading workers to work more**. Productivity increases therefore lead to increases in both output and employment, just as we observe in the real world.

■ Not surprisingly, this radical **view of fluctuations has been criticized on many fronts**. **Technological progress is the result of many innovations**, each taking a **long time to diffuse** throughout the economy. It is hard to see **how this process could generate** anything like the **large short-run fluctuations in output** that we observe in practice.

■ It is also hard to think of **recessions as times of technological regress**, times in which productivity and output both go down. Finally, as we have seen, there is strong evidence that **changes in money, which have no effect on output in RBC models, in fact have strong effects on output** in the real world.

■ Still, the **conceptual RBC approach has proved useful and influential**. It has reinforced an important point: that **not all fluctuations in output are deviations of output from its natural level**.

New Keynesian economics

■ The term **new Keynesians** denotes a loosely connected group of researchers who share a common **belief that the synthesis that emerged in response to the rational-expectations critique was basically correct**. But they also share the **belief that much remains to be**

learned about the nature of imperfections in different markets and about the implications of those imperfections for macroeconomic fluctuations.

■ **One line of research** has focused on the **determination of wages** in the labor market. We will discuss the notion of **efficiency wages** – the idea that wages, if perceived by workers as being too low, may lead to **shirking** by workers on the job, to problems of morale within the firm, to **difficulties in recruiting or keeping good workers**, and so on.

■ One influential researcher in this area has been George **Akerlof** from Berkeley, who has explored the role of **"norms," the rules that develop in any organization** – in this case, the firm – to assess **what is fair or unfair**. This research has led him and others to explore issues previously left to research in **sociology and psychology** and to examine their macroeconomic implications.

■ Another line of new Keynesian research has explored the role of **imperfections in credit markets**. **Except** for a discussion of the role of banks in the **Great Depression** and in the **Japanese slump**, it is typically assumed that the **effects of monetary policy worked through interest rates**, and that firms could borrow as much as they wanted at the market interest rate.

■ In practice, many firms can borrow only from banks. And **banks often turn down potential borrowers**, despite the willingness of these borrowers to pay the interest rate charged by the bank. Why this happens, and **how it affects our view of how monetary policy works**, has been the subject of much research, in particular by Ben **Bernanke** (then from Princeton, and now the chairman of the Fed).

■ Yet another direction of research is **nominal rigidities**. As we saw earlier, **Fischer and Taylor** have shown that **with staggering of wage or price decisions, output can deviate from its natural level for a long time**. This conclusion raises a **number of questions**. If staggering of decisions is responsible, at least in part, for fluctuations, **why don't wage setters/price setters synchronize decisions? Why aren't prices and wages adjusted more often?** Why aren't all prices and all wages changed, say, on the first day of each week? In tackling these issues, **Akerlof** and N. Gregory **Mankiw** (from Harvard University) have derived a surprising and important result, often referred to as the **menu cost explanation of output fluctuations**.

■ Each **wage setter or price setter is largely indifferent as to when and how often he changes his own wage or price** (for a retailer, changing the prices on the shelf every day

versus every week **does not make much of a difference to the store's overall profits**). Therefore, **even small costs of changing prices** – such as the costs involved in printing a new menu, for example – **can lead to infrequent and staggered price adjustment**.

■ This staggering leads to **slow adjustment of the price level and to large aggregate output fluctuations in response to movements in aggregate demand**. In short, **decisions that do not matter much at the individual level** (how often to change prices or wages) **lead to large aggregate effects** (slow adjustment of the price level and shifts in aggregate demand that have a large effect on output).

New growth theory

■ After being **one of the most active topics of research in the 1960s**, growth theory went into an intellectual slump. **Since the late 1980s, however, growth theory has made a strong comeback**. The set of new contributions goes under the name **new growth theory**.

■ Two economists, Robert **Lucas** (the same Lucas who spearheaded the rational-expectations critique) and Paul **Romer**, then from Berkeley, now at Stanford, have played an important role in defining the issues. When growth theory faded in the late 1960s, **two major**

issues were left largely unresolved. One issue was the **role of increasing returns to scale** – whether, say, doubling capital and labor can actually cause output to more than double. The other was the **determinants of technological progress**. These are the two major issues on which new growth theory has concentrated.

■ An important contribution here is the work of Philippe **Aghion** (from Harvard University) and Peter **Howitt** (from Brown University) who have developed a theme first explored by Joseph **Schumpeter** in the 1930s – the notion that **growth is a process of creative destruction**, in which new products are constantly introduced, making old ones obsolete. **Institutions that slow this process of reallocation** – for example, by making it harder to create new firms or by making it more expensive for firms to lay off workers – may **slow down the rate of technological progress** and thus decrease growth.

■ Research has also tried to identify the precise **role of specific institutions in determining growth**. Andrei **Shleifer** (from Harvard University) has explored the **role of different legal systems** in affecting the organization of the economy, from financial markets to labor markets, and, through these channels, the effects of legal systems on growth.

■ Daron **Acemoglu** (from MIT) has explored **how to go from correlations between institutions and growth** – democratic countries are on average richer – **to causality** from institutions to growth – **does the correlation tell us that democracy leads to higher output** per person, or does it tell us that higher output per person leads to democracy, or that some other factor leads to both more democracy and higher output per person? Examining the **history of former colonies**, he argues that their growth performance has been very much shaped by the type of institutions put in place by their colonizers, thus showing a strong causal role of institutions on economic performance.

Toward an integration

■ In the 1980s and 1990s, discussions between these three groups, and in particular between new classicals and new Keynesians, were often heated:

- **New Keynesians would accuse new classicals of relying on an implausible explanation of fluctuations and ignoring obvious imperfections**;
- **New classicals** would in turn **point to the *ad hoc* nature of some of the new Keynesian models**.

■ From the outside – and indeed sometimes from the inside – macroeconomics looked like a battlefield rather than a research field. Things have changed, and a new synthesis was emerging before the crisis of 2008-2009. Methodologically, it was **building on the RBC approach and its careful description of the optimization problems of people and firms**.

■ Conceptually, it **recognized the potential importance**, emphasized by the RBC approach and the new growth theory, **of changes in the pace of technological progress**. But it also **allowed for many of the imperfections** emphasized by the new Keynesians, from the role of **bargaining in the determination of wages**, to the role of **imperfect information in credit and financial markets**, to the role of **nominal rigidities in creating a role for aggregate demand to affect output**.

■ There was **no convergence on a single model** or on a single **list of important imperfections**, but there was broad agreement on the framework and on the way to proceed. A particularly good example of this convergence is shown by the work of Michael **Woodfor**d (from Columbia) and of Jordi **Gali** (from Pompeu Fabra in Catalonia).

■ Woodford, Gali, and a number of co-authors have developed a high-tech model, known as the **new-Keynesian model**, that **embodies utility and profit maximization, rational**

expectations, and nominal rigidities. This model has proven useful and influential in the redesign of monetary policy – from the **focus on inflation targeting** to the **reliance on interest rate rules**.

■ It has also led to the development of a **class of larger models that build on its simple structure**, but allow for a **longer menu of imperfections and thus must be solved numerically**.

■ These models, which are now used in most central banks, are known as **dynamic stochastic general equilibrium (DSGE) models**. How to specify, to estimate, and to simulate these models is one of the major topics of research in macroeconomics today.

Commom beliefs

■ Let's restate the basic set of propositions on which most macroeconomists agree:
  - In the short run**, shifts in aggregate demand affect output**. Higher consumer confidence, a larger budget deficit, and faster growth of money are all likely to increase output and to decrease unemployment.

- In the medium run, **output returns to the natural level of output**. This natural level **depends on the natural rate of unemployment** (which, together with the size of the labor force, determines the level of employment), the **capital stock**, and the **state of technology**.
- In the long run, **two main factors** determine the evolution of the level of output: **capital accumulation** and the **rate of technological progress**.
- **Monetary policy affects output in the short run, but not in the medium run or the long run**. A higher rate of money growth eventually translates one-for-one into a higher rate of inflation.
- **Fiscal policy has short-run, medium-run, and long-run effects on output**. Higher budget deficits are likely to increase output in the short run. They leave output unaffected in the medium run. And they are likely to decrease capital accumulation and output in the long run.

- These propositions leave **room for disagreements**:
  - One is about the **length of the "short run,"** the period of time over which aggregate demand affects output. At one extreme, **real business cycle theorists start from the assumption that output is always at the natural level of output**: the "short run" is very short. At the other extreme, the **study of slumps and depressions implies that**

the effects of demand may be extremely long-lasting, that the "short run" may be very long.

- Another is about the **role of policy**. Although conceptually distinct, this disagreement is largely related to the previous one. **Those who believe that output returns quickly to the natural level of output are typically willing to impose tight rules on both monetary and fiscal policy**, from constant money growth to the requirement of a balanced budget. Those **who believe the adjustment is slow** typically believe in the **need for more flexible stabilization policies**.

Is macroeconomics off track?

- Modern macroeconomics embodies **two central tenets**:
  - The frst one is that a **macroeconomic model should be "micro founded"**; i.e. based on **dynamic utility maximisation of individual agents**, and the macroeconomic outcome must be described in terms of a **general equilibrium with mutually consistent decisions of different economic agents** (consumers, firms, the government etc.).
  - The second tenet is that **expectations of the agents should be model consistent**, which implies that **agents make forecasts based on the information embedded in the model**. This idea in turn implies that **agents have a full understanding of the**

structure of the underlying model as part of the "rational expectations equilibrium". The most successful implementation of these ideas is to be found in the Dynamic Stochastic General Equilibrium models (DSGE-models) that are increasingly used in central banks for policy analysis (see Smets and Wouters 2003[2]; Christiano *et al*. 2005[3]).

■ There can be no doubt that **this approach to macroeconomics has important advantages** compared to he previous macroeconomic models. The main advantage is that it **provides a coherent and self-contained framework of analysis**. This creates a **great intellectual appeal**. There is **no need to invoke *ad hoc* assumptions** about how agents behave and how they make forecasts. Rational expectations and utility maximisation provide the **discipline** for what is acceptable in modelling the behaviour of economic agents.

Problems with the models

[2] Frank Smets and Raf Wouters (2003), "An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area," *Journal of the European Economic Association*, MIT Press, vol. 1(5), pages 1123-1175.
[3] Lawrence J. Christiano, Martin Eichenbaum, and Charles L. Evans (2005), "Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy," *Journal of Political Economy*, University of Chicago Press, vol. 113(1), pages 1-45, February.

■ This **paradigm** is, however, increasingly **subjected to criticism** which has become more intense **since the start of the financial crisis**. This criticism has been formulated at different levels.

■ **Theoretical problems.** First, the **plausibility of the underlying assumptions** has been questioned. There is a very large literature (preceding the current fnancial crisis) documenting **deviations from the paradigm of the utility maximising agent who understands the nature of the underlying economic model**. For recent surveys, see Kahneman and Thaler (2006)[4] and DellaVigna (2009)[5].

■ This literature has followed **two tracks**. One is to **question the idea of utility maximisation** as a description of agents' behaviour. The other puts in **doubt the rational expectations assumption**.

[4] Daniel Kahneman and Richard H. Thaler (2006), "Anomalies: Utility Maximization and Experienced Utility," *Journal of Economic Perspectives*, American Economic Association, vol. 20(1), pages 221-234, Winter.
[5] DellaVigna, S. (2009), "Psychology and Economics: Evidence from The Field," *Journal of Economic Literature*, June 2009, Vol. 47, pp. 315-372.

■ Many anomalies that challenge the rational expectations assumption were discovered; see Thaler (1994)[6] for discussions of these anomalies; see also DellaVigna (2009). Let's just mention "anchoring" effects here, whereby **agents who do not fully understand the world in which they live are highly selective in the way they use information** and **concentrate on the information they understand** or the **information that is fresh** in their minds. This anchoring effect explains **why agents often extrapolate recent movements in prices**.

■ Thus the accumulated scientifc evidence casts doubts on the plausibility of the main behavioural assumptions in modern macroeconomic models. One could object here and argue that a **model should not be judged by the plausibility of its assumptions but rather by its ability to make powerful empirical predictions**.

However, **empirical tests of the DSGE-models have generally not been favourable** (see Chari *et al*. 2009[7]; Juselius and Franchi 2007[8]).

[6] Thaler, Richard H (1994), "Psychology and Savings Policies," *American Economic Review*, American Economic Association, vol. 84(2), pages 186-92, May.

[7] V.V. Chari, Patrick J. Kehoe, and Ellen R. McGrattan (2009), "New Keynesian Models: Not Yet Useful for Policy Analysis," *American Economic Journal: Macroeconomics*, American Economic Association, vol. 1(1), pages 242-66, January.

■ **Empirical problems.** The main **empirical problem of the "pure" micro-founded macro model with forward-looking agents** appears to be that it **underestimates the degree of inertia in wages and prices**. For example, it predicts that **when new information reaches the market, rational agents will immediately change their optimal plans**, leading to instantaneous price changes.

■ This prediction flies in the face of empirical evidence showing quite universally that **prices have a strong inertial component and react sluggishly to shocks**. The observed **inertia in prices, wages and output has led macroeconomists to add lags** into the models. In addition, the models were loaded with **exogenous shocks exhibiting strong autoregressive structures**. All this has made it possible to improve the fit of the models.

■ The result has been that the **models produce price and output dynamics that correspond to empirically observed ones** but that it is **not clear whether this comes from the lags and the autoregressive nature of the shocks**, **rather than from the rational-agent structure** of the models (see Chari *et al*. 2009).

---

[8] Franchi, Massimo and Juselius, Katarina (2007), "Taking a DSGE Model to the Data Meaningfully," Economics Discussion Papers 2007-6, Kiel Institute for the World Economy.

■ Despite their poor empirical record, **DSGE-models have been infuential** in shaping macroeconomists' views about how the economy functions. This is very prominent in the way modern macroeconomists interpret the business cycle. **Business cycle movements in the DSGE-models arise as a result of exogenous shocks** (in **productivity** and **preferences**) and **lags in the transmission** of these shocks to output and infation. This combination of exogenous disturbances and inertia in the transmission generates **wave-like movements in infation and output**.

■ There can be no doubt that exogenous shocks matter in generating business cycles. At the same time it is equally obvious that **DSGE-models miss an important feature of business cycle movements**. The latter are also infuenced by **waves of optimism and pessimism (**"**animal spirits**"**)** that are grounded in **agents' imperfect understanding of the world** and that, by their **self-fulflling nature**, can create **booms and busts endogenously**. The macroeconomic **developments of the last decade testify to the power of these waves of optimism and pessimism** in shaping **first the boom** and **later the bust** phase in economic activity.

■ **Modelling individual behaviour.** Modern macroeconomics has also led to a **methodological step that is becoming increasingly questionable**. The **paradigm of the**

utility-maximising individual agent who understands the full complexity of the world has an important implication.

■ Since **all individuals understand the same "Truth"**, modern macroeconomics has taken the view that it **suffices to model one "representative individual" to fully represent reality**. Thus in such a model **there cannot be any coordination failures in which decisions of individual agents can lead to undesirable aggregate outcomes**.

■ The **representative agent fully internalises the external effects of all his actions**. But macroeconomic **fuctuations can also arise as a result of a failure of consumers and frms to coordinate their actions** to achieve a good outcome. For example, the famous **"paradox of thrift"** as formulated by **Keynes** arises from the fact that **when savers all attempt to save at the same time they will fail to increase their savings**. The economic downturn that started in 2007 again shows how these coordination failures can shape a recession. Akerlof and Shiller (2009)[9] have again made a case for the role of "animal spirits" in shaping macroeconomic outcomes.

[9] Akerlof, G.A. and Shiller, R.J. (2009), *Animal Spirits: How Human Psychology Drives the Economy, and Why it Matters for Global Capitalism*, Princeton University Press.

■ **Possible new directions.** From the preceding analysis we learn that modern **macroeconomics has hit against its own limitations** and that there is a need for going beyond the rationality paradigm. One fruitful **new direction of research** was given an impetus by Sargent (1993)[10], and Evans and Honkapohja (2001)[11] who in macroeconomic models introduced the **notion that agents should not be assumed to be cleverer than econometricians** and that therefore they **should be modelled as agents who learn about the underlying model as time passes**.

■ This has led to **models of learning in macroeconomics**, which assume that agents use their estimated model in decision making. Slowly this idea is being incorporated into macroeconomic models. Much remains to be done, however, to analyse the implications of learning on macroeconomic dynamics.

■ **Another** potentially fruitful **direction of research** uses concepts from **behavioural economics**. This approach starts from the proposition that **individuals understand only**

[10] Thomas J. Sargent, (1993), *Bounded rationality in macroeconomics*, Oxford University Press, New York.
[11] Evans, G. W., and Honkapohja, S (2001), *Learning and Expectations in Macroeconomics*, Princeton University Press.

small parts of the total information set, and they are **not capable of describing the statistical distribution of economic shocks**.

■ The **cognitive limitations of individuals** in understanding and processing information leads them to use **simple rules** ("**heuristics**") to guide their behaviour (see Gigerenzer and Todd 1999[12]). They do this **not because they are irrational** but rather **because the complexity of the world is overwhelming**. In a way it can be said that using **heuristics is a rational response** of agents who are aware of their limited capacity to understand the world. In this sense they are **"boundedly rational"**.

■ The problem **with models based on bounded rationality** is that **"everything becomes possible"**. The challenge therefore is to introduce **discipline in the selection of behavioural rules**. This can be achieved by subjecting the selection of rules to a "fitness" criterion, **allowing agents to switch from one rule to the other**. At the moment there is no "consensus model" to bounded rationality though. Much remains to be done to achieve a formulation of bounded rationality that is broadly empirically workable and can be used in a wide variety of macroeconomic contexts.

[12] Gigerenzer, G. and Todd, P.M., eds. (1999), *Simple Heuristics that Make Us Smart*, New York: Oxford University Press.

The global crisis

■ There have been **numerous financial crises** since the 1970s, when the post-Second World War **fixed exchange rate environment broke down** and a gradual process of **deregulation and liberalisation of financial markets** started. Often these crises took place in **developing countries**, but there were also **financial crises in advanced market economies** (for example, see Reinhart and Rogoff, 2009[13]).

■ The **current financial crisis**, which started in August 2007, differs from the earlier ones in that it is **global in nature** affecting all economies in the globe. The global nature of the current crisis means that **policy is being made in an environment where much is unknown** and, in particular, **empirical precedents do not exist**.

[13] Carmen M. Reinhart and Kenneth S. Rogoff (2009), "The Aftermath of Financial Crises," *American Economic Review*, American Economic Association, vol. 99(2), pages 466-72, May.

■ Another new feature of the current crisis is that it **manifested itself in misguided fnancial innovation** (see Rajan (2005)[14] for an early warning). The current crisis is providing several **lessons** that are going to **require a re-orientation of macroeconomics**, both in terms of areas of **emphasis** and also in terms of emerging huge **gaps in knowledge** requiring new research to fill these gaps.

■ **Finance and banking.** Given that the current **crisis originated in the financial system**, several areas in finance require a major research effort. One case is the **failure of the efficient market doctrine**. Most of the currently employed **macroeconomic models assume market efficiency**. This is not satisfactory.

■ Problems with **imperfect and asymmetric information** and the behaviour of economic agents in response to these information problems will require greatly increased attention. In this field the **paradigm of full rationality appears to be facing its limits**. In practice individual **agents cannot prepare in advance against all conceivable contingencies** and, in situations of asymmetric information, **different agents do not necessarily agree on the**

[14] Raghuram G. Rajan (2005), "Has Financial Development Made the World Riskier?," NBER Working Papers 11728, National Bureau of Economic Research.

possible contingencies against which they would need to respond under full rationality (for example, see Tirole 2009[15]).

■ The **functioning of the international financial system** and the **behaviour of banks** are two other major areas in which **new research is badly needed**. The new **plans to reform the regulation of the financial system** require that thinking moves **away from the hypothesis of effcient financial markets** and the associated very **liberal attitudes**. Providing input to changing financial regulation and reform of international institutions is a big **challenge to the research community** in macroeconomics and finance.

The history of macroeconomic thought via the AS-AD model

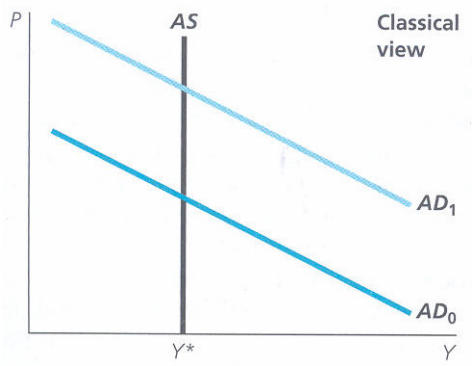
■ As we have seen many bright minds have contributed to what macroeconomics is today. This section does not even try to do justice to the richness of ideas found in their writings. Instead, it settles for the modest **goal of projecting the major schools of macroeconomic thought onto the AD-AS diagram** and highlighting selected key contributions.

[15] Tirole, Jean (2009) "Cognition and Incomplete Contracts," *American Economic Review*, American Economic Association, vol. 99(1), pages 265-94, March.

Classical economics

■ Long before the term macroeconomics had even been invented, **classical economists** (like Adam Smith, David Ricardo, David Hume and John Stuart Mill) believed that the **flexibility of wages and prices ensured that markets very much cleared all the time**. In the view of classical macroeconomics **income remained so close to potential output that no policy intervention was warranted**.

■ Translated into the AD-AS diagram, the **AS curve is vertical**, and it **moves slowly and smoothly as the labour force grows, the capital stock increases and technology improves**.



The classical view: Demand fluctuations do not affect income. Potential income evolves slowly. Classical dichotomy holds at all times.

■ **Shifts in the AD curve cannot affect income**. **When nominal variables, such as the money supply, change, this affects only the price level but none of the real variables**. This phenomenon is called the **classical dichotomy**.

■ We actually have **two separate, independent parts of the economy**: one where **real variables like the capital stock or productivity determine other real variables like income, employment or the real wage**, and the other where **nominal variables like the**

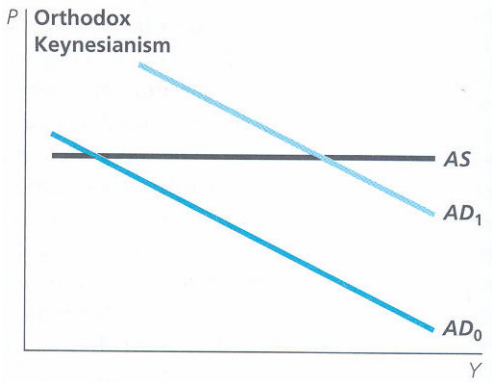
money supply or foreign prices determine other nominal variables like prices or the exchange rate.

Keynesianism

■ After a long reign well into the 20th century, the experience of the **Great Depression** (1929-32) **left the classical view in shambles**. There was **no way to rationalize a drop in industrial production** of 47% within little more than 3 years, as had happened in the USA, or of 42%, as experienced in Germany, **as a movement in potential income**.

■ British economist **John Maynard Keynes came up with a new way to look at the economy**. He argued that **when there were high levels of unemployment, even at unchanged prices firms would produce any volume of output that was demanded**.

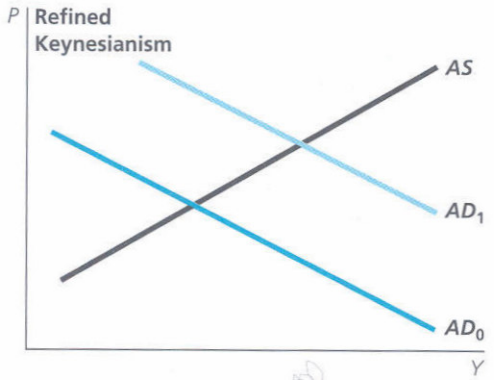
■ Under such circumstances **AS is flat and the classical dichotomy breaks down**. If an **increase in government spending shifts AD to the right, this has real consequences** in the form of a rise in income.



The orthodox Keynesianism: Demand fluctuations affect income only. Classical dichotomy does not hold.

■ While Keynes **did not contest the possibility of a return of income to potential income in the long run**, this was not the focus of his analysis. In fact, he shrugged it off with the famous remark: **"In the long run we are all dead"**. With market **forces considered too slow**, Keynesians believed that **during periods of lack of demand the government had to step in by means of fiscal and monetary policy**.

■ **In the orthodox Keynesian scenario prices remain fairly constant**. Later, faced by the **challenge to explain increasing inflation and encouraged by the Phillips curve** that was discovered in the late 1950s, **refined Keynesian views proposed a positively sloped AS curve**.



The refined Keynesianism: Demand fluctuations affect income and prices. Classical dichotomy does not hold.

■ **One rationalization for the underlying stickiness of money wages focused on money illusion**: when workers were offered, say, a 10% higher money wage, they believed they were better off even if prices rose by the same or an even higher percentage.

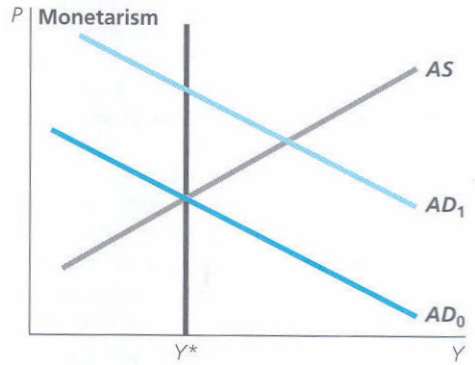
■ Thus as we move up this Keynesian AS curve the nominal wage rises and makes **workers suffering from money illusion supply more labour**. But **prices rise faster than nominal wages**. So the **real wage falls, and firms demand more labour**. This makes employment and income increase. Fluctuations in the AD curve generate movements along the AS curve. So increases in income always go hand in hand with inflation.

Monetarism

■ Again, the failure of the ruling model to offer a satisfactory explanation of a new empirical phenomenon set the stage for the success of a new kid on the block. The phenomenon was **stagflation**, and it occurred in the early 1970s.

■ **Stagflation** is the occurrence of rising **inflation and falling income at the same time**. This **cannot happen when the economy is bound to move up and down a given,**

positively sloped AS curve, as the Keynesian approach postulated. **It can happen, though, if the economy moves up a given AD curve**.



Monetarism: Demand fluctuations have a lasting affect on prices, but no lasting effect on income. Classical dichotomy holds only in the long run.

■ For this to occur, however, the **AS curve needs to move**. The first one to argue on these lines and to investigate why this may happen was Nobel Laureate **Milton Friedman**, the father of **monetarism**.

■ **Monetarists had been challenging the Keynesian view for a while**. One area of disagreement was **whether monetary or fiscal policy was more effective in influencing aggregate demand**. **Monetarists believed it was monetary policy**, with the rationalization that the **LM curve was very steep and shifts in IS would generate only small responses in income**. Keynesians favoured fiscal policy, believing that the IS curve was steep, so that shifts in LM would hardly have any real bearing on income.

■ A second line of **criticism attacked money illusion**. Monetarists insisted that **money illusion was not compatible with rational behaviour**. They maintained that **workers looked at the buying power of their wage**. So when prices rose, this would raise nominal wage demands by the same percentage. Thus, **as actual prices rose, or expected prices in the presence of long-term wage contracts, AS would shift upwards**. Since **monetarists believed that price or inflation expectations were formed adaptively, this process would take time**.

■ The figure above shows how the economy digests a **money-supply increase which shifts AD to the right**. After the **initial jump in income and the price level**, the **economy moves gradually up the new AD curve, until it settles into a new long-run equilibrium on the**

vertical long-run AS curve. During this adjustment we observe **stagflation**: falling income and rising prices.

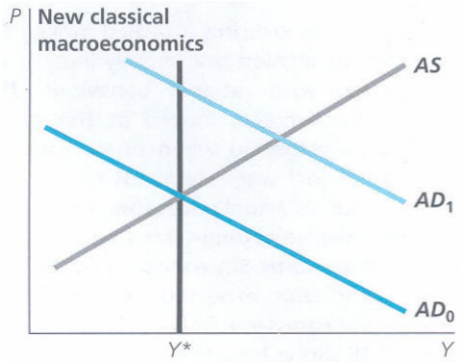
■ While it had been a formidable challenger for more than a decade and its effects were lasting, the **monetarist reign in macroeconomics was short-lived**. At the time of victory it had already lost its bite.

■ First, because its **best parts had already found their way into a modern Keynesian approach** represented by Nobel Laureates **Paul Samuelson** and **Robert Solow**, which had **dropped money illusion**, **accepted the distinction between short- and long-run aggregate supply**, with **potential income as an anchor**, and adopted **adaptive inflation expectations** to link the short with the long run, to form what some called a **neoclassical synthesis**.

■ Second, because it came under **attack itself from new classical macroeconomics for its use of adaptive expectations formation**, which was considered irrational by a growing group of new classical macroeconomists led by US Nobel Laureate **Robert Lucas** and his compatriot **Thomas Sargent**.

New classical macroeconomics

■ New classical macroeconomics has **a lot in common with monetarism**. When displayed in an AD-AS diagram it looks **deceivingly similar to the monetarist diagram** with its distinction between a positively sloped short-run AS curve and a vertical long-run AS curve.



New classical macroeconomics: Demand and fluctuations have a surprise effect on income, but a lasting effect on prices. Classical dichotomy is violated only by surprises.

■ But it goes **one step further**. It criticizes **the assumption of adaptive expectations** as too mechanical and, in fact, irrational. **Adaptive expectations can give rise to systematic forecast errors**, which rational individuals seek to avoid, and its **backward-looking nature cannot deal properly with future events, even when these are announced**. A major **innovation of new classical macroeconomics is to replace adaptive expectations formation with the concept of rational expectations**, originally developed by **John Muth**.

■ Rational expectations propose that the **labour market knows the model, which enables firms and trade unions to correctly work out the inflationary effects of any changes in aggregate demand**.

■ **Whether, faced by a shift of the AD curve, the economy moves up the positively sloped AS curve or the vertical one depends on whether the shift was anticipated or not**. Only **when the shift comes as a surprise does the positively sloped AS curve come into play and income rises along with prices**, as in the monetarist model. When the shift is anticipated, the movement is up the vertical AS curve, and there is no income response.

■ In this scenario **monetary or fiscal policy works only if it surprises the labour market and thus cannot be used systematically**. In any case, **deviations of income from potential income occur randomly and are very short-lived**.

■ **This does not describe real-world business cycles correctly**. **Economists with a classical orientation therefore soon set out to mend this**. They did so by means of a complete **change of perspective**: economic **fluctuations no longer were considered deviations of income from potential income, but movements of potential income itself**.

Real business cycles

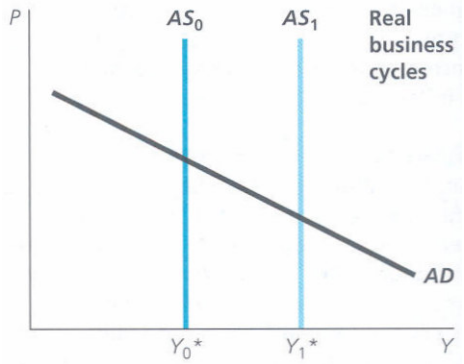
■ This new perspective is known as **real business cycle theory**. Spearheaded by **Edward Prescott** and **Finn Kydland** from the US and Norway, respectively, it **discards the segmentation of macroeconomics into explanations of short-run fluctuations, caused by fluctuations in employment, and of long-run growth, caused by evolving capital stocks and technological progress, as artificial**.

■ Instead it proposes a coherent **view in which technological change and capital stock dynamics affect short- to medium-run fluctuations in a significant way**. The **propagation**

mechanism, the process by which shocks to technology or preferences trigger responses in income and other real variables, **rests on intertemporal substitution of labour and consumption**.

■ Real business cycle **theory also discards the methodological differences that used to separate microeconomics from macroeconomics by analyzing the behaviour of optimizing agents which are considered representative for the entire economy**.

■ This behaviour makes the **AS curve move about in ways that resemble the macroeconomic fluctuations known as business cycles**. With **prices and wages considered fully flexible, AS is vertical**, and the **classical dichotomy strikes again**. **Nominal variables and, hence, the position of AD do not bear on income**.



Real business cycles: Demand fluctuations do not affect income. Potential income grows in cycles. Classical dichotomy holds at all times.

■ While the **methodological innovations of real business cycle theory are widely acknowledged**, one of its key implications, **that nominal variables do not affect real income, seems to be at odds with empirical observations**.

■ **Current research seeks to tackle this, within the real business cycle framework**, but also under the heading of New Keynesian macroeconomics.

New Keynesian macroeconomics

■ In the advent of what might turn out to be **another synthesis**, **New Keynesian macroeconomics adopts the methodology and rationality postulates of real business cycle theorists, but rejects the paradigm of perfect markets and flexible wages and prices**.

■ Their agenda is to explore **market imperfections that lead to involuntary unemployment** (examples are **efficiency wage theory** or **insider-outsider models**) and to **rationalize the stickiness of wages and prices** observed in reality.

Literature

■ For a much deeper discussion see:

- B. Snowdon, H. Vane and P. Wynarczyk (1994), *A Modern Guide to Macroeconomics: An Introduction to Competing Schools of Thought*, Aldershot: Edward Elgar;

- B. Snowdon and Howard R. Vane (2005), *Modern Macroeconomics: Its Origins, Development And Current State*, Aldershot: Edward Elgar.

Economics Nobel prize winners and earlier giants

■ The brightest minds in the field of economics have paved the way for and contributed to the consolidated body of knowledge presented in economics textbooks. Many of those have been awarded **The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel**.

■ Of the 64 laureates who have been honoured since the prize was established in 1969, we **highlight those with the most direct bearing on the concepts and models taught and the general approach taken in this course**.

Nobel prize laureates with direct bearing on macroeconomics

George Akerlof, A. Michael Spence and Joseph E. Stiglitz: Efficiency wages
Nobel prize in 2001 together with, "for their analyses of markets with asymmetric information".

James Buchanan: Political economy
Nobel prize in 1986, “for his development of the contractual and constitutional bases for the theory of economic and political decision-making”.

Milton Friedman: Expectations and monetary theory
Nobel prize in 1976, “for his achievement in the fields of consumption analysis, monetary history and theory and for his demonstration of the complexity of stabilization policy”.

John Hicks: IS-LM model
Nobel prize in 1972 together with Kenneth J. Arrow, “for their pioneering contributions to general economic equilibrium theory and welfare theory”.

Paul Krugman: Liquidity traps, crashes, crises
Nobel prize in 2008, “for his analysis of trade patterns and location of economic activity”.

Finn Kydland and Edward S. Prescott: Time inconsistency, real business cycles
Nobel prize in 2004, “for their contributions to dynamic macroeconomics: the time consistency of economic policy and the driving forces behind business cycles”.

Robert E. Lucas: Rational expectations
Nobel prize in 1995, "for having developed and applied the hypothesis of rational expectations, and thereby having transformed macroeconomic analysis and deepened our understanding of economic policy".

Franco Modigliani: Consumption behaviour
Nobel prize in 1985, "for his pioneering analyses of saving and of financial markets".

Robert Mundell: IS-LM-FE or Mundell-Fleming model
Nobel prize in 1999, "for his analysis of monetary and fiscal policy under different exchange rate regimes and his analysis of optimum currency areas".

John Nash, John C. Harsanyi and Reinhard Selten: Game theory
Nobel prize in 1994, "for their pioneering analysis of equilibria in the theory of non-cooperative games".

Edmund S. Phelps: Golden rule of capital accumulation; natural rate of unemployment
Nobel prize in 2006, "for his analysis of intertemporal tradeoffs in macroeconomic policy".

Paul A. Samuelson: Consumer theory; comparative statics; neoclassical synthesis
Nobel prize in 1970, "for the scientific work through which he has developed static and dynamic economic theory and actively contributed to raising the level of analysis in economic science".

Robert M. Solow: Neoclassical or Solow growth model, Solow residual
Nobel prize in 1987, "for his contributions to the theory of economic growth".

James Tobin: Money demand (Baumol-Tobin model)
Nobel prize in 1981, "for his analysis of financial markets and their relations to expenditure decisions, employment, production and prices".

Earlier giants

- Modern **macroeconomics has its roots in the works of so-called classical economists**. While **their work lacked the mathematical tools, the statistical methods as well as the data** available to current generations, many ideas that characterize contemporary thinking can be found in their work.

■ Reflecting the **superior stage of industrial development and material wealth** of their time, **most classical economists were of British origin**. Adam **Smith** (1723-91) and other classical economists, including Thomas **Malthus** (1766-1834), David **Ricardo** (1772-1823) and John Stuart **Mill** (1806-73), **focused on the economy's supply side**.

■ Formidable classical or preclassical economists from other countries include François **Quesnay** (1694-1774) of France, who **introduced the circular flow of income** and, thus, **the first macroeconomic model on record**, and Heinrich von Thünen (1783-1850) of Germany.

■ Subsequent generations produced a steady flow of new ideas, spurned by the events and experiences of their times, bringing us to what we know and how we perceive the economy today. Those who contributed massively include the following:

■ Leon **Walras** (France, 1834-1910) was **the first mathematical economist**. He revolutionized economics with his **rigorous formal analysis of the price system**.

■ Alfred **Marshall** (England, 1842-1924) introduced **demand and supply curves** as theoretical concepts, as well as the critical **distinction between the short run and the long run**.

■ Irving **Fisher** (United States, 1867-1947) was one of **the first to employ sophisticated statistical techniques**. His **work on money and prices** provided the basis for later theoretical work in economics. It lives on in various versions of the **Fisher equation**.

■ John Maynard **Keynes** (England, 1883-1946) introduced **emphasis on the demand side**. By many he was considered **the most influential macroeconomist of all time**, and certainly also one of the most controversial. Keynesianism is a school of thought that attributes a key role to the demand side of the economy, as opposed to classical and new classical economics which focus on the supply side.

Appendix 1.1: The Greek Alphabet

α	A	Alpha
β	B	Beta
γ	Γ	Gamma
δ	Δ	Delta
ε	E	Epsilon
ζ	Z	Zeta
η	H	Eta
θ	Θ	Theta
ι	I	Iota
κ	K	Kappa
λ	Λ	Lambda
μ	M	Mu
ν	N	Nu
ξ	Ξ	Xi
ο	O	Omicron
π	Π	Pi
ρ	P	Rho
σ	Σ	Sigma
τ	T	Tau

υ	Y	Upsilon
φ	Φ	Phi
χ	X	Chi
ψ	Ψ	Psi
ω	Ω	Omega

Appendix 1.2: Refresher on Exponents

■ Let z, a, and b stand for three numbers. Then

$$z^0 = 1$$

$$z^1 = z$$

$$z^{-a} = \frac{1}{z^a}$$

$$z^a z^b = z^{a+b}$$

$$\frac{z^a}{z^b} z^a z^{-b} = z^{a-b}$$

$$(z^a)^b = z^{ab}$$

$$(z^a)^{1/b} = z^{a/b}$$

Appendix 1.3: Logarithms, growth rates and logarithmic scales

■ Taking the logarithm of a number or of a variable is nothing mysterious. Just as taking the square root of 9 amounts to picking 3, since $32 = 3 \cdot 3 = 9$, taking the logarithm of 1 to base 5 is zero, since $5^0 = 1$.

■ Economists find it convenient to use **Euler's number** e = 2.71828... as the base. Logarithms to the base of e are called **natural logarithms** and are referred to by the shorthand symbol ln. Then, in general terms: the natural logarithm of some number or variable a is the power to which e must be raised to yield a, that is $e^{\ln a} = a$.

■ Logarithms possess some properties that assist with model-building and the visual display of models and data in graphs. Since we are not interested in the higher mathematics of logarithms, we skip proofs and illustrate the concepts needed by means of numerical examples.

■ Consider a country's nominal income PY, which is the product of the price level P and real income Y. If $P = 100$ and $Y = 200$, then $PY = 20{,}000$. The natural logarithm of 100, that is $\ln 100 = 4.605$. For real income you get $\ln 200 = 5.298$. The natural logarithm of nominal income $\ln (100 \cdot 200) = \ln 20{,}000 = 9.903$.

■ What is noteworthy about this result is that obviously $\ln (100 \cdot 200) = \ln 100 + \ln 200$, since $9.903 = 4.605 + 5.298$. That is, the logarithm of the product PY is the sum of the logarithms of its two components. This result

$$\ln PY = \ln P + \ln Y \qquad \text{Property 1}$$

holds generally, as you may check by entering other numbers for P and Y. You may use the above or other numbers to convince yourself that

$\ln (P/Y) = \ln P - \ln Y$ Property 2

that is, the logarithm of the fraction P/Y equals the difference between the logarithms of the numerator and the denominator. A third useful property is

$\ln X^n = n \ln X$ Property 3

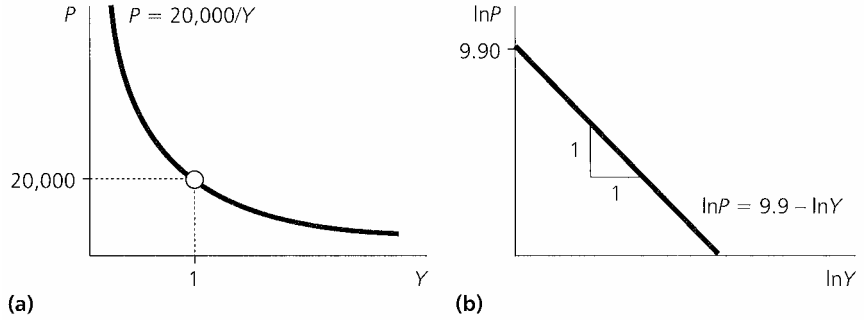
■ You may derive this third property directly from property 1. For n being an integer, X^n may be written as

$$X^n = \underbrace{X \cdot X \ldots X}_{\text{n times}}$$

■ With the above rules for products, taking the logarithm of this gives

$$\ln X^n = \underbrace{\ln X \cdot \ln X \ldots \ln X}_{\text{n times}} = n \ln X$$

■ What is so great about these results? Assume that you want to know what combinations of P and Y multiply into a given nominal income of 20,000. After writing $PY = 20{,}000$ you may solve for P to obtain $P = 20{,}000/Y$. The graph of this relationship is curved (called a hyperbola) as shown in panel (a) in the following Figure. Drawing it is not easy, since the slope is different for each value of Y. Working with it is not easy either: increasing nominal income from 20,000 to, say, 22,000 shifts and turns the line at the same time.



■ Now take the logarithm on both sides of $P = 20{,}000/Y$ and you obtain $\ln P = \ln 20{,}000 - \ln Y$. This new equation is additive and linear (see panel (b)). It intersects the vertical axis at ln

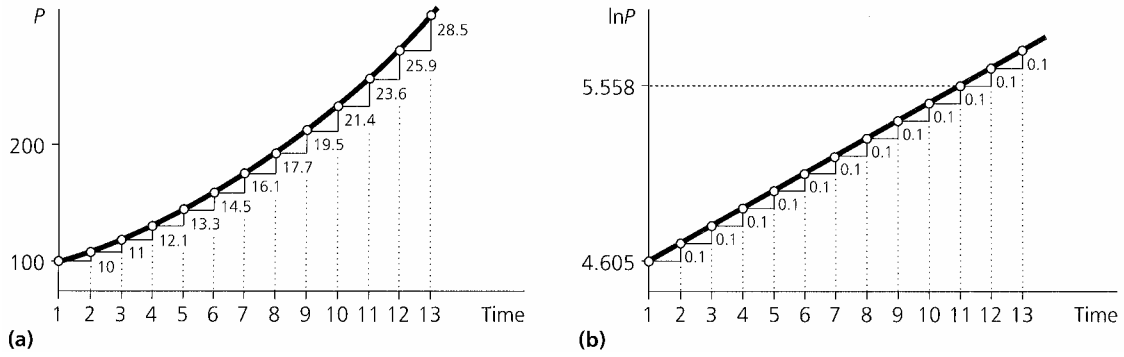
20,000 = 9.90 and has a slope of –1 all over. Working with such a linear graph or model is much more convenient than manipulating a hyperbola.

Growth rates

■ The growth rate of Y over its previous value Y_{-1} is computed as $(Y - Y_{-1})/Y_{-1}$. Logarithms come in handy when we discuss such growth rates. Let inflation be 10%, or 0.1. As the P column in the table illustrates, this means that the price level rises in larger and larger increments: after a change in the price level of 10 units in period 2, the change in period 6 is already 14.64. If P is plotted against the time axis, P turns out to follow a non-linear, accelerating path. This acceleration is not very visible for such short time horizons, but it becomes more and more pronounced as time passes.

Time	**P**	$\Delta P = P - P_{-1}$	$(P - P_{-1})/P_{-1}$	**ln** P	$\Delta \ln P = \ln P - \ln P_{-1}$
1	100			4.605	
2	110	10	0.1	4.700	0.0953
3	121	11	0.1	4.7957	0.0953
4	133.1	12.1	0.1	4.8911	0.0953
5	146.41	13.31	0.1	4.9864	0.0953
6	161.05	14.64	0.1	5.0817	0.0953

■ Now look at the sixth column in table, which gives $\Delta \ln P$. The period-to-period changes in the logarithm of P are obviously constant at 0.0953 – and they closely approximate the growth rate of P which is 0.1. The useful property of logarithms suggested by these numbers is that if a variable grows at a constant rate, and thus the variable moves up at an accelerating pace as time progresses (see the following Figure), the logarithm of this variable moves up at a constant pace. Thus as time progresses, the logarithm of this variable follows a straight line. The slope of this line closely approximates the growth rate of the variable.



■ The approximation becomes better as the growth rates become smaller. With high precision it only holds for very small growth rates. As a rule of thumb, however, for practical purposes growth rates smaller than 0.2 may be approximated by the change in the logarithm of the variable under consideration:

$$\frac{Y - Y_{-1}}{Y_{-1}} \cong \ln Y - \ln Y_{-1} = \Delta \ln Y$$

■ Growth rates along a given path as depicted in the figure above also turn smaller, and the approximation becomes better, if we make time units shorter. When the time unit becomes very small, infinitesimally small, we enter the world of differential calculus. We would have to write $P(t)$ to indicate that P is a function of time, but we omit this for convenience. Now the derivative of the logarithm of a variable with respect to time equals the instantaneous growth rate of this variable:

$$\frac{d \ln P}{dt} = g_P$$ Property 4

with g_p denoting the growth rate of P. Combined with properties 1 and 2 stated above, this new property of logarithms makes it easy to determine the growth rates of composite variables such as nominal income $P \cdot Y$ or the real money supply M/P.

■ Examples: Taking the logarithm of nominal income and differentiating with respect to time yields

$$\ln (PY) = \ln P + \ln Y$$

$$\frac{d \ln(PY)}{dt} = \frac{d \ln P}{dt} + \frac{d \ln Y}{dt} \Rightarrow g_{PY} = g_P + g_Y$$

■ So the growth rate of nominal income PY is the sum of the growth rates of its two components. Similarly, when we look at a fraction, such as the real money supply M/P, we obtain

$\ln (M/P) = \ln M - \ln P$

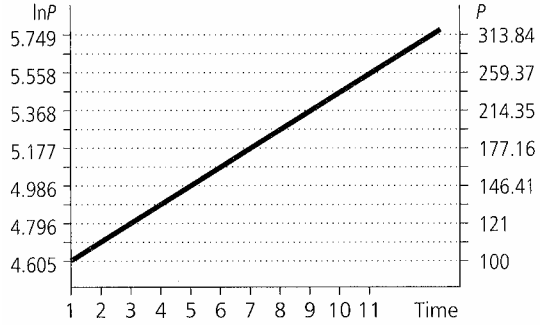
$$\frac{d \ln(M / P)}{dt} = \frac{d \ln M}{dt} + \frac{d \ln P}{dt} \Rightarrow g_{M/P} = g_M - g_P$$

which shows that the growth rate of a fraction M/P equals the difference between the growth rates of the numerator M and the denominator P.

Logarithmic scales

■ The one major drawback that arises when the logarithm of a variable is measured along the axis instead of the variable itself is that the units of measurement do not have a direct interpretation. To overcome this we may retain the logarithm as the unit of measurement that determines the equidistant tick marks on the vertical axis, but after that translate the logarithms back into original values. This is called **logarithmic scaling**.

■ The following figure illustrates the procedure.



■ The vertical axis on the left measures the logarithm of *P*. The distance between two tick marks equals 0.0953 units of ln *P*. The vertical axis on the right translates each value of ln *P* back into the corresponding value for *P*. What happens then, and this is important, is that now one tick mark on the ordinate represents ever larger changes of *P* as we move up. In fact, equal distances on this vertical axis represent equal percentage increases of 10%. So the distance between 100 and 110 is the same as the distances between 200 and 220 or between 1,000 and 1,100.

1. MACROECONOMICS FOR THE LONG RUN AND THE SHORT RUN

■ What is the **subject matter** of macroeconomics? What **methods and simplifying assumptions** do macroeconomists use in their efforts to explain how the economy works? These are the issues addressed in this introductory lecture.

■ We start by discussing **how to define macroeconomics**. We then go on to explain why it is **useful to develop separate macroeconomic theories for the long run and for the short run**. Finally, we end by summing up the different assumptions underlying macroeconomic models for the short run versus macro models for the long run.

What is macroeconomics?

■ The economist and Nobel Prize winner **Gary Becker** once said that **"economics is the study of the allocation of scarce resources to satisfy competing ends"**. The idea behind this definition goes back to the nineteenth century, and the first scholar to give a comprehensive statement of it was Lionel Robbins in his famous *Essay on the Nature and Significance of Economic Science* (London, Macmillan, 1st edition, 1932).

■ This certainly says something essential about what (mainly micro) economics is. However, **some parts of macroeconomics are concerned with situations where resources are not scarce**, because the available supplies of **labour and capital are not fully utilized**. These important real-world situations would not fall within the realm of economics according to the above definition.

■ Given the difficulties of providing a brief and accurate definition of economics, one should not be surprised that **a perfectly clear subdivision into micro- and macroeconomics is also elusive**. It is sometimes said that **macroeconomics is that part of economics which is concerned with the economy as a whole**.

■ This suggests that **microeconomics focuses only on the small elements of the economy** such as the single agent or the market for a particular product. Although much of macroeconomics is concerned with the economy in the large, **this distinction between macro and micro is inaccurate**. **Important parts of macroeconomics** are not (directly) concerned with the whole economy, but rather with understanding particular markets such as the **labour market** or the **credit market**. And a large and important **part of microeconomics**, **general equilibrium theory**, is concerned with the interaction among markets, that is, with the economy as a whole.

■ Therefore the **best characterization of macroeconomics** is one that simply states the main **questions asked in this branch of economics**.

A definition of macroeconomics by subject

■ **What creates growth** in aggregate output and income per capita in the long run? And **what causes the fluctuations** in economic activity that we observe in the short run? These are the **basic questions in macroeconomics**.

■ At the risk of oversimplifying, we may therefore say that **macroeconomics is the study of economic growth and business cycles**. As we shall see later on, to explain the movements in total output **we must also understand the movements in total consumption, investment and the rate of unemployment**, as well as the **interaction of these real variables with nominal variables** such as the general level of **wages, prices, nominal interest rates**, foreign exchange rates, etc.

■ Hence **macroeconomics also includes the study of these variables**.

A definition of macroeconomics by method

■ What we have offered above is a definition of macroeconomics by subject: **macroeconomics is defined by the issues studied by macroeconomists**.

■ A strict **"empiricist" version** of this definition, which also involves the choice of method, is to say that **macroeconomics is concerned with explaining observed time series for economic variables** like GDP, consumption, investment, prices and wages, the rate of unemployment, etc. This reflects the view that **a scientific discipline should be defined in terms of the data it seeks to explain**.

■ To secure the link between theory and the real world, **theories should be evaluated by holding them up against the facts**.

Why do macroeconomists aggregate?

■ **The variables entering into macroeconomic models are typically aggregate variables** covering the economy as a whole. For instance, in macroeconomics we often describe the entire **production side of the economy as if a single commodity were produced** by the use of just **two different inputs, capital and labour**, both one-dimensional variables which can be represented by a number. By contrast, microeconomics studies disaggregated models in

which it is typically not "allowed" to aggregate the production of, say, oranges and apples into the production of fruit.

■ The **aggregation** undertaken in macroeconomic models **raises obvious problems**. Take the concept of the **aggregate capital stock**, for example. Capital is defined as produced means of production, so it includes, for example, **buildings as well as computers**. How should the quantities of these two capital goods be added into one number representing their **combined productivity?**

■ In practice, the **aggregate real capital stock** is measured by **multiplying the quantities of the different capital goods by their respective prices** in some base year, and then **adding up the values** of the stocks of buildings, computers, etc., calculated **at the fixed base-year prices**.

■ This would seem to be a **sensible way of measuring the quantity of aggregate capital** input provided the **relative prices** of the different capital goods remain **reasonably constant over time**. But we know that over the past decades the **relative price of computers has decreased** enormously, and at the same time **computers have become tremendously more productive**. Using relative prices to obtain an aggregate measure of capital representing the productivity of produced inputs is therefore **a dubious procedure**.

■ Nevertheless, the **assumption that capital input as well as total output can be represented by single numbers is standard in macroeconomics**. How can we defend, for instance, letting the production of myriads of different goods and services being represented by one number called "aggregate output"? There are **several lines of defence**:

1. Over time the **outputs of a lot of goods and services** – including capital goods – do in fact **tend to move in the same direction**. Given that the **production volumes of most industries tend to be positively correlated**, it seems **defensible to use concepts like aggregate output** or aggregate investment, even if we do not have a method of measuring these aggregates which is fully correct in all circumstances.
2. The **economy is such a complex mechanism** that we cannot hope to explain and describe it all in detail. To understand at least some of the economic regularities observed, we have to make **strong simplifications by abstracting** from many details. Aggregation of variables is one convenient way of simplifying.
3. Whether a certain highly **simplifying assumption is useful or not is** ultimately an **empirical question**. If a model built on strong simplifications yields predictions which accord with observed movements in some economic variables, then that model seems useful for understanding (some of) the determinants of those

variables. Presumably, it will then also be useful for evaluating the effects of economic policies intended to affect the variables considered.

■ Economist Robert Solow has put it the following way:

> **All theory depends on assumptions which are not quite true**. That is **what makes it theory**. The art of successful theorizing is to make the inevitable **simplifying assumptions in such a way that the final results are not very sensitive** (Robert M. Solow, "A Contribution to the Theory of Economic Growth", *Quarterly Journal of Economics*, 70, 1956).

The long run versus the short run

■ As we have noted, macroeconomics seeks answers to the questions "**what creates growth in GDP per capita in the long run?**" and "**what creates fluctuations in GDP in the short run?**" It also tries to answer some related questions like "what explains the level of **long-run unemployment?**", and "what explains the **short-run variations in unemployment?**".

■ Because **these questions relate to different time horizons**, the lectures will be split into two large parts, where the first is concerned with the long-run questions above, and the second is concerned with the short-run questions.

■ Both parts of macroeconomics are very important, but one can argue that the **issues addressed in long-run macroeconomics are the most important ones**. For a poor country the most important policy issue in long-run macroeconomics is how could it initiate a growth process that would gradually take it up to the level of prosperity of economically advanced nations?

■ A typical **policy issue in short-run macroeconomics** is **what could a government do to avoid an increase in the rate of unemployment**, which would otherwise follow after a negative shock to the economy? The latter question is also important, but for anyone concerned with the long-run welfare of human beings, the first type of question seems more essential.

Long-run and short-run economic phenomena

■ The **distinction between long-run and short-run macroeconomics** is first and fundamentally a **distinction between the phenomena we want to understand**. This leads to

a **distinction between the fundamental characteristics of the models** we use, and of the **policies we analyse**.

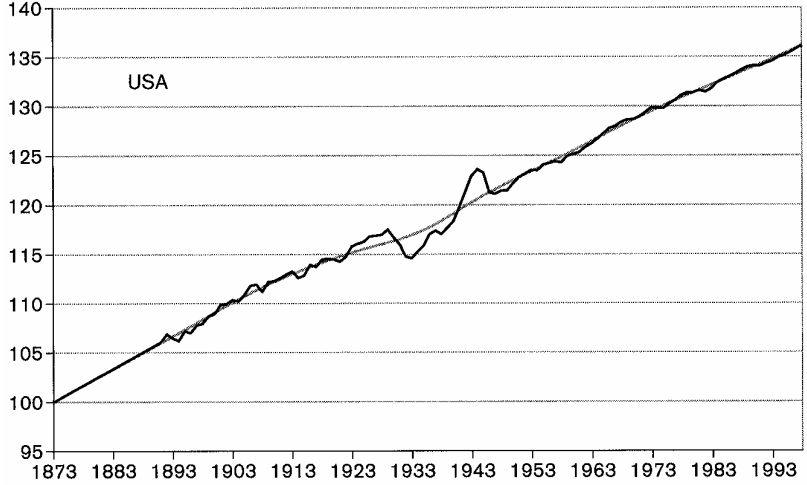


Figure 1.1: Logarithm of real GDP in the USA, 1873-1995 (1873 = 100).

Source: Angus Maddison, *The World Economy: Historical Statistics*, Development Centre Studies, OECD, 2003.

■ In : Logarithm of real GDP in the USA, 1 the **natural logarithm of the annual real GDPs** of the USA is drawn up for the period from 1873 to 1995, with the value in 1873 indexed to 100. : Annual unemployment rate in the USA shows the **average annual rates of unemployment** for the US during the past century.

■ These figures also include **curves which are much more smooth**. These are meant to express the **trends of the relevant series**. Later we will learn about the techniques for constructing such a trend.

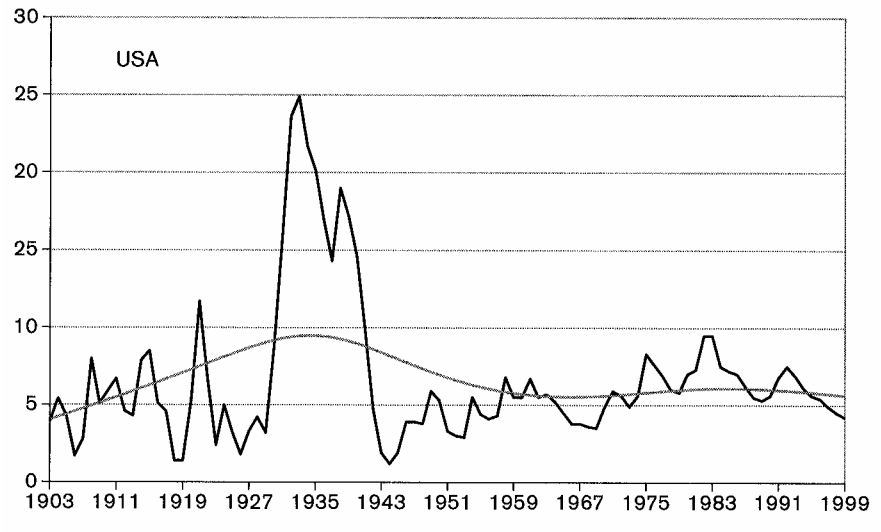


Figure 1.2: Annual unemployment rate in the USA in the twentieth century

Source: R.B. Mitchell, *International Historical Statistics*, Macmillan, 1998; US Bureau of Labour Statistics.

■ The figures suggest that **one way to interpret the movements** of each of the series is to view them as being **made up of two components**: a **trend component** representing the overall evolution and captured by the smooth curves, and a **cyclical component** representing the year-to-year fluctuations and captured by the shifting **vertical deviations between the actual data curve and the trend curve**.

■ **Macroeconomics for the long run** is about **understanding the trends** in series like those just shown, representing the **long-run growth in GDP** and the long-run or so-called **structural unemployment**, respectively.

■ **Macroeconomics for the short run** is about understanding the **annual or quarterly fluctuations** in, for instance, the GDP and the rate of unemployment.

■ Most economists believe that an **understanding of the trend requires a different type of explanation** than an understanding of the fluctuations. The **different macroeconomic models are formal expressions of these different explanations**. The fundamental **assumptions of the models for the long run and for the short run therefore differ**, and hence the models themselves become different.

■ But **why should there be different macroeconomic theories for understanding the trends and for explaining the fluctuations**? We will now consider this question in more detail.

Macroeconomic theory for the short run: a preview

Exogenous shocks

■ One of the **standard macroeconomic explanations for the short-run fluctuations** are that "the economy was hit by a **positive or negative** **exogenous shock**", that is, by a sudden event which is best seen as coming **from outside the local economic system**.

■ Such an event could be either a **supply shock** like a sudden increase in the **productivity of resources**, or a **demand shock** like a sudden **rise in domestic consumption or investment** rooted, for example, in **more optimistic expectations** concerning the future, or in a more **expansionary fiscal or monetary policy**, or in a **sudden increase** in the demand for country's **exports**.

■ To say that the sudden increase in country's production was caused by an exogenous shock, basically an **unexplained event**, is not exactly deep. But note two things. First, **economies**

are hit all the time by events which are best considered as exogenous from the viewpoint of economic theory. For example, **economists should not be concerned with explaining fluctuations in harvests due to shifting weather conditions**, and probably they should not try to explain all sudden changes in the moods of consumers and investors. Focusing on a small economy, a sudden increase in the demand for exports due to events in foreign countries should also be considered exogenous.

■ Second, the **occurrence of the shock is not the end** of the story. A shock may be what initiated the change in economic activity, but **it cannot itself explain all the subsequent economic reactions** of households and firms. There is more explanation to do.

Nominal rigidities

■ For an increase in the aggregate demand for goods and services to lead to an increase in production **it must be profitable for the firms to increase their supply** of output to accommodate the increase in demand. **In the short run the capital stock is more or less given**, so **production can only increase if more labour is used**.

■ As **more workers** come to utilize the **given capital stock**, the **marginal productivity of additional hours worked is likely to decline**. If the marginal productivity of labour is

indeed falling, it seems plausible that **firms will only want to expand employment if the real wage falls**.

■ The **real wage** rate is defined as W/P, where W is the money wage rate and P is the price level. Presumably the **higher demand for goods and services will lead to some increase in *P***. If the nominal wage rate W is rigid in the short run, this **rise in prices will indeed cause a fall in the real wage**, inducing firms to hire more labour to increase their supply of output.

■ Thus **another key ingredient** in our explanation of the fluctuation is the assumption of some **short-run nominal rigidity**, in this case a rigid money wage. The assumption that nominal wage rates are fixed for a certain period of time is **quite realistic**. Firms and workers **do not renegotiate their wage rates every day** or every month, because **negotiation is a time-consuming process** involving the risk of unpleasant and costly **industrial conflict**.

■ But experience also indicates that the **nominal prices of most goods and services are only adjusted with certain time intervals**. In an empirical analysis of newsstand prices of American magazines, Stephen G. Cecchetti ("The Frequency of Price Adjustment: A Study of the Newsstand Prices of Magazines", *Journal of Econometrics*, 31, 1986) found that under an average general inflation of 4 per cent per year **magazine prices were only changed**

every 6 years on the average. This means that on average the real price of a magazine is eroded by about 25 per cent by inflation before the nominal price is changed.

■ The rigidity of nominal magazine prices is not just a special case. In an empirical analysis of price rigidity, Alan Blinder ("On Sticky Prices: Academic Theories Meet the Real World", in N.G. Mankiw, ed., *Monetary Policy*, Chicago, University of Chicago Press, 1994) asked a sample of business managers: "How often do the prices of your most important products change in a typical year?" About **50 per cent of the managers responded that they only changed their prices once or less than once a year**.

■ Explaining why (most) firms do not immediately adjust their prices in response to changes in demand and cost is an intriguing issue to which we will return.

■ We argued above that a **rigid nominal wage in association with a flexible, upward adjusting nominal price could create the fall in real wages** that would make it **profitable for firms to supply more output in response to a positive demand shock**. If a fall in the real wage is the typical reason why firms want to increase their output in reaction to a positive demand shock, **we should expect to observe a negative relationship between output and real wages**.

■ However, **output often increases without a simultaneous decrease in real wages**. It is therefore important to ask **if an increase in the demand for output can induce firms to increase their supply even if all nominal prices are fixed in the short run** (so the real wage does not fall)? The answer is **"yes", provided that prices are above marginal costs** before the demand shock hits the economy.

■ In practice **most markets are characterized by imperfect competition** where firms have some monopoly power enabling them to charge prices which are indeed above marginal costs. In that case they will be able to **increase their total profit by increasing their output** in response to an increase in demand, even if they have to keep their prices temporarily fixed.

■ The basic point is that **short-run nominal price or wage rigidity can explain why an exogenous increase in nominal aggregate demand leads to a short-run increase in real output and employment**. If nominal prices are fixed, **all of the increase in demand will be reflected in a rise in real output**, because imperfectly competitive firms will be happy to increase their supply **as long as their (fixed) prices remain above marginal costs**.

■ And **even if prices increase in response to higher demand, a rigid nominal wage means that the price hike will drive down the real wage** which in turn will stimulate employment

and output. In practice, **both nominal wages and nominal prices are rigid in the short run**, although to different degrees in different markets.

Expectational errors

■ There is a **third ingredient** which is essential for a full understanding of the short-run fluctuations: **expectational errors**.

■ **Suppose that there is some fall in the real wage during a boom**, as **some prices increased** in response to growing demand and **nominal wages lagged behind**. Faced with falling real wages, **why were workers nevertheless willing to increase their supply of labour**, thereby enabling firms to expand employment and output?

■ One possible answer is that **trade unions** in the unionized labour market had **pushed real wages above the marginal disutility of work** so that **some workers were involuntarily unemployed** prior to the demand boom. By definition, a worker who is **involuntarily unemployed is willing to take a job even if the real wage falls below its current level** (provided it does not fall too much).

■ But this hypothesis begs the question **why trade unions** faced with growing labour demand would **allow the real wage to fall**? The most **plausible answer** is that the **fall in real wages was unintended by unions**. If unions had perfectly anticipated the positive demand shock and its effect on the price level, they **would have bargained for a higher money wage** rate to secure their target real wage.

■ However, since (most) **wages had to be set before the occurrence of the shock**, and since the **shock was not perfectly foreseen**, the **negotiated money wage had to be based on the expected price level** which did not include the full inflationary effect of the shock. When the shock hit and prices increased above their expected level, **unions were locked into their nominal wage contracts**, and given the **employer's right to hire more workers at the negotiated money wage**, unions had to allow their members to supply additional labour even though the realized real wage turned out to be lower than the target real wage.

■ This example illustrates the point that **business fluctuations typically involve expectational errors**, in this case errors made **by workers (trade unions)**.

■ In the case where some prices as well as money wages are rigid in the short run, an **unanticipated shock will also cause some firms to err in their expectations**. When **firms**

pre-set their prices for a certain period, they will **base their pricing decisions on their expected costs** which will be influenced by the expected general price level.

■ When the unanticipated shock hits the economy, **some firms (Group 1) will be just about to adjust their prices** and will be able to account for the inflationary cost effect of the shock. But many **other firms (Group 2) which have recently reset their prices will choose to maintain their existing prices** for a while, even though the increase in the prices charged by **Group 1 firms drives the costs of Group 2** firms above the previously expected level. As long as the **shock does not push marginal costs above the preset prices,** even **Group 2** firms will want to **expand their output** to accommodate the unexpected rise in demand.

Macroeconomics for the short run: summing up

■ We may sum up the points of this section as follows: **macroeconomic theory for the short run**, intended to explain the economic fluctuations from year to year or from quarter to quarter, typically includes the following **three modelling features**:

1. **Exogenous shocks**, i.e., sudden abrupt influences on the economy coming from changes in **preferences, technology**, or economic **policies**;
2. **Short-run nominal rigidity**, i.e., some period after the occurrence of a shock during which some **prices and/or wages are sticky**;

3. **Expectational errors**, i.e., a period after the occurrence of a shock during which some prices are different from what was expected before the shock.

■ **Some short-run macroeconomic theories do not assume price rigidity**, e.g. the theory of **Milton Friedman** presented in "The Role of Monetary Policy", *American Economic Review*, 58, 1968, and related more formal contributions such as **Robert E. Lucas, Jr**, "Expectations and the Neutrality of Money", *Journal of Economic Theory*, 4, 1972, or the **real business cycle theory**.

■ A main point in these theories is that **fluctuations can be understood within a framework that only assumes shocks and possibly expectational errors**, but **today it is widely accepted that short-run price and wage rigidities are indeed important** for understanding the economy's short-run reactions to shocks and that **demand shocks are important**.

Macroeconomic theory for the long run: a preview

■ While **exogenous shocks, temporarily sticky wages or prices and erroneous expectations** are required for an understanding of the changes from year to year in unemployment and GDP, most economists think that **these features are best disregarded**

when we try to explain the **"gravity level" of the rate of unemployment** and the **trend-wise gradual growth** of GDP over long periods.

■ The **smooth trend curves** in : Logarithm of real GDP in the USA, 1 and : Annual unemployment rate in the USA **could not possibly reflect a succession of random shocks** over the more than 100 years considered. **By definition, shocks have to go in opposite directions from time to time**.

■ **If technology improves constantly each year** to imply a 2 per cent increase in GDP per head, then this **annual shift in technology should not be considered as a shock**, but rather as a **foreseeable gradual movement**. Moreover, although **nominal wages and prices** may be sticky in the short run, they **do adjust in the longer run**.

■ In **macroeconomics for the long run** we therefore **abstract from the three features** which define short-run macroeconomics.

Long-run modelling: the basic assumptions

■ In other words, **macroeconomic theory for the long run**, intended to explain the trend-wise movements of main economic variables around which the year-to-year fluctuations

occur, **portrays the economy as if exogenous shocks do not occur**, i.e., the economic **fundamentals like preferences and technology develop in a smooth and foreseeable way** over time; **prices are fully adjusted** in all periods in accordance with the economy's full long-run price flexibility; and **expectations are correct** all the time.

■ You should carefully note the **"as if"** in this definition. In **every year the economy will be reacting to shocks**, with prices still not fully adjusted and expectational errors still prevailing. This is **because new shocks occur all the time**. Nevertheless, **certain phenomena may be better understood** by considering the economy **as if shocks did not occur**, prices were always fully adjusted, and expectations always correct.

■ Among such phenomena we include the **long-run growth** performance and the **long-run gravity level of unemployment**. Thus macroeconomic models for the long-run describe the underlying long-run equilibrium towards which the economy is gravitating, **even though** recurring shocks and the time-consuming adjustment to these shocks imply that the e**conomy is never exactly in this long-run equilibrium**.

Real rigidities and natural rate theory

■ The assumption in long-run macroeconomics that all wages and prices are fully adjusted in all periods means that **there are no nominal rigidities in the long term**. But there may well be **permanent real rigidities** preventing real prices and wages from adjusting to the **values which would prevail under perfect competition**. The economy's **long-run wage and price flexibility** can be **different from the flexibility** assumed in the traditional model **of perfect competition**.

■ **Real rigidities may arise from the market power of trade unions**, but even if unions are weak or non-existent, there are other mechanisms which may cause significant real rigidities.

■ It is well known **from microeconomics** that a **profit-maximizing firm facing a downward-sloping demand curve with a constant price elasticity of demand** will set its **price as a constant mark-up over its marginal cost**. As we will see later, the **unemployment problem** is to a large extent **rooted in the market distortions reflected in this mark-up factor**.

■ This is because **weaker product market competition implies a higher value of the price mark-up** and this will increase the unemployment level: **when firms drive down the level of real wages by pushing prices above marginal costs, the amount of involuntary unemployment must rise**.

■ When economists speak of "**real rigidities**", they often mean that **market imperfections permanently distort the real prices and real wages** claimed by firms and workers **away from the competitive relative (real) prices** which would ensure **full resource utilization**. **Even in the long run**, when all nominal wages and prices have had time to fully adjust to their desired levels, these **structural market distortions will persist**, leaving the economy in a **state of permanent unemployment**.

■ According to established tradition in macroeconomics, the **long-run equilibrium unemployment rate implied by the economy's real rigidities is called the natural rate**. This is the rate of **unemployment** emerging **when all relative prices have fully adjusted** in accordance with the economy's long-run wage and price flexibility.

■ In line with this tradition, we will use the term "**natural rate of resource utilization**" to denote the **rate at which factors of production are utilized in long-run equilibrium** when the economy has exhausted its potential for price adjustment. By definition, **there are no real rigidities if perfect competition prevails**, since real (relative) prices in a competitive economy adjust until the demand for each resource equals the full supply of that resource.

■ We have suggested that the **degree of real rigidity may be measured by the level of the natural unemployment rate**. We should add that economists sometimes find it fruitful to work with a **slightly different concept of real rigidity**.

■ In this alternative definition, the degree of real rigidity is measured by the **responsiveness of real wages and real prices to a short run change in the unemployment rate** away from the natural rate. If this responsiveness is low, the degree of real rigidity is said to be high. In any case, real rigidity in a broad sense refers to the fact that the economy's degree of relative price flexibility is less than it would be in an ideal world of perfect competition.

The crucial role of the supply side in long-run modelling

■ The **natural rate of employment is given from the supply side** of the economy, since the **mark-up** parameters, the **behaviour of trade unions** are characteristics of the economy's **supply side structures**.

■ This has an important implication: **in macroeconomic models for the long run**, where wages and prices are assumed to be fully adjusted in all periods, **output is determined solely from the supply side**.

■ In any given period there is a certain labour force L, and a certain (predetermined) capital stock K. Output is then completely constrained from the supply side, since it cannot exceed the volume which can be produced by means of the labour input $(1 - u)L$ and the predetermined capital input K.

■ By contrast, **in short-run macroeconomic models** nominal wage and price rigidities and/or expectational errors may cause **employment to deviate from its natural rate**. Hence we **do not have the simple supply side determination of employment** just described. Instead, **employment is also influenced by the aggregate demand** for goods and services.

■ Thus, **in long-run macroeconomic models employment always corresponds to the natural rate**, whereas i**n short-run models employment** is determined also from the demand side and **fluctuates around the natural rate**.

Static versus dynamic models

■ A **macroeconomic model for the long run can be a single-period static model**. This may seem surprising, but sometimes it is useful to focus on a **single period which is an "end period"** in the sense that **no new shocks** have occurred for a long time and the **economy has finished all its adjustments**. The purpose is to characterize the **equilibrium towards which**

the economy is tending in the long run, without complicating the theory with an explicit analysis of the **dynamic process** which takes the economy to the long-run equilibrium. The **models of long-run structural unemployment are of this nature**.

■ By contrast, **dynamic models for the long run describe the process of capital accumulation explicitly**, and typically they also **describe the evolution** of other important **stock variables such as the labour force**, the stock of **natural resources**, etc. These models, also called **growth models**, always contain the following **dynamic link between the current flow of investment and the increase in the stock of capital**:

$$K_{t+1} - K_t = I_t - \delta K_t \qquad 1.1$$

where K_t is the amount of capital available in period t, I_t is gross investment in period t, and δ is the rate at which capital depreciates.

■ **In a closed economy the level of gross investment** I_t must **equal gross savings** S_t. For a closed economy the capital accumulation equation therefore becomes:

$$K_{t+1} - K_t = S_t - \delta K_t \qquad 1.2$$

■ Thus **savings play a central role in growth models**. In many models it is simply assumed that households always **save an exogenous fraction *s*** of total income so that in any period *t* we have $S_t = sY_t$. The growth models using this assumption are called **Solow models**.

■ There are **more advanced growth models** in which **savings are derived from maximization** of utility functions under appropriate budget constraints (Ramsey model, Overlapping Generations Model).

■ **Solow models** are well suited and **widely used for understanding many growth issues**. However, for analysing the effects of economic policies, these models have the **shortcoming that they do not contain utility functions** and therefore **do not allow an explicit evaluation of the welfare consequences** of alternative economic policies. **In Solow models** one will just have to look at the policy implications for economic variables like **GDP** or the level of consumption, and simply **assume that it is "good" to have high per capita income** or consumption.

Long-run versus short-run economic policies

■ A **main motivation** for studying economic phenomena is the need **to improve the basis for economic policy advice**. For instance, we want to understand the **sources of economic growth** because this could be helpful in designing a **growth-promoting policy** for a low-income country trying to escape poverty.

■ The division of macroeconomics described above leads to a parallel **division of economic policies into long-run policies** aimed at promoting **growth** and long-run prosperity and at reducing long-run **unemployment**, and **short-run policies** aimed at mitigating **economic fluctuations** and their harmful consequences coming, for example, from sudden increases in unemployment.

■ However, the division of macroeconomics suggests more than this categorization of policies according to their aims. The basic and **different assumptions underlying the two parts of macroeconomic theory** have consequences for the **channels** through which long-run and short-run policies can affect the economy.

■ For example, recall that long-run macroeconomics assumes full nominal wage and price adjustment. This implies that long-run unemployment is determined exclusively by the parameters which reflect the structural characteristics of labour and product markets. Because

it is rooted in the basic structural features of the economy, the natural rate of unemployment is also referred to as the "structural" unemployment rate.

■ It follows that a **policy intended to reduce long-run unemployment can only be successful if it affects the economy's basic structures**. Specifically, our analysis suggests that such a policy must try to **increase the degree of competition in labour or product markets** and/or r**educe the generosity of the system of unemployment insurance**.

■ In richer models of the labour market there are other ways of reducing the natural unemployment rate, such as **improving the level and composition of work skills** through **education and training** to attain a better match between the skills possessed by workers and the skills demanded by employers.

■ In a similar way, **policies aimed at promoting long-run growth and prosperity** must affect one or several structural characteristics of the economy such as the **long-run propensities to save and invest,** to engage in **education** and **R&D**, etc. In short, **policies for the long run must be structural policies**.

■ A **short-run policy to mitigate business cycles**, on the other hand, can be a **monetary or fiscal policy of demand management**. Such a policy can affect the rate of employment in

the short run **even if it does not influence the basic structures and incentives** in the economy. The reason is that i**n the short run prices and expectations are not fully adjusted**, and hence **changes in nominal demand will affect real economic variables**.

Summary

■ The economy's long-run equilibrium is the combination of relative prices and quantities which would emerge in a general equilibrium where wages and prices have had time to adjust fully to past shocks and where no further shocks have occurred over a sufficiently long period.

■ If the long-run equilibrium is the outcome of perfect competition, all economic agents have taken wages and prices as given and found their optimal price-taking supplies and demands, and prices have adjusted to equate these supplies and demands market by market.

■ In practice empirical studies often find that prices are above marginal costs, indicating that most markets - including the labour market - are characterized by imperfect competition. Still we can think of long-run relative prices as being determined by an underlying general equilibrium system, although not one that ensures equality between price-taking supplies and demands.

■ The natural rate is the rate of resource utilization emerging when relative prices have fully adjusted to their long-run equilibrium values. Imperfect competition typically means that the natural rate is less than 100 per cent. When this is the case, we say that real rigidities prevail. Real rigidities imply that individual agents do not wish to reduce their real (relative) wages and prices very much in response to unemployment or excess capacity. Hence real wages and prices do not adjust sufficiently to prevent permanent underutilization of resources.

■ Macroeconomics for the long run aims at explaining the trends in main economic time series and the effects of structural economic policies. In long-run macroeconomics the economy is analysed as if relative prices are fully adjusted to their long-run equilibrium values in each period, the fundamentals of the economy such as preferences and technology evolve smoothly and predictably, and expectations are correct all the time. One implication is that in long-run macroeconomics aggregate output is determined from the supply side alone, as the level of output that can be produced when available resources are utilized at their natural rates.

■ Short-run nominal wage and price rigidities mean that some money wages and/or prices are fixed over a certain period. Empirical evidence shows that most money prices and money wages are only adjusted with certain time intervals even under considerable inflation. Thus

nominal rigidities prevail in the short run, and these may cause the rate of resource utilization to deviate from the natural rate for periods of sufficient length to be of interest.

■ Individual agents adjust their nominal wages or prices with the purpose of changing their real wages or prices. Because real rigidities imply that agents do not want to change their real prices very much in response to changes in economic activity, real rigidities also tend to generate nominal rigidities. When the degree of real rigidity is strong, short-run nominal wage and price rigidities can be privately optimal even if the menu costs of nominal wage and price adjustment are very small. At the same time the social cost of nominal rigidity can be many times as large as the perceived private cost for the individual agent.

■ Short-run nominal wage and price rigidities may imply that some relative prices are also fixed in the short run. For instance, if both nominal wages and nominal prices are fixed, real wages are fixed. Short-run nominal rigidities can explain why it takes time for relative (real) prices to adjust to their long-run equilibrium levels.

■ Macroeconomics for the short run seeks to explain the fluctuations in main economic time series around their trends and the effects of stabilization policies. Economists believe that exogenous shocks (sudden unpredictable changes in factors such as business confidence, preferences and technology), short-run nominal wage and price rigidities, and expectational

errors are fundamental for understanding short-run fluctuations. Because of nominal rigidities and expectational errors, the actual rate of resource utilization can deviate from the natural rate. In the short run aggregate demand is therefore just as important for economic activity as aggregate supply.