Chapter 1

Introduction

Macroeconomics focuses on the analysis of economies in the aggregate. It seeks to provide answers to some of the most important social and economic questions, such as the ones concerning economic growth, aggregate fluctuations and the role of monetary and fiscal policy. Why are some countries “rich” and others “poor”? What determines the improvement of living standards and the process of economic growth? Why are there recessions and upswings in economic activity? What are the causes and consequences of inflation? What are the determinants of unemployment and its fluctuations? What are the possibilities for government policy to promote economic growth, to avoid recessions and to maintain low inflation and unemployment?

These, and a host of related questions, have occupied social thinkers even before economics was founded as a discipline by Adam Smith’s pathbreaking 1776 book, *The Wealth of Nations*. Smith sought to systematically analyze the causes of differences in wealth and living standards among countries. In the process, he founded economics as an academic discipline, separate from the other social sciences. 160 years later, in 1936, following the publication of *The General Theory of Employment, Interest and Money* by John Maynard Keynes, macroeconomics emerged as a separate sub-discipline of economics.1

1The term “macroeconomics”, coined by Frisch [1933], only prevailed during the 1950s. For example, in the first edition of the most successful introductory economics textbook of the postwar period, Samuelson [1948], the terms macro-economics and micro-economics were not used at all. Samuelson titled the, unabashedly keynesian, macro-economic section of his textbook as “Determination of National Income and its Fluctuations”, and the, unabashedly neoclassical, micro-economic section as, “The Composition and Pricing of National Income”. However, by the 3rd edition, in 1955, Samuelson uses the terms macro-economics and micro-economics repeatedly to distinguish between the two main
Macroeconomics uses relatively simple, aggregate, general equilibrium models, which focus on the operation of three sets of markets. The first is the market for goods and services. Such goods and services are typically assumed to consist of a homogeneous final output. The second is the set of markets for factors of production, which are usually assumed to be mainly capital and labor. The third is the set of markets for financial assets, such as interest yielding securities and money.

The main groups of agents assumed to be making choices in the context of macroeconomic models, are households, firms and the government, or independent government agencies, such as a central bank.

Through their choices, and through their market interactions, such agents determine macroeconomic outcomes, such as the volume of production and consumption, employment and unemployment, investment and capital accumulation, real wages and real interest rates, the price level and inflation, and nominal wages and interest rates.

1.1 The Nature and Evolution of Macroeconomics

The subject matter of macroeconomics is usually divided into two distinct areas. The analysis of long run economic growth, which was the main focus of Smith [1776] and other classical economists, and the analysis of aggregate fluctuations, which was the main focus of Hume [1752], subsequent monetary and other business cycle theorists and, of course, Keynes [1936].

1.1.1 Pre-Keynesian Macroeconomics

Macroeconomics, did not exist as a separate field of economics before the publication of the General Theory. However, there were at least three important theoretical streams that foreshadowed it.

One was the analysis of long run economic growth, an important concern of classical economists such as Smith, Malthus, Ricardo and Mill. The classical economists sought to explain economic growth in terms of population growth, the accumulation of capital and the increase in the efficiency of production, as determined by the division of labor and technical progress. These factors, interacted with land, a factor of production which was assumed to be in fixed supply.\(^2\)

\(^2\)The other important concern of the classical economists was the distribution of total income, among the owners of the factors of production. See Samuelson [1978], for an analysis of the canonical classical model of economic growth, synthesizing the views of
The second stream of pre-Keynesian macroeconomics was monetary theory. Monetary theory was quite advanced even before the development of classical economics. Hume [1752] provides important examples of monetary analysis more than twenty years before Smith. By the early 20th century, monetary theory had established the quantity theory of money, the classical dichotomy between “real” and “nominal” variables, and a number of monetary explanations of the business cycle. The quantity theory of money suggested that increases in the money supply lead, at least eventually, to equiproportional increases in the general level of prices. The classical dichotomy suggested that, at least in the long run, “real” variables are determined purely by non-monetary factors. Monetary theories of the business cycle attributed the business cycle to the short term real effects of monetary factors, interacting with the gradual adjustment of wages and prices and with temporary deviations of the interest rate from its equilibrium value.3

The third stream, consisted of various types of real business cycle theories. Apart from the dominant monetary theories, there were a number of alternative theories, which had attempted to explain aggregate fluctuations in terms of over-investment, under-consumption, excess indebtedness, psychology, technology, or harvest and agricultural cycles. These theories were essentially macroeconomic in nature.4

The term macroeconomics predates the General Theory, and has to be credited to Frisch [1933], who defined it as follows:

“When we approach the study of business cycles with the intention of carrying through an analysis that is truly dynamic and determinate, we are naturally led to distinguish between two types of analyses: the micro-dynamic and the macro-dynamic types. ... The macro-dynamic analysis ... tries to give an account of the fluctuations of the whole economic system taken in

3A number of monetary schools of thought had evolved by the latter part of the 19th century and existed in the early part of the 20th century. These included Irving Fisher of the Yale School (see Fisher [1896], Fisher [1911], Fisher [1930]), the Cambridge School (Marshall [1923], Keynes [1923] and Pigou [1917], the Stockholm School (Wicksell [1898] and the Austrian School (von Mises [1912]). Monetary theories of aggregate fluctuations included, among others, those of Hawtrey [1919], Marshall [1923] and Keynes [1923]. These economists stressed the short run real effects of money, when there is partial adjustment of nominal wages and prices. Wicksell [1898] and von Mises [1912], among others, also stressed monetary factors in aggregate fluctuations, through short run deviations of the market interest rate from the Wicksellian “natural” (equilibrium) rate of interest.

4Pre-Keynesian trade cycle or business cycle theories are surveyed and analyzed by Haberler [1937].
its entirety.”, p. 2.

In any event, The General Theory, as codified in the IS – LM framework of Hicks [1937], and later by Modigliani [1944], Patinkin [1956] and others, eventually prevailed upon previous approaches, and was pivotal in the establishment of macroeconomics as a separate field of economics.¹

Macroeconomics gradually integrated the three theoretical streams mentioned above, and experienced explosive growth during the rest of the twentieth century. In its evolution over the years, macroeconomics has displayed continuity but also significant controversies, changes of direction and outright “scientific revolutions”.²

1.1.2 Classical and Keynesian Macroeconomics

Following the Keynesian revolution of the 1930s, macroeconomics originally evolved with little reliance on underlying microeconomic theory. For the most part, in the aftermath of the trauma of the “Great Depression” and Keynes’ (1936) scathing attack on “classical” economics, macroeconomics based on solid microeconomic principles was dismissed as “classical macroeconomics”. In the increasingly dominant paradigm of keynesian macroeconomics, during the 1950s and the 1960s, most of the key aggregate relations, such as the consumption function, the investment function, the relation between inflation and unemployment and others, were postulated, rather than derived from explicit choice theoretic microeconomic foundations. Surprisingly, this applied not only to the keynesian model of aggregate fluctuations, but also to models of long run economic growth.

To a large extent, the instability and knife edge conditions characterizing the early post-keynesian models of economic growth, by Harrod [1939] and Domar [1946], were due to their unsatisfactory microeconomic foundations, such as a constant savings rate and the absence of substitution possibilities between capital and labor in the production of goods and services. Even

¹It is again useful to quote Frisch [1933], who also wrote that “as far as I know no determinate macro-dynamic analysis is yet to be found in the literature.” (p.3). This was a statement about the state of the pre-keynesian business cycle models, which were mainly heuristic and non-rigorous.

²For the concept of “scientific revolutions” see Kuhn [1962]. Macroeconomics itself was established through such a revolution, the “keynesian revolution” (Klein [1947]). The keynesian orthodoxy was later challenged by the “monetarist counter-revolution” (Johnson [1971]), the “rational expectations revolution” (Begg [1982]), to end up with the revolution implied by the adoption of current “dynamic stochastic general equilibrium” models. For an analysis of the theoretical developments in macroeconomics since Keynes, see Vroey [2016].
the important Solow [1956] model of economic growth, which was based on a much more general neoclassical production function, also relied on a postulated ad hoc keynesian consumption function, rooted on the assumption of the General Theory that consumption is an exogenous fraction of current income. It took some time before Cass [1965] and Koopmans [1965] rediscovered and extended the Ramsey [1928] representative household model of savings, and re-established the missing link between growth theory and optimizing households. At around the same time, Diamond [1965] extended the Samuelson [1958] model of overlapping generations, which was a different type of optimizing general equilibrium model of aggregate savings. Diamond used this model to analyze economic growth and the effects of government debt. Both the representative household model and the overlapping generations model are dynamic general equilibrium models, with explicit microeconomic foundations, and are widely used in growth theory to this day.

The keynesian approach to aggregate fluctuations, which became totally dominant in the 1950s and the 1960s, suffered from similar defects to an even greater extent. This applied to both theoretical models, such as the IS – LM framework of Hicks [1937], and the models of Samuelson [1939] and Modigliani [1944], and econometric models, such as the Klein [1950] and Klein and Goldberger [1955] models.\textsuperscript{7}

For example, the multiplier-accelerator model of Samuelson [1939]), probably the most influential early dynamic business cycle model based on Keynesian principles, relied on a simple postulated consumption function, with consumption a linear function of past income, and investment a constant multiple of the change in consumption. The marginal propensity to consume out of past income defined the multiplier, and the marginal propensity to invest, following a change in consumption, defined the accelerator. Yet, neither the multiplier nor the accelerator were derived from an optimizing microeconomic model for households and firms.

The same also applied, although to a lesser extent, to the so called neoclassical synthesis, which was a combination of the IS – LM framework, with an aggregate short run supply function, which depended on the assumption

\textsuperscript{7}It has to be noted that Klein [1950] went through a lot of effort to provide microeconomic foundations for his econometric model of the United States. For the most part, the 45 pages of Chapter II are devoted to economic theory, with profit maximizing firms and utility maximizing households. However, when shifting from economic theory to his statistical models, Klein uses the theory relatively loosely, as a rationalization of “simple” aggregate behavioral equations.
of the short run rigidity of nominal wages and prices.\footnote{Modigliani [1944] is probably the first exponent of this neoclassical synthesis, which was nonetheless derived from the \textit{General Theory} itself.}

This state of affairs was a significant concern to many economists, including the protagonists of the development of the keynesian models themselves, who were unhappy with the weakness of the microeconomic foundations of many of the postulated macroeconomic relations, and sought to provide better links between macroeconomics and microeconomics.

\subsection*{1.1.3 Microeconomic Foundations of Macroeconomics}

It was not long before the various attempts to provide better microeconomic foundations for macroeconomics began to bear fruit.

Modigliani and Brumberg [1954] and Friedman [1957] provided dynamic microeconomic foundations for the consumption function, based on intertemporal considerations. Hence, the \textit{life cycle} and \textit{permanent income} theories of consumption, which differed from the simple static keynesian consumption function. We analyze deterministic and stochastic versions of these theories of consumption in Chapters 3 and 8.

Jorgenson [1963] introduced the \textit{flexible accelerator} model of investment, based on profit maximization by firms and the assumption of adjustment costs for the capital stock. His contribution, and that of Tobin [1969] led to the modern optimizing \textit{q theories of investment}, which we analyze in Chapter 9.

Baumol [1952], Tobin [1956], Friedman [1956], Patinkin [1956], Samuelson [1958] and others derived the \textit{demand for money} from the optimizing behavior of households and firms. We analyze optimizing general equilibrium models of the demand for money in Chapter 10.

More importantly, Patinkin [1956] sought to base the whole model of the neoclassical synthesis on a better microeconomic footing, consistent with Walrasian general equilibrium theory. The program of Patinkin was carried forward by Clower [1965], Leijonhufvud [1968] and the so called \textit{non Walrasian equilibrium modeling} of Barro and Grossman [1971], Muellbauer and Portes [1978] and others.

These are only some of the early attempts to provide microeconomic foundations for the postulated key relations of keynesian macroeconomic models.

The most important case of an empirical relationship with inadequate microeconomic foundations is probably the \textit{Phillips curve}. This was an inverse empirical relation between inflation and unemployment, discovered by
Phillips [1958]. Initially there was very little theory underlying the Phillips curve, which was interpreted simply as an adjustment equation for wages, depending on the excess demand for labor. The Phillips curve was incorporated in keynesian econometric models as the missing aggregate supply function, and helped determine the extent to which changes in aggregate demand were translated into changes in wages and prices or changes in real output and employment. Samuelson and Solow [1960] were quick to suggest that aggregate demand policies could be used to select the socially desirable combination of inflation and unemployment along the Phillips curve.

However, in the late 1960s, the Phillips curve appeared to break down. Rises in inflation resulted in only temporary reductions in unemployment. Phelps [1967] and Friedman [1968] were able to explain the breakdown in terms of shifts in inflationary expectations, using the first rudimentary optimizing models of inflation and unemployment, which resulted in the so called expectations augmented Phillips curve and the “natural” rate hypothesis.

An important research effort, seeking to provide firm dynamic microeconomic foundations for the Phillips curve, followed almost immediately afterwards. Phelps [1970] kick-started this program. The rational expectations revolution followed suit, when Lucas [1972] applied the rational expectations hypothesis of Muth [1961] to a general equilibrium model of the Phillips curve, instead of the Cagan [1956] hypothesis of adaptive expectations which was used until then.

Gradually, the focus shifted to dynamic stochastic general equilibrium (DSGE) models of aggregate fluctuations, following the ideas of Lucas [1977] and the important early such model by Kydland and Prescott [1982]. These models were initially in the classical tradition, and led to what is now termed new classical macroeconomics, or, real business cycle theory.\(^9\)

Alternative dynamic stochastic general equilibrium models were also developed in the monetary and Keynesian tradition of gradual adjustment of prices and nominal wages. These alternative models also emphasized real distortions, such as labor market imperfections or imperfect competition in the product markets. Mankiw and Romer [1991] is an early collection of papers in what is now termed new keynesian macroeconomics. These models can account for fluctuations caused by monetary factors, as well as real factors. They can also justify a stabilizing role for monetary policy, not only for inflation, but also for fluctuations of real output and employment.\(^10\)

Both the new classical and the new keynesian approaches coexist today,

\(^9\)See King and Rebello [1999] for an overview of such models.

\(^10\)Woodford [2003] and Gali [2008] are based on such models.
and both are analyzed in Chapters 11 to 15 on aggregate fluctuations.

1.1.4 Dynamic and Dynamic Stochastic General Equilibrium Models

In seeking to explain long run economic growth and fluctuations in aggregate economic activity, modern macroeconomics is *dynamic*. The element of time is indispensable for understanding and explaining both types of phenomena. In seeking to explain aggregate fluctuations, modern macroeconomics is also *stochastic*, in that it explains aggregate fluctuations in terms of the response of dynamic economic systems to random disturbances.

This dynamic stochastic approach to aggregate fluctuations follows a tradition which was also founded in the 1930s, by mathematical economists and statisticians such as Frisch [1933] and Slutsky [1937]. This tradition, which initially evolved independently of the *General Theory*, was subsequently followed and extended in various directions by econometricians such as Tinbergen [1937], Haavelmo [1944] and the Cowles Commission, and Burns and Mitchell [1946]. The development of early keynesian macro-econometric models by Klein [1950], Klein and Goldberger [1955] and others, applied this tradition to the framework of the *General Theory*.\(^{11}\)

The way in which modern macroeconomics approaches and analyzes aggregate fluctuations owes a lot to the following important observation of Lucas [1977]:

> "Technically, movements about trend in gross national product in any country can be well described by a stochastically disturbed difference equation of very low order. These movements do not exhibit uniformity of either period or amplitude, which is to say, they do not resemble the deterministic wave motions which sometimes arise in the natural sciences. Those regularities which are observed are in the co-movements among different aggregative time series ... One is led by the facts to conclude that, with respect to the qualitative behavior of co-movements among series, business cycles are all alike. To theoretically inclined economists, this conclusion should be attractive and challenging, for it suggests the possibility of a unified explanation of business cycles, grounded in the general laws governing market\(^{11}\)

\(^{11}\)The term econometrics is also due to Frisch, who was one of the founders of the *Econometric Society* and the academic journal *Econometrica*.\]
This observation by Lucas caused significant changes in the way in which all schools of thought in modern macroeconomics are approaching and try to explain aggregate fluctuations.

The traditional macroeconomic and macro-econometric models, from the 1950s to the 1970s, were deemed to have a number of weaknesses in the detailed study of aggregate fluctuations, and the impact of monetary and fiscal policy, in relation to the criteria of Lucas. The most important of these weaknesses was that the macroeconomic relationships assumed in traditional models were not explicitly drawn from well defined microeconomic foundations, based on intertemporal optimization on the part of households and firms. Therefore one could not easily interpret their parameters, and be confident in their stability. This was the basis of the Lucas critique of econometric policy evaluation.\footnote{See Lucas [1976].}

Lucas [1976] concluded that,

\begin{quote}
“Given that the structure of all econometric model consists of optimal decision rules of economic agents, and that optimal decision rules vary systematically with changes in the structure of series relevant to the decision maker, it follows that any change in policy will systematically alter the structure of econometric models.” (p. 41).
\end{quote}

Lucas arrived to this conclusion after having demonstrated the fragility of traditional econometric models of aggregate consumption, investment and the Phillips curve. Following this critique, and the quest for dynamic microeconomic foundations in macroeconomic models, the macroeconomics of aggregate fluctuations shifted to the study of dynamic stochastic general equilibrium models, with explicit microeconomic foundations.

Modern macroeconomics is now almost entirely based on such dynamic and dynamic stochastic general equilibrium models. Naturally, such models form the backbone of the present book. We present the main theories of economic growth and aggregate fluctuations, through a sequence of such dynamic models, based on intertemporal optimization on the part of economic agents. For completeness, some of the important precursors to these models are also discussed.\footnote{For example, in Chapter 2 we devote a lot of space to the Solow (1956) model, even}
The models we utilize are treated as tools for understanding the main macroeconomic phenomena of long run economic growth, aggregate fluctuations, inflation and unemployment, and the role of monetary and fiscal policy. This book highlights both their potential strengths, as well as their limitations.

It is worth keeping in mind that modern macroeconomics is not based on a single, generally accepted all encompassing model. For this reason, this book treats macroeconomics as applied and policy oriented general equilibrium analysis, based on relatively simple aggregate dynamic or dynamic stochastic models. We examine a plurality of models, each of which is suitable for investigating specific issues and addressing specific questions, but may be unsuitable for other issues or questions.

However, there are some unifying principles in the models that we adopt. It is assumed throughout that economic agents base their decisions on intertemporal optimization of some well defined objective function, under appropriate constraints. Thus, for the most part, we rely on dynamic general equilibrium models with explicit intertemporal microeconomic foundations. Where there are theoretical disagreements, alternative approaches are juxtaposed, their pros and cons are analyzed, and their compatibility with the empirical evidence is also briefly discussed.

Before we turn to the theory and the models themselves, it is worth looking at the key facts concerning long run economic growth and aggregate fluctuations. These key facts are what macroeconomics seeks to explain and account for. We start we some of the key facts about long run economic growth, and then move on to some of the key facts about aggregate fluctuations. Knowledge of these key facts will facilitate the process of evaluating the empirical validity and therefore the usefulness of the theoretical models in the rest of this book, although additional facts will be presented as we move to the particular models.

1.2 Key Facts about Long Run Economic Growth

In order to examine the key facts about long run economic growth, we shall first examine current cross country differences in living standards, and then we shall examine the evolution of living standards over time for a number through its consumption function is postulated and not derived from explicit microeconomic foundations. We also devote Chapter 12 to the traditional keynesian model and the Phillips curve, both because of their significance, and in order to compare its structure and implications with the new keynesian models of Chapters 14 and 15.
Living standards are usually measured by annual Gross National Income (GNI) per capita, or annual Gross Domestic Product (GDP) per capita. However, in order to perform cross country comparisons, per capita income must be measured in comparable units. This requires the transformation of per capita incomes in a common currency, usually the US dollar. In order to adjust for differences in purchasing power among countries, we use exchange rates that reflect such differences. These exchange rates ensure purchasing power parity (PPP), and are called PPP adjusted exchange rates. Thus, in order to compare GNI per capita, or GDP per capita among different countries, these are measured in PPP adjusted, or international, dollars. For comparisons over time, we also adjust for inflation in each country, using real per capita income or output.\footnote{For the exact methodology see the World Bank site, Summers and Heston [1991], or Maddison [1982]. World Bank data, the data of the Penn World Tables (which are based on the Summers and Heston methodology), and the data of the Maddison Project (based on the Maddison methodology) are revised at regular intervals. For the Maddison Project see Bolt and van Zanden [2014].}

1.2.1 Cross Country Differences in Per Capita Output and Income

The world today consists of countries characterized by very large differences both in the standard of living of their inhabitants, and the rate of growth of their living standards.

For example, in the USA, annual per capita Gross National Income (GNI) in 2012 was $52,220, while the annual per capita income of the Congo, one of the poorest economies, was only $710, of comparable purchasing power. The Congo had a per capita income which was just 1.4% of the US per capita income.

The World Bank publishes comparable data, in international US dollars, measuring the per capita Gross National Income (GNI) of 214 countries of the world. For 2012 the relevant data existed for 184 countries. The average per capita GNI of countries classified as high income economies was $39,903, while the average per capita GNI of low income economies was $1,870. The per capita income of high income (developed) economies was thus on average 20 times higher than that of low income, or least-developed economies. The average per capita income of middle income economies was equal to $9,075. The per capita income of high income (developed) economies is thus on average 4 times higher than that of middle income economies.
The number of countries with per capita GNI in a particular income bracket, measured in international US dollars, is depicted in Figure 1.1.

Five countries (Qatar, Macau, Singapore, Bermuda and Norway) had GNI per capita above $60,000. Seven countries (United Arab Emirates, Luxembourg, Switzerland, Saudi Arabia, Oman, the USA and Hong Kong) had GNI per capita between $50,000 and $60,000. Eight developed European economies, as well as Australia and Canada, had GNI per capita between $40,000 and $50,000. Twelve countries (including France, Great Britain, Japan, Italy, N. Korea, Spain, New Zealand and Israel) had GNI per capita between $30,000 and $40,000. Twenty-two countries (including Greece, Cyprus, and Russia) had GNI per capita between $20,000 and $30,000. Forty countries (including Turkey, Brazil and China) had GNI per capita between $10,000 and $20,000. Ninety countries, about half of the 184, had a GNI per capita between $1,000 and $10,000. These included India, with per capita GNI of $5,080. Finally, six countries in sub-Saharan Africa, had per capita GNI of less than $1,000.

These numbers suggest the extent of the disparities in per capita output.
and income. An adequate theory of economic growth ought to be able to account for such disparities.

1.2.2 The Evolution of Per Capita Output and Income over Time

Reliable data on the per capita output and income of various countries and their growth rates before 1820, is extremely rare.

The estimates of Maddison [1982], based on heroic assumptions, suggest that the average growth rate of real world GDP per capita in the period 1500-1700 AD was only 0.04% per annum, while in the period 1700-1820 AD it was just 0.07% per annum. Even in Western Europe, for which the period 1500-1820 was one of relative economic prosperity compared to other world regions, the average growth rate of GDP per capita did not exceed 0.14% per annum.

Before 1500, all indications suggest that the standard of living, despite large cyclical fluctuations, showed no long-term trend.

A second feature of the period before 1820 was that income differences between countries were very small compared to today. According to the estimates of Bairoch [1993], the differences in living standards between the richest and the poorest countries did not exceed 1.5-2.0 to 1. Moreover, Bairoch estimates that there were no significant differences in living standards between Rome in the 1st century AD, the Arab caliphates in the 10th century AD, China in the 11th century, India on the 17th and Europe in the early 18th century.

In the 15th century AD, before the economic boom in Europe, China, the Ottoman Empire, the Incas and the Aztecs seem to have had a higher standard of living than Western Europe. However, economic growth in Western Europe picked up after 1500 AD.\textsuperscript{15}

The average growth rate of world per capita output increased between

\textsuperscript{15}A dramatic case of relative economic decline was that of China. Between the 8th and 12th century China experienced a unprecedented period of economic and cultural prosperity. It was in this period that gunpowder, printing and the hydraulic hose reel were invented. Coal was used in the production of steel and a series of canals and waterways for water supply and transportation of products was constructed. The magnetic compass was invented in that period, and the imperial fleet of China had reached as far as the eastern coast of Africa by the early 15th century. However, China gradually withdrew from the world economy, following a policy of introversion, and around 1750 the standard of living in Europe had overtaken the Chinese standard of living. One hundred years later, in the 19th century, China was unable to defend itself during the opium wars against Great Britain, and in the 20th century it was one of the least developed economies of the world.
1820 and 1870, reaching 0.5% per annum. Between 1870 and 1950 the average growth rate doubled to 1.1%, and since 1950 it doubled again to over 2%. Between 1950 and the early twenty-first century, many countries have seen their standard of living to more than triple.\(^{16}\)

As a result, in the high income countries of today, real per capita output and income is, depending on the country, between 10 and 30 times higher than it was two hundred years ago.

The increase in per capita output and income is not, and has not been uniform. Table 1.1 presents relevant data based on Maddison [1982] and the Maddison Project. After centuries of stagnation in the average standard of living of all countries of the world, the average growth rate began to rise in Europe and its former colonies, such as the USA, Canada and Australia, from the early 19th century. In other countries, such as Japan, the growth process started later.

However, the growth process has been uneven. In 1820, the more developed countries had a per capita GDP which was about three times the per capita GDP of less developed countries. In 2012, it was about twenty (20) times higher. The former colonies of Western Europe (USA, Canada, Australia and New Zealand) in 1820 had a slightly lower standard of living compared to Western Europe itself. In 1950 they had twice the per capita income of Western Europe. Japan surpassed the standard of living of Eastern Europe, Latin America, the former Soviet Union and Western Europe in the second half of the 20th century. China, one of the poorest countries in the world in 1950, in 2010 had a per capita income which was more than double the per capita income of India and Africa. Latin America, parts of Asia and Africa have been left behind.

### 1.2.3 Economic Growth and Convergence since 1820

Figure 1.2 depicts the long run evolution of (the log of) per capita GDP in Britain (UK), the USA and Japan.

In 1800, British per capita GDP was more than 60% higher than in the USA. At the beginning of the 20th century, per capita GDP in the USA had surpassed the corresponding British one, because of the higher growth

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\(^{16}\)The number of years required for a magnitude like per capita output or income to double in value depends on its growth rate. If per capita real income grows at \(g\)\% per annum, it takes approximately \(70/g\) years for it to double. Thus, if \(g\) is 1%, it takes 70 years for per capita real income to double, if \(g\) is 2% it takes 35 years, if \(g\) is 3% it takes 23 years, and so on. This rule of 70 is derived from \(100 \ln 2 = 69.3\), which is approximately equal to 70.
Table 1.1: Per Capita GDP and Average Annual Growth Rates

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<tr>
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<td>1.7%</td>
<td>1.1%</td>
<td>1.05%</td>
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Source: Maddison Project. Per Capital GDP in 1990 International $

rate in the USA during the 19th century. The two World Wars led to a widening of the gap between the USA and Britain, despite the fact that the Great Depression of the 1930s was more severe in the USA. After the Second World War, per capita output in the USA has remained consistently higher than in Britain and the other main industrial economies.

GDP per capita in Japan, for which continuous annual estimates exist only after 1870, has been consistently lower than the British and American one in the 19th century. In 1870, it was only 23% of the corresponding British one, and only 30% of the American one. By 1913, on the eve of World War I, it had risen to 28% of the British per capita GDP, but had
fallen to 26% of US per capita GDP. Japan had experienced slightly higher growth than Britain, but lower growth than the USA. By 1939, on the eve of World War II, GDP per capita in Japan had risen to 45% of the corresponding one in Britain, and to 43% of the corresponding one in the USA. Japan experienced much higher growth than Britain and the USA during World War I and the interwar years. Japanese per capita output fell precipitously in the aftermath of World War II, much more than in Britain and the USA. However, since the end of the World War II, Japan has experienced extremely high growth, and, by the mid-1970s, the Japanese GDP per capita had converged to the British one. Since the early 1980s, Japanese growth slowed down, and British growth picked up, with the result that Britain has again surpassed the living standards of Japan.

Figure 1.3 depicts the long run evolution of per capita GDP in the four major European economies, i.e Britain (UK), France, Germany and Italy. France, Germany and Italy had lower per capita GDP than Britain throughout the 19th century and the first half of the 20th century. For France and
Germany there was a slow process of convergence until the eve of World War I, and faster convergence in the interwar period. In the aftermath of World War II, convergence was much more rapid, and by the early 1970s, per capita GDP did not differ by much in these four economies.

Both Figure 1.2 and Figure 1.3 display the significant increase of the rate of economic growth in the post World War II period. Between 1950 and 2010, i.e. during the last 60 years, the real per capita GDP of the USA more than tripled. In fact, it rose by about 3.2 times, from $9,561 (in 1990 prices) in 1950, to $30,491 in 2010. Its average annual growth rate was about 2% per annum. The major developed European economies displayed even higher growth. The average annual growth rates of real per capita GDP in Britain was 2.1%, slightly higher than in the USA. Italy achieved an average annual growth rate of 3.0%, Germany 2.8% and France 2.4%. As a result, there was significant convergence of the per capita GDP of the major European economies to that of the USA. The average annual growth rate of per capita income in Japan was 4.1% in the same period, significantly
higher than in the USA and the major European economies. However, even during the past 60 years, the less developed economies have not demonstrated a uniform tendency towards convergence with the per capita income of the developed economies. Some developing economies, particularly in the rest of Western Europe and Southeast Asia, have achieved impressive increases in per capita income compared to 1950, and significant convergence with the living standards of the developed economies. However, other economies, particularly in Latin America, the rest of Asia and Africa, have failed to display significant convergence, and in fact, some of them, have fallen dramatically behind.

1.3 Key Facts about Aggregate Fluctuations

Historically, the process of economic growth has been anything but smooth. As can be seen from both Figure 1.2 and Figure 1.3, GDP per capita displays significant fluctuations around its long run trend. The explanation of these fluctuations in economic activity is the second main area of macroeconomics.

In accounting for the key facts about aggregate fluctuations, we shall present evidence mainly from the United States and the United Kingdom. These two countries have long and relatively consistent time series for the relevant variables, and, to a large extent, it is the experience of those two countries that has contributed to the development of macroeconomics as we know it. However, where appropriate, we shall present evidence for other countries as well.

1.3.1 The Frequency, Severity and Duration of Recessions

In Figure 1.4 we present the evolution of the log of real GDP per capita in the United States, from 1854 to 2014. In Figure 1.5 we present the evolution of the log of real GDP per capita in the United Kingdom, from 1820 to 2014. The grey shaded areas indicate years of recession. Recessions are generally defined as periods in which there is a contraction in economic activity, with real GDP falling rather than rising.

In the United States, the Business Cycle Dating Committee of the National Bureau of Economic Research (NBER) is generally considered as the authority for dating US recessions. The NBER defines an economic recession as: “a significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in real GDP, real income, employment, industrial production, and wholesale-retail sales”. In the United Kingdom, recessions are generally defined as two consecutive
quarters of negative economic growth, as measured by the seasonally adjusted quarter-on-quarter figures for real GDP. The exact same definition of a recession applies for all member states of the European Union, and is the most widely used definition of a recession.

As can be seen from Figure 1.4, there were 54 years of recession in the United States between 1854 and 2014, and 107 years of no recession. In periods of recession, per capita GDP usually falls or remains stagnant. In the 161 years, between 1854 and 2014, a recession occurred, on average, in one of every 3 years. In the period after World War II, there was a drop in the frequency of US recessions. There were 14 years of recession between 1946 and 2014. In the 69 post war years, a recession occurred, on average, in one of every 4.9 years.

In the United Kingdom (Figure 1.5), there were 41 years of recession between 1820 and 2014, and 154 years of no recession. In the 195 years between 1820 and 2014, a recession occurred, on average, in one of every 4.75 years. In the post World War II period, there were 13 years of recession, with a recession occurring in one of every 5.3 years on average.
What is also clear from Figures 1.4 and 1.5 is that not all recessions are alike. Many recessions are short and shallow, but there are also a few deep and quite prolonged ones.

The longest US recession was the recession of the 1870s, while the deepest and second longest recession was the Great Depression of the 1930s. The recessions of the 1890s were the deepest recessions before the onset of the Great Depression. In the post World War II period, the most severe recessions were the ones of the early 1970s and early 1980s, as well as the most recent recession of 2008-09. In the UK, deep and long recessions occurred in the 1840s, in the aftermath of the two World Wars, in the early and late 1970s and the early 1980s, in the early 1990s, as well as in 2008-09.

### 1.3.2 Unemployment and Recessions

One of the key characteristics of recessions is that they are associated with falls in employment and persistent rises in unemployment rates.

Figures 1.6 and 1.7 depict the evolution of unemployment rates in the United Kingdom...
USA and the UK respectively. As is clear from both Figures, there are large and prolonged rises in unemployment rates during recessions. On many occasions, the rise in unemployment continues even after the end of the recession, and the return of unemployment to lower levels is on many occasions quite slow.

The rise in unemployment is considered by many as the most significant economic and social cost of recessions, along with the general fall of real incomes.

Figure 1.6: Recessions and the Unemployment Rate in the United States

Whereas in the pre-World War II period unemployment in the United States tended to fluctuate around a rate slightly below 5% of the labor force, in the Great Depression unemployment reached almost 25% of the labor force. The average unemployment rate in the 1930s was 18.8% of the US labor force, higher than the peak unemployment rate of 18.4% in the previously deepest recession of the 1890s.\(^{17}\)

In the post World War II period, fluctuations in the US unemployment

\(^{17}\)Darby [1976] and Romer [1994] have provided lower revised estimates of the pre-World War II unemployment rates in the USA, but the general picture does not change.
rate are smaller, but significant nonetheless. In the recession of the 1970s unemployment rose from 4.9% of the labor force in 1973, to a peak of 8.5% of the labor force in 1975. In the recession of the early 1980s, unemployment rose from 5.8% of the labor force in 1979, to 9.7% in 1982. In the recession of 2008-09, unemployment rose from 4.6% of the labor force in 2007, to 9.6% in 2010.

![Figure 1.7: Recessions and the Unemployment Rate in the United Kingdom](Image)

The UK experience is not too different. Unemployment rates as high as 7-10% were not uncommon in the recessions of the 19th century. In the recession of the early 1920s unemployment rose to 12.1%, and in the Great Depression of the early 1930s it rose to a peak of 15.3% in 1932.

In the post World War II period unemployment in the UK was remarkably low for many years. Yet, following the recession of the early 1970s, it started creeping up. From 2.2% of the labor force in 1973, it rose to 5.1% in 1977. It is remarkable that it continued rising even after the recovery had started. From 4.6% in 1979, it rose significantly during the recession of the early 1980s. It peaked at 11.2% of the labor force in 1985, long after the recovery had started. The same pattern was repeated in the recession
of the early 1990s, and the latest recession of 2008-09. In the early 1990s, the unemployment rate rose from 7.1% in 1989 to 10.2% in 1993, after the recession had ended, while in the last recession, it rose from 5.3% in 2007 to a peak of 8.1% in 2011, two years after the end of the recession.

The sustained and persistent rise in unemployment, along with the sustained drop in real incomes, is thus one of the key characteristics of recessions, and one of the most important reasons that macroeconomics is concerned with aggregate fluctuations. Unemployment not only rises during recessions, but it also persists, and on many occasions it peaks after a recession has turned into recovery. Thereafter, it falls only gradually during the recovery.

1.3.3 Trends and Fluctuations in the Price Level and the Rate of Inflation

A third key macroeconomic variable is the price level, and its rate of change, the rate of inflation. The price level and its rate of change is what determines the purchasing power of money incomes. Figures 1.8 and 1.9 depict the evolution of the price level in the USA and the UK respectively, while Figures 1.10 and 1.11 depict the evolution of inflation.

A number of interesting facts emerge from these Figures, with regard to the evolution of the price level and inflation.

The first fact is that before World War II, the price level did not display a marked upwards trend, as it did after World War II. If anything, there were long periods of a falling price level, both during the gold standard period, and in the interwar years. Inflation was a temporary phenomenon, associated with wars, such as the American Civil War of 1861-1865, World War I, or periods of economic boom. On the other hand, the price level tended to fall during recessions, which were thus also periods of deflation.

Average annual inflation in the 1854-1913 period was only 0.6% in the USA, and average annual inflation in the 1821-1913 period in the UK was -0.2%. The price level in the UK was on a slightly negative trend until World War I. Had it not been for the American Civil War, the US would probably have been characterized by falling prices too.

During the American Civil War US inflation averaged 15% per annum approximately, with peak inflation rates of about 25% in both 1863 and 1864. During World War I, average annual inflation was equal to 9.7% in the USA, and to 15.3% in the UK.

In the interwar period of 1919-1939, there was deflation in both countries. Prices in the USA were falling by 0.2% per annum on average, while prices
in the UK were falling by 0.9% per annum on average.

As can be seen from Figures 1.8 to 1.11, after World War II the price level displays a significant positive trend in both the USA and the UK. Average inflation has been positive, and periodically high, in both countries throughout the post World War II period.

In addition, the negative impact of recessions on the price level and inflation, which was a regular characteristic of the pre-World War II period, does not seem to hold as firmly in the postwar period. The recessions of the 1970s and the early 1980s are associated with an increase rather than a decrease in inflation, a phenomenon that has been described as *stagflation*.

What stands out in trying to explain the long run trends of the price level and inflation, is the very high correlation of inflation and the rate of growth of the money supply and the total lack of correlation of economic growth and the growth of the money supply.

Figure 1.12, which is adapted from McCandles and Weber [1995], shows the close correlation between inflation and the rate of growth of the money supply, as measured by a broad measure of the money stock (M2) in 110
countries, for the period 1960-1990. The correlation coefficient is equal to 0.95. In Figure 1.13, which is again adapted from the same source, one can see the complete absence of any correlation between the growth rate of real GDP and the rate of growth of the money supply. The correlation coefficient is -0.014.

These two facts, the almost complete correlation of money growth and inflation and the total absence of any correlation between money growth and economic growth, is the empirical basis of the assumption of the long run neutrality of money, characteristic of both models of economic growth and models of aggregate fluctuations. This long run neutrality of money is one of the main predictions of the quantity theory of money. As Lucas [1996] has commented, “the prediction that prices respond proportionally to changes in money in the long run, deduced by Hume in 1752 (and by many other theorists, by many different routes, since), has received ample - I would say decisive - confirmation, in data from many times and places. The observation that money changes induce output changes in the same direction receives confirmation in some data sets but is hard to see in others. Large-scale
reductions in money growth can be associated with large-scale depressions or, if carried out in the form of a credible reform, with no depression at all.”

1.3.4 The Price Level, Inflation and Monetary and Fiscal Policy

As we shall see, when we discuss models of the determination of inflation in the relevant chapters, one cannot explain the evolution of the price level and inflation without reference to monetary policy and its relation to fiscal policy and the aims of stabilization policy.

At the risk of running a bit ahead of ourselves, we shall provide a short explanation of the trends in prices and inflation depicted in Figures 1.8 to 1.11. A fuller explanation will have to wait for the analysis of models of inflation and monetary policy in Chapters 10 and 17.

The reason that there was no systematic inflation, and that the price level did not display a particular trend until World War I, is related to the fact that, throughout this period, both the USA and the UK had adopted
metallic monetary systems, based on precious metals (specie), such as gold and silver. Such metallic systems constrained the rate of growth of the money supply. When they were forced to temporarily abandon such systems, as during wars, they sought to return to such systems as soon as possible.

Britain was on a de facto gold standard since the early 18th century. The USA was on a silver standard until 1834, on a bimetallic standard until 1861, and an effective gold standard since 1879.

During the Civil War, the convertibility of the dollar to specie was suspended, and the link of the money supply to gold was relaxed, through the issuance of non convertible paper currency, the *greenbacks*. The issuance of non convertible greenbacks was used to finance the war, and resulted in large increases in the money supply. The increase in the money supply resulted in a rise of the price level through inflation. The suspension of convertibility was always considered as temporary, and dollar convertibility was finally restored in 1879.

What happened during the American Civil War is an example of the use of so called *seigniorage*, i.e revenue from money creation, to partly finance
temporary increases in government expenditure. Government expenditure rises significantly during a war, and money creation is one of the ways to finance this temporarily increased expenditure. The other is government debt.

Paper currency was also issued by the UK during World War I, when convertibility to gold was suspended. Again, the reason was to help finance the war. However, after the war, the major aim of UK postwar financial policy became the return to gold at the prewar parity. Thus, from the early 1920s, UK monetary policy was extremely deflationary, so as to reverse the war time rise of the price level, and allow sterling to return to the gold
Figure 1.13: Money Growth and Real GDP Growth in 110 Countries 1960-1990

standard at the pre-war parity to gold and the US dollar.

The USA, had remained on the gold standard during World War I. In addition, in 1914, the Federal Reserve System was created, and assumed the role of the Central Bank of the United States. The money supply increased less in the USA than in the UK during World War I, as the war affected the US economy and federal government expenditure less than in the case of Britain. As a result the need for seigniorage was not as large.

The UK returned to the gold standard in 1925, after a prolonged period of deflation. The deflation was caused by attempts to reduce the money supply, in order to return to a price level consistent with the pre-war parity between sterling and the dollar. However, when the Great Depression struck, the UK was forced to again abandon the gold standard, which it did in 1931. The USA, which had maintained the gold standard during the war allowed the dollar to be gradually devalued by about 40% against gold in both 1933 and 1934. From $20.67 an ounce, the price of gold rose to $35 an ounce.

The gold standard changed permanently in 1934, as gold coinage was
discontinued in the USA, and significant holdings of gold coins or bullion by the public made illegal. Thus, convertibility only remained for the purposes of foreign payments. This change had important consequences for monetary policy and inflation, especially in the post World War II period.

To explain the change in the behavior of prices and inflation during World War II and, especially, in the postwar period, one must thus again refer to monetary policy. Both the USA and the UK resorted to significant increases in the money supply in order to finance part of the cost of World War II. As a result the price level and inflation rose, despite extensive price controls during the war.

The nature of monetary policy changed after World War II. The Bretton Woods system of fixed but adjustable exchange rates, which was agreed in 1944, by the USA, the UK and a host of other countries, was quite different from the gold standard. Although the USA undertook to maintain a fixed price of gold, at $35 an ounce, and managed to do so until 1968, convertibility existed only for the purpose of foreign payments. Domestic convertibility to gold was not restored in any of the industrial economies. The UK, undertook to maintain a fixed exchange rate of sterling vis-a-vis the dollar, but the system allowed for devaluations in the case of “fundamental disequilibrium”. Monetary policy in the post World War II period, free from the constraints of convertibility, and influenced by keynesian macroeconomics, was directed towards the goal of maintaining high employment. This was partly because no country was prepared to see a return to the unemployment rates of the 1930s.

As we shall see in the relevant chapters (Chapter 12 and Chapter 17), if a central bank seeks to keep unemployment at a very low rate, this can eventually lead to high inflation, through an increase in inflationary expectations. In the post war period, both the Bank of England and the Federal Reserve System sought to maintain low nominal interest rates, and the money supply accommodated changes in the demand for money, caused either by real output growth or by inflation. The goal of maintaining low unemployment took higher precedence relative to the pre-war period and this contributed to a rise in the equilibrium rate of inflation.

When the Bretton Woods system collapsed in the early 1970s, monetary policy became even more accommodating of inflation. Inflation, which until the 1970s was persistently positive but relatively low, increased significantly in the 1970s, a period also characterized by two recessions and low growth. The term stagflation was invented to explain this particular phenomenon. It was only after the restrictive monetary policies of the early 1980s, in both the USA and the UK, that inflation returned to low levels, as the monetary
authorities in both countries changed the primary emphasis of monetary policy from low unemployment to low inflation.

To summarize, both the long run evolution and the fluctuations of the price level and inflation cannot be analyzed without reference to monetary factors and in particular monetary policy. In periods of temporarily high government expenditure, monetary policy is subordinated to fiscal policy, as governments finance a large part of the increased expenditure through money creation and government debt. Money creation results in inflation, which is higher in periods of war.

In the period before World War II, when most developed countries were on the gold or silver standard, their price level did not display a significant upward trend, and average inflation was close to zero. This was because the requirement of convertibility constrained the rate of growth of the money supply to be very low. Periods of war, resulted in suspension of convertibility and temporarily high inflation, as monetary policy was subordinated to the financing needs of national treasuries, and the rate of growth of the money supply increased significantly. Periods of recession were usually associated with deflation.

In the postwar period, the stance of monetary policy appears to have become more accommodative, leading to a positive trend for the price level, and permanently positive inflation. Inflation increased significantly in both the USA and the UK in the 1970s, when the system of floating exchange rates further freed up national monetary policies to pursue high employment targets.

Since the early 1980s, the problem of high inflation has been addressed in the main industrial economies, as national central banks shifted the focus of monetary policy from low unemployment to low inflation. The negative link between inflation and recessions was also broken in the post World War II period, as the recessions of the 1970s were characterized by rises in inflation, resulting in stagflation.

Yet, a number of countries continue to be plagued by high inflation rates. The underlying reason for their problems is the same that has caused inflation to rise in wartime in both the USA and the UK. The need to finance part of government expenditure through seigniorage, as other methods of finance do not suffice. Thus, the problem of high and persistent inflation that plagues a number of countries with weak fiscal systems, or even the problem of hyperinflation, which first appeared in the inter-war period in Europe, but also in the post war period in a limited number of countries, has its roots in the inadequacies of fiscal systems, or their temporary collapse through wars, civil wars, revolutions or extreme forms of political and economic instability.
Episodes of very high inflation and hyperinflation are studied in Chapter 10.

1.4 Conclusions

In this introductory chapter, we have provided a brief overview of the evolution and the current state of macroeconomics, as well as a number of key facts about long run economic growth and fluctuations in output, unemployment and inflation.

We have thus set the stage for an examination and assessment of the main macroeconomic models of long run growth and aggregate fluctuations that are presented in the remainder of this book.

The remainder of the book is divided into eighteen chapters, presenting models of economic growth, aggregate fluctuations and monetary and fiscal policy.

The process of economic growth is analyzed in Chapters 2 to 7. Chapter 2 discusses the basic Solow model of savings, investment and economic growth. Chapter 3 presents and analyzes the Ramsey model of the representative household Overlapping generations models such as the models of Diamond and Blanchard and Weil are presented in Chapter 4. Chapter 5 discusses models that highlight the inter-temporal effects of fiscal policy, while Chapter 6 discusses models that highlight the inter-temporal effects of the money supply and monetary growth. Models of externalities, human capital accumulation, ideas and innovations and endogenous growth are discussed in Chapter 7.

Chapters 8 to 10 focus on models of the microeconomic foundations of consumption under uncertainty (Ch. 8), investment (Ch. 9), as well as money demand, interest rates, the price level and inflation (Ch. 10).

Chapters 11 to 16 present and analyze dynamic stochastic general equilibrium models of aggregate fluctuations. We present the stochastic growth model of aggregate fluctuations (Ch. 11), introduce the basic Keynesian model and the Phillips curve (Ch. 12), and then present a dynamic stochastic version of the prototype new classical model (Ch. 13), an imperfectly competitive model with staggered pricing (Ch. 14), a new Keynesian model with periodic wage setting, (Ch. 15), and a matching model of the determination of equilibrium unemployment (Ch. 16).

Chapters 17 and 18 focus on monetary and fiscal policy. The role and the effectiveness of monetary policy is analyzed in Chapter 17, while fiscal policy and the determination of the public debt is analyzed in Chapter 18.

Chapter 19 focuses of models of multiple macroeconomic equilibria, bub-
bles and endogenous business cycles, while Chapter 20 discusses some of the latest developments in macroeconomics and provides hints for the future of the discipline.