Principles of Macroeconomics

Ian Irvine Steve Ambler Doug Curtis

2023

To Elizabeth and Wendy

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Our Philosophy

Principles of Macroeconomics is focused on the material that students need to cover in a first introductory course. It is slightly more compact than the majority of introductory macroeconomics books in the Canadian marketplace. Decades of teaching experience and textbook writing has led the authors to avoid the encyclopedic approach that characterizes the recent trends in textbooks.

Consistent with this approach, there are no appendices or 'afterthought' chapters. If important material is challenging then it is still included in the main body of the text; it is not relegated elsewhere for a limited audience; the text makes choices on what issues and topics are important in an introductory course. This philosophy has resulted in a Macro book of just 13 chapters, with three introductory chapters common to both the *Principles of Microeconomics* and *Principles of Macroeconomics* books.

Examples are domestic and international in their subject matter and are of the modern era — financial markets, monetary and fiscal policies aimed at inflation and debt control, globalization and the importance of trade flows in economic structure and concerns about slow growth and the risk of deflation are included.

The title is intended to be informative. Students are introduced to the concepts of models early, and the working of such models is illustrated in every chapter. While this book avoids calculus and uses algebra sparingly, it still aims to be rigorous. In contrast to many books on

the market that simply insert diagrams and discuss concepts in a diagrammatic framework, our books develop and analyze key concepts and relations by introducing numerical and empirical examples at the outset. Students are introduced immediately to the practice of taking a set of data, examining it numerically, plotting it and thinking about how it illustrates a concept or relationship. The process is not difficult but it is rigorous and stresses the link between empirical observation, economic theory, models and policy. Hence numerical examples, diagrams and straight line equations and are introduced early and are used throughout.

Structure of the Text

Principles of Macroeconomics provides complete, concise coverage of introductory macroeconomic theory and policy. It examines the Canadian economy as an economic system, and embeds current Canadian institutions and approaches to monetary policy and fiscal policy within that system. Particular attention is given to the recent structure, performance, and evolution of the Canadian economy, and to the current targets and instruments of Canadian monetary and fiscal policy.

These are exciting and challenging times in which to study macroeconomics. We focus on short-run macroeconomic performance, analysis, and policy motivated by the recessions of the early 1980s and 1990s, the financial crisis and recession of 2008-2009, and the prolonged recovery from that recession. The COVID-19 pandemic and its effects on employment, income, output and prices provide a whole new set of challenges for economic analysis and policy. To that end, the text examines macroeconomic institutions, performance, and policies in ways that help students understand and evaluate critically the news media coverage and broader public discussion of the following topics:

- recessions and recoveries, unemployment, inflation, deflation and conditions in financial

markets — topics of ongoing reporting, discussion, and debate;

- monetary and fiscal policy announcements and discussions focused on inflation targets, interest rate settings, budget balances, tax rates, expenditures, and public debt targets as these affect economic performance;
- exports, imports, international capital flows, foreign exchange rates, commodity prices and the importance of the international sector of the Canadian economy; and
- economic growth, productivity growth, and the importance of productivity growth for standards of living in Canada and other countries.

We develop a simple modern Aggregate Demand and Aggregate Supply model of real GDP and the inflation rate based on:

- expenditure decisions by households and businesses in an open economy;
- government sector expenditures, taxes and budgets;
- current Canadian monetary policy based on inflation targets, interest rate policy instruments, and current Bank of Canada operating techniques, including the potential for quantitative or credit easing; and
- Canadian fiscal policy based on deficit and debt ratio targets, and the government's budget function. We discuss the temporary shift to fiscal stimulus in 2009 and the subsequent fiscal austerity designed to achieve a balanced budget by 2015. We also discuss the fiscal stimulus associated with the COVID-19 pandemic and its implications for economic performance and the public debt.

Numerical examples, diagrams, and basic arithmetic are used in combination to illustrate and explain economic relationships. Students learn about: the importance of consumption, capital expenditures, and government budgets; money supply; financial asset prices, yields,

and interest rates; employment and unemployment; and other key relationships in the economy. Canadian and selected international data are used to provide real world examples and comparisons.

Part One

The Building Blocks

1. Introduction to key ideas
2. Theories, models and data
3. The classical marketplace – demand and supply

Economics is a social science; it analyzes human interactions in a scientific manner. We begin by defining the central aspects of this social science – trading, the marketplace, opportunity cost and resources. We explore how producers and consumers interact in society. Trade is central to improving the living standards of individuals. This material forms the subject matter of Chapter 1.

Methods of analysis are central to any science. Consequently we explore how data can be displayed and analyzed in order to better understand the economy around us in Chapter 2. Understanding the world is facilitated by the development of theories and models and then testing such theories with the use of data-driven models.

Trade is critical to individual well-being, whether domestically or internationally. To understand this trading process we analyze the behaviour of suppliers and buyers in the mar-

ketplace. Markets are formed by suppliers and demanders coming together for the purpose of trading. Thus, demand and supply are examined in Chapter 3 in tabular, graphical and mathematical form.

Chapter 1

Introduction to key ideas

In this chapter we will explore the following topics.

1. 1.1 What it's all about
2. 1.2 Macroeconomics versus microeconomics
3. 1.3 Understanding through the use of models
4. 1.4 Opportunity cost and the market
5. 1.5 A model of exchange and specialization
6. 1.6 Production possibilities for the economy
7. 1.7 Aggregate output, growth and cycles

1.1 What's it all about?

The big issues

Economics is the study of human behaviour. Since it uses scientific methods it is called a social science. We study human behaviour to better understand and to improve our world. During his acceptance speech, Nobel Laureate in Economics Christopher Sims (2011) suggested:

> Economics, at its best, is a set of ideas and methods for the improvement of society. It is not, as so often seems the case today, a set of ideological rules for asserting why we cannot face the challenges of stagnation, job loss and widening inequality.

This is an elegant definition of economics and serves as a timely caution about the perils of ideology. Economics evolves continuously as current observations and experience provide new evidence about economic behaviour and relationships. Inference and policy recommendations based on earlier theories, observations and institutional structures require constant analysis and updating if they are to furnish useful responses to changing conditions and problems.

Much of today's developed world faces severe challenges as a result of the financial crisis that began in 2008, and then because of the worldwide pandemic of 2020. Unemployment rates among young people are at historically high levels in several economies, many government balance sheets are in disarray, and inequality is increasing. The world also faces structural upheaval: demographic changes, climate change, political instability and globalization challenge us to understand and modify our behaviour.

Today's world faces several significant challenges: some government balance sheets are in disarray as a result of government expenditures exceeding revenues for prolonged periods;

labour shortages characterize many economies as the demand for workers continues to expand (for skilled workers in particular) while many in the baby-boom cohort (those born mainly in the fifties) are retiring; inflation has hit virtually every economy as a result of rising energy and food prices due primarily to the war between Russia and Ukraine; supply chain shortages are in evidence almost universally as manufacturers in Asia are unable to keep up with the changing demand patterns in its Western markets, which were brought on in part by the COVID-19 pandemic; the increasing share of the population aged 65 and above means higher demographic dependency ratio; income inequality is increasing in many developed economies, and changing climate patterns beg for understanding and solutions. Increasing political polarization will make all of these issues more difficult to confront and resolve.

The COVID-19 pandemic led to forced lockdowns of many sectors in many economies all over the world. In Canada, the pandemic led to the most severe recession (in terms of the drop in output) since the Great Depression of the 1930s. At the time of writing, output and employment in Canada have recovered, but the growth of the federal government's debt and of the Bank of Canada's balance sheet have been unprecedented.[1] See also Application Box 1.1 below.

These challenges do not imply that our world is deteriorating. Literacy rates have been rising dramatically in the developing world for decades; child mortality has plummeted; family size is a fraction of what it was 50 years ago; prosperity is on the rise in much of Asia; life expectancy is increasing universally, deaths through wars are in a state of long-term decline, and absolute poverty has decreased dramatically worldwide over the last several decades. For more details on the overall global improvement in the human condition and economic welfare, see Bailey and Tupey (2020), Tupey and Pooley (2022), or the website humanprogress.org

These developments, good and bad, have a universal character and affect billions of indi-

[1] Chapter 7 of *Principles of Macroeconomics* covers the fiscal policy response to the pandemic in more detail.

viduals. They involve an understanding of economies as large organisms with interactive components.

1.2 Macroeconomics versus microeconomics

Microeconomics is concerned with economic actions at the level of the individual or of the organization. Formally, microeconomics is the study of individual behaviour in the context of scarcity. Microeconomics deals with various issues like demand and supply in individual markets, the determination of equilibrium product prices and quantities, economic welfare, the structure of markets, and much more.

> **Microeconomics**: the study of individual behaviour and market equilibrium in the context of scarcity.

Microeconomics is concerned with the following types of questions among others.

1. What determines how households and individuals allocate their budgets to the purchase of different goods and services?
2. How do people decide whether or not to work and if so to work full time or part time?
3. How do households and individuals decide how much of their after-tax incomes to spend on purchases and how much either to save for the future or to borrow so they can spend beyond their current means?
4. What determines which products a firm will produce and how many of each?
5. How does a firm decide what prices it will charge?
6. How does a firm decide how many workers to hire and for what wages?

7. What determines how much a firm will invest to buy more productive equipment?

8. What determines how a firm will finance these purchases?

Macroeconomics is concerned with the structure, performance and behaviour of the economy as a whole. The prime concern of macroeconomists is to analyze and to understand the underlying determinants of the main trends with respect to the total output of goods and services (**gross domestic product** or **GDP**),[2] unemployment, inflation and international transactions. Macroeconomic analysis seeks to explain both short-run fluctuations in GDP (the business cycle), and the long-run path of GDP (economic growth). An economy with successful macroeconomic management will experience low unemployment and inflation along with steady and sustained economic growth. In contrast, poor management can lead to adverse impacts on living standards and employment. In extreme circumstances the consequences of macroeconomic instability have been devastating, such as during the Great Depression of the 1930s.

> **Macroeconomics**: the study of the economy as a system in which interactions and feedbacks among sectors determine national output, employment and prices.

Macroeconomists study the following types of questions.

1. What determines the level of economic activity in a society?

2. What determines how many jobs are available in an economy?

3. What determines a nation's standard of living?

4. What determines the rate at which an economy's total output increases or decreases?

5. What influences firms to hire more workers or to lay workers off?

[2] Chapter 4 of *Principles of Macroeconomics* covers in detail how GDP is calculated.

6. What causes the economy to grow over the long term?

7. How does the monetary policy of central banks influence interest rates, an economy's total output, and inflation?

8. How does fiscal policy (government spending and taxation) affect macroeconomic outcomes?

Aggregate Output in a National Economy

A national economy is a complete multi-sector system, made up of household, business, financial, government and international sectors. Each of these sectors is an aggregate or sum of many smaller economic units with similar characteristics. For example, the government sector aggregates the taxing and spending activities of local, provincial and national governments. Similarly, the household sector is an aggregate of the income, spending and saving of all households while abstracting from the specifics of each individual household. Economic activity within any one of these sectors reflects the conditions and choices made in that sector, but it also the conditions and actions in the other sectors. These *interactions* and *feedbacks* mean that the workings of the macro-economy are more complex than the operation of the sum of its parts.

The standard measure of aggregate economic activity is **real gross domestic product** or **GDP**. GDP measures the quantity of final goods and services (goods purchased by their ultimate users).[3]

> **Real gross domestic product (GDP)**: the quantity of final goods and services produced by the economy.

For example, consider a simple economy with just household, business and financial sectors.

[3]Chapter 4 of *Principles of Macroeconomics* discusses in detail how GDP is measured.

The household sector earns income by providing labour to the other sectors. Households are also the ultimate owners of the economy's firms, and receive income in the form of dividends, interest payments, wages and salaries, etc. Households make choices about spending or saving this income. Businesses make decisions about the sizes of their establishments, their stock of capital, their labour forces, and their outputs of goods and services. The financial sector provides banking services: bank deposits, loans, and the payments system used by all three sectors.

Suppose households decide to spend more money on goods and services and therefore to save less. That decision by itself does not change household sector income, but it does increase business sector sales and revenues. It also reduces the flow of household savings into bank deposits in the financial sector. As a result, the business sector has an incentive to increase employment and output and perhaps to borrow from the financial sector to finance that expansion. Increased employment in the business sector increases incomes in the household sector and further increases household expenditure and savings. These linkages and feedbacks between sectors produce a response in aggregate economy greater than the initial change.

Expanding this simple example to include more sectors increases its complexity but does not change the basics. A change in behaviour within a sector, or disturbance from outside that sector, changes aggregate levels of output, employment and prices. A complete multi-sector macroeconomic theory and model is required to understand the effects, on the aggregate economy, of changes in either internal or external economic conditions. It is also essential for the design of policies to manage the macroeconomic conditions.

Mitigating the effects of a large random shock from outside the economy, like the COVID-19 pandemic, disrupts all sectors of the economy. Flows of income, expenditure, revenue,and output among sectors are reduced sharply both by the pandemic and by government and financial sectors policy responses.

Application Box 1.1: COVID-19 and the Economy

The COVID-19 pandemic attacked Canada (and the rest of the world) in early 2020. It revealed the complexities and inter-dependencies that drive the macro economy. The federal and provincial governments mandated personal and social distancing for individuals plus self-isolation and quarantine in some cases, with the goal of slowing the spread of infections so as not to overwhelm hospital emergency wards.

In addition many businesses, mainly those in the service sector which relied on face-to-face interactions with customers or live audiences were forced to close. As a result, businesses lost sales revenues and cut output. They reduced employment to cut labour costs, but overhead costs remained. Households lost employment and employment incomes. They reduced their discretionary spending, but their overhead costs continued. As a result the economy faced a unique, simultaneous collapse in overall private supply and demand. This led to a deep recession. The government and financial sectors intervened with fiscal and monetary policy support. Government introduced a wide range of new income supports for the household sector, and loan and subsidy programs to support businesses, funded by large increases in the government's budget deficit. The Bank of Canada lowered interest rates and increased the monetary base to support the financial sector.

According to data from Statistics Canada, quarterly real GDP in Canada decreased by 1.7 percent in the first quarter of 2020 and by 11.2 percent in the second quarter of 2020. GDP growth was positive in the third quarter, but GDP did not regain its level in the last quarter of 2019 until the third quarter of 2021. The decline in GDP was the steepest and shortest recession in Canada since the Second World War.

The unprecedented support from fiscal and monetary policy offset part of the loss in national output and income. Government income support to households combined with the lack of spending opportunities with businesses shut down led to a very high rate of household saving in the second quarter of 2020. Households kept much of this extra saving in bank accounts. As the economy gradually opened up starting in the third quarter of 2020, demand for goods grew more quickly than supply, leading to rates of inflation not seen in Canada since the early 1980s. At the time of writing inflation remains very high.

Individual behaviours

Individual economic decisions need not be world-changing events, or motivated by a search for profit. Microeconomics is also about how we choose to spend our time and money. There are quite a few options to choose from: sleep, work, study, food, shelter, transportation, entertainment, recreation and so forth. Because both time and income are limited we cannot do all things all the time. Many choices are routine or are driven by necessity. You have to eat and you need a place to live. If you have a job you have committed some of your time to work, or if you are a student some of your time is committed to lectures and study. There is more flexibility in other choices. Critically, microeconomics seeks to understand and explain how we make choices and how those choices affect our behaviour in the workplace, the marketplace, and society more generally.

A critical element in making choices is that there exists a scarcity of time, or income or productive resources. Decisions are invariably subject to limits or constraints, and it is these constraints that make decisions both challenging and scientific.

Microeconomics also concerns business choices. How does a business use its funds and

management skill to produce goods and services? The individual business operator or firm has to decide what to produce, how to produce it, how to sell it and in many cases, how to price it. To make and sell pizza, for example, the pizza parlour needs, in addition to a source of pizza ingredients, a store location (land), a pizza oven (capital), a cook and a sales person (labour). Payments for the use of these inputs generate income to those supplying them. If revenue from the sale of pizzas is greater than the costs of production, the business earns a profit for the owner. A business fails if it cannot cover its costs.

In these micro-level behaviours the decision makers have a common goal: To do as well as they can, *given the constraints imposed by the operating environment*. The individual wants to mix work and leisure in a way that makes her as happy or contented as possible. The entrepreneur aims at making a profit. These actors, or agents as we sometimes call them, are *maximizing*. Such maximizing behaviour is a central theme in this book and in economics at large.

Markets and government

Markets play a key role in coordinating the choices of individuals with the decisions of business. In modern market economies goods and services are supplied by both business and government. Hence we call them **mixed economies**. Some products or services are available through the marketplace to those who wish to buy them and have the necessary income — such as coffee and wireless services. Other services are provided to all people through government programs like law enforcement and health care.

> **Mixed economy**: goods and services are supplied both by private suppliers and governments.

Markets offer the choice of a wide range of goods and services at various prices. Individuals decide the pattern of expenditures and the bundle of goods and services they prefer. Busi-

nesses sell goods and services in the expectation that the market price will cover costs and yield a profit.

The market also allows for specialization and separation between production and use. Rather than each individual growing her own food, for example, she can sell her time or labour to employers in return for income. That income can then support her desired purchases. If businesses can produce food more cheaply than individuals the individual obviously gains from using the market — by both having the food to consume, and additional income with which to buy other goods and services. Economics seeks to explain how markets and specialization might yield such gains for individuals and for society as a whole.

Individuals and firms are assumed to have explicit objectives — their happiness or their profit. This does not imply that individuals and firms are concerned only with such objectives. On the contrary, much of microeconomics and macroeconomics focuses upon the role of government: how it manages the economy through fiscal and monetary policy, how it redistributes income through taxes and transfers, and how it supplies information to buyers and sets safety standards for products.

These government policies reflect (imperfectly) the preferences and social ethos of voters. So, while these voters may be seeking to increase their own happiness or profits (and our models of human behaviour in microeconomics certainly emphasize this optimization), economics does not see individuals and corporations as being devoid of civic virtue or compassion. Neither does it assume that only market-based activity is important. Governments play a central role in modern economies. Government spending accounts for more than one third of all economic activity in modern economies like Canada's.

Governments supply goods and services in many spheres, for example health and education. The provision of public education is motivated both by a concern for equality and a realization that an educated labour force increases the productivity of an economy. Likewise,

the provision of law and order, through our legal system broadly defined, represents more than a commitment to a just society at the individual level. Without a legal system that enforces contracts and respects property rights, the private sector of the economy would diminish dramatically as a result of corruption, uncertainty and insecurity. It is the lack of such a secure environment in many of the world's economies that inhibits their growth and prosperity.

Let us consider now the basic methodology of economics, which is common to all science-based disciplines.

1.3 Understanding through the use of models

Most students have seen an image of Ptolemy's concept of our Universe. Earth forms the centre, with the other planets and our sun revolving around it. The ancients' anthropocentric view of the universe necessarily placed the earth at the centre. Despite being false, this view of our world worked reasonably well, in the sense that they could predict celestial motions, lunar patterns and the seasons quite accurately.

More than one Greek astronomer believed that it was more natural for smaller objects such as the earth to revolve around larger objects such as the sun, and they knew that the sun had to be larger as a result of having studied eclipses of the moon and sun. Nonetheless, the Ptolemaic description of the universe persisted until Copernicus wrote his treatise *On the Revolutions of the Celestial Spheres* in the early sixteenth century. It was another hundred years before the Roman Catholic Church accepted that our corner of the universe is heliocentric. During this time evidence accumulated as a result of the work of Brahe, Kepler and Galileo. The time had come for the Ptolemaic model of the universe to be supplanted with a better model.

All disciplines progress and develop and explain themselves using **models** of reality. A model is a formalization of theory that facilitates scientific inquiry. Any history or philosophy of science book will describe the essential features of a model. First, it is a stripped down, or reduced, version of the phenomenon that is under study. It incorporates the key elements while disregarding what are considered to be secondary elements. Second, it should accord with reality. Third, it should be able to make meaningful predictions. Ptolemy's model of the known universe met these criteria. It was not excessively complicated (for example distant stars were considered as secondary elements in the universe and were excluded), it corresponded to the known reality of the day, and it made pretty good predictions. Evidently not all models are correct and this was the case here.

> **Model**: a formalization of theory that facilitates scientific inquiry.

Models help us organize how we think about a problem. Economists sometimes interchange the terms theories and models, though they are conceptually distinct. A **theory** is a logical view of how things work, and is frequently formulated on the basis of observation. A model is a formalization of the essential elements of a theory, and has the characteristics we described above. As an example of an economic model, suppose we theorize that a household's expenditure depends on its key characteristics: A corresponding model might specify that wealth, income, and household size determine its expenditures, while it might ignore other, less important, traits such as the household's neighbourhood or its religious beliefs. The model reduces and simplifies the theory to manageable dimensions. From such a reduced picture of reality we develop an analysis of how an economy and its components work.

> **Theory**: a logical view of how things work, frequently formulated on the basis of observation.

Economists are not alone in this approach; astronomers, meteorologists, physicists, and genetic scientists operate in much the same way. Meteorologists disregard weather conditions

in South Africa when predicting tomorrow's conditions in Winnipeg. Genetic scientists concentrate on the interactions of limited subsets of genes that they believe are the most important for their purpose. Even with huge computers, all of these scientists build models that concentrate on the essentials.

Economists, along with other scientists, use models to make predictions about the real world. Ideally, the predictions are falsifiable. That is, they can be checked against real-world data. If the predictions do not line up with the data, they will either make minor modifications to their models or replace them with entirely new ones.

1.4 Opportunity cost and the market

Individuals face choices at every turn. For example, in deciding to go to the hockey game tonight, you may have to forgo a concert. Ot you will have to forgo some leisure time this week in order to earn additional income for the hockey game ticket. Indeed, there is no such thing as a free lunch, a free hockey game or a free concert. In economics we say that these limits or constraints reflect opportunity cost. The **opportunity cost** of a choice is what must be sacrificed when a choice is made. The cost may be financial, it may be measured in time, or it may simply be the alternative foregone.

> **Opportunity cost**: what must be sacrificed when a choice is made.

Opportunity costs play a determining role in markets. It is precisely because individuals and organizations have different opportunity costs that they enter into exchange agreements. If you are a skilled plumber and an unskilled gardener, while your neighbour is a skilled gardener and an unskilled plumber, then you and your neighbour not only have different capabilities, you also have different opportunity costs, and *you could gain by trading your skills.* Here's why. Fixing a leaking pipe has a low opportunity cost for you in terms of time: you can do

it quickly. But pruning your apple trees will be costly because you must first learn how to avoid killing them and this may require many hours. Your neighbour has exactly the same problem, with the tasks in reverse positions. In a sensible world you would fix your own pipes and your neighbour's pipes, and she would ensure the health of the apple trees in both backyards.

This "sensible" solution resembles the one provided by the marketplace. You may not have a gardener as a neighbour, so you buy the services of a gardener in the marketplace. If you can generate more than enough income as a plumber in the time it would take you to trim your tree, you gain by doing so. Likewise, your immediate neighbour may not need a leaking pipe repaired, but many others in your neighbourhood do, so you sell your service to them. You each specialize in the performance of specific tasks as a result of having different opportunity costs.

Let's develop a model of exchange to illustrate the advantages of specialization and trade, and hence the markets that facilitate these activities. This model is developed with the help of some two-dimensional graphs.

1.5 A model of exchange and specialization

Production and specialization

We have two producers and two goods: Amanda and Zoe produce vegetables (V) and or fish (F). Their production capabilities are defined in Table 1.1 and in Figure 1.1, where the quantity of V appears on the vertical axis and the quantity of F on the horizontal axis. Zoe and Amanda each have 36-hour weeks and they devote that time to producing the two goods. But their efficiencies differ: Amanda requires two hours to produce a unit of V and three hours for a unit of F. As a consequence, if she devotes all of her time to V she can

produce 18 units, or if she devotes all of her time to F she can produce 12 units. Or, she could split her time between the two. Her production possibilities are illustrated in Figure 1.1 along with Zoe's.

Table 1.1: **Production Possibilities in a two-person economy**

	Hours/fish	Hours/vegetable	Fish only	Vegetables only
Amanda	3	2	12	18
Zoe	2	4	18	9

Each producer has a time allocation of 36 hours. By allocating total time to one activity, Amanda can produce $12F$ or $18V$, and Zoe can produce $18F$ or $9V$. By splitting their time, each person can also produce a combination of the two.

Two-dimensional graphs are a means of portraying the operation of a model, as defined above. We will use these graphical representations throughout the text. In this case, Amanda's production capability is represented by the line that meets the vertical axis at 18 and the horizontal axis at 12. The vertical point indicates that she can produce 18 units of V if she produces zero units of F — keep in mind that where V has a value of 18, Amanda has no time left for fish production. Likewise, if she devotes all of her time to fish she can produce 12 units, since each unit requires 3 of her 36 hours. The point $F = 12$ is thus another possibility for her. In addition to these two possibilities, which we can term 'specialization,' she could allocate her time to producing some of each good. For example, by dividing her 36 hours equally she could produce 6 units of F and 9 units of V. A little computation will quickly convince us that different allocations of her time will lead to combinations of the two goods that lie along a straight line joining the specialization points.

We will call this straight line Amanda's **production possibility frontier** (PPF). It is the combination of goods she can produce while using all of her resources (time). She could not produce combinations of goods represented by points beyond this line (to the top right). She could of course produce combinations below it (lower left) — for example, a combination of 4 units of V and 4 units of F — but such points would not require all of her time. The (4,4) combination would require just 20 hours. In sum, points beyond this line are not feasible,

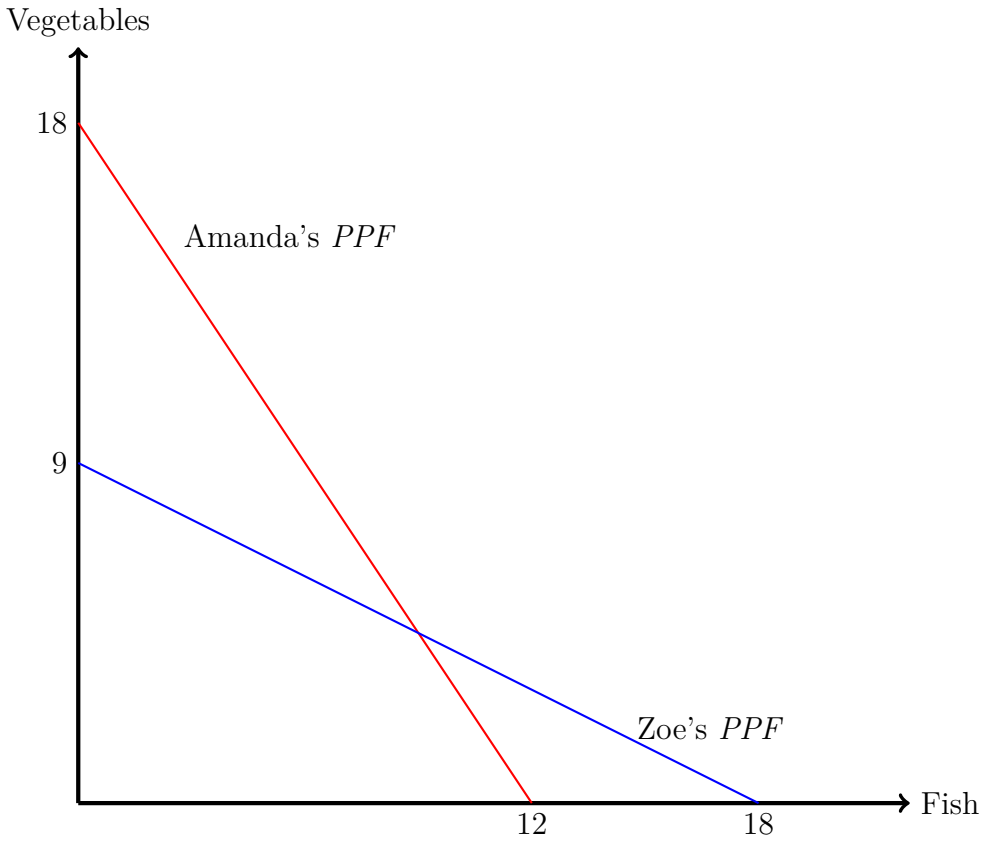


Figure 1.1: **Absolute advantage in production**

Amanda's PPF indicates that she can produce either $18V$ (and zero F), or $12F$ (and zero V), or some combination of the two. Zoe's PPF indicates she can produce either $9V$ (and zero F), or $18F$ (and zero V), or some combination of the two. Amanda is more efficient in producing V and Zoe is more efficient at producing F.

and points within it do not require all of her time resources.

> **Production possibility frontier** (PPF): the combination of goods that can be produced using all available resources.

Having developed Amanda's PPF, it is straightforward to develop a corresponding set of possibilities for Zoe. If she requires 4 hours to produce a unit of V and 2 hours to produce a unit of F, then her 36 hours will enable her to specialize in 9 units of V or 18 units of F; or she could produce a combination represented by the straight line that joins these two specialty extremes.

Consider now the opportunity costs for each person. Suppose Amanda is currently producing 18 V and zero F, and considers producing more F and less V. For each unit of F she wishes to produce, it is evident from her PPF that she must sacrifice 1.5 units of V. This is because F requires 50 percent more hours than V. Her trade-off ratio is 1.5/1.0. The additional time requirement is also expressed in the intercept values: She could give up 18 units of V and produce 12 units of F instead; this again is a ratio of 1.5/1.0. This ratio defines her opportunity cost: the cost of an additional unit of F is that 1.5 units of V must be "sacrificed."

Applying the same reasoning to Zoe's PPF, her opportunity cost is 0.5/1; she must sacrifice one half of a unit of V to free up enough time to produce one unit of F.

So we have established two things about Amanda and Zoe's production possibilities. First, if Amanda specializes in V she can produce more than Zoe, just as Zoe can produce more than Amanda if Zoe specializes in F. Second, their opportunity costs are different: Amanda must sacrifice more V than Zoe in producing one more unit of F. The different opportunity costs translate into potential gains for each individual.

The gains from trade

We can illustrate the gains that arise from specialization and exchange graphically. Note first that if these individuals are self-sufficient, in the sense that they consume their own production, each individual's consumption combination will lie on their own PPF. For example, Amanda could allocate half of her time to each good, and produce (and consume) $6F$ and $9V$. Such a point necessarily lies on her PPF. Likewise for Zoe. So, in the absence of exchange, each individual's PPF is also her **consumption possibility frontier** (CPF). In Figure 1.1 the PPF for each individual is thus also her CPF.

> **Consumption possibility frontier** (CPF): the combination of goods that can be consumed as a result of a given production choice.

Upon realizing that they are not equally efficient in producing the two goods, they decide to specialize completely in producing just the single good where they are most efficient. Amanda specializes in V and Zoe in F. Next they must agree to a rate at which to exchange V for F. Since Amanda's opportunity cost is 1.5/1 and Zoe's is 0.5/1, suppose they agree to exchange V for F at an intermediate rate of 1/1. There are many trading, or exchange, rates possible; our purpose is to illustrate that **gains from trade** are possible for both individuals at some exchange rate. The choice of this rate also makes the graphic as simple as possible. At this exchange rate, $18V$ must exchange for $18F$. In Figure 1.2, this means that each individual is now able to consume along the line joining the coordinates (0, 18) and (18, 0).[4] This is because Amanda produces $18V$ and she can trade at a rate of 1:1, while Zoe produces $18F$ and trades at the same rate of 1:1.

> **Gains from trade**: the net benefits to individuals from being allowed to engage in voluntary trading with each other.

[4] When two values, separated by a comma, appear in parentheses, the first value refers to the horizontal-axis variable, and the second to the vertical-axis variable.

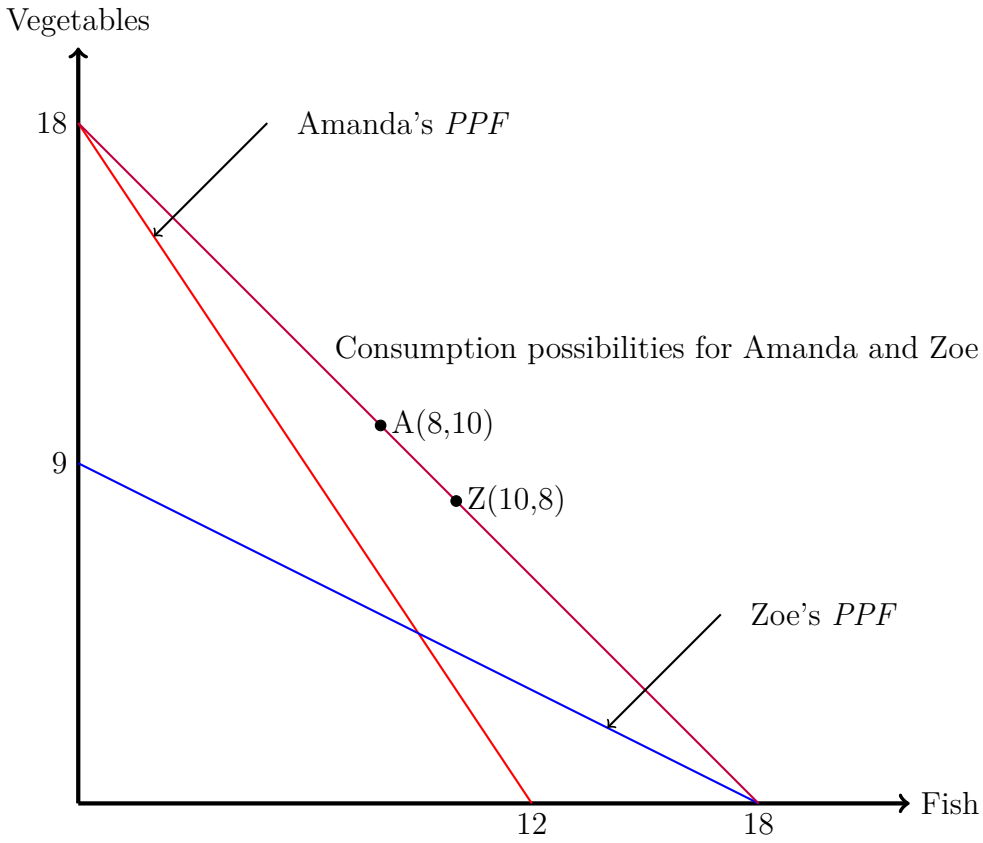


Figure 1.2: **Absolute advantage in consumption**

With specialization and trade at a rate of 1/1 they consume along the line joining the specialization points. If Amanda trades $8V$ to Zoe in return for $8F$, Amanda moves to the point A (8,10) and Zoe to Z (10,8). Each can consume more after specialization than before specialization.

The fundamental result illustrated in Figure 1.2 is that, as a result of specialization and trade, each individual can consume combinations of goods that lie on a line beyond her initial consumption possibilities. Their consumption well-being has thus improved. For example, suppose Amanda trades away $8V$ to Zoe and obtains $8F$ in return. The points A and Z with coordinates (8, 10) and (10, 8) respectively define their final consumption. Before specialization, if Amanda wished to consume $8F$ she would have been constrained to consume $6V$ rather than the $10V$ which is now possible. Zoe benefits correspondingly.[5]

[5]In the situation we describe above one individual is absolutely more efficient in producing one of the goods and absolutely less efficient in the other. We will return to this model in Chapter 15 of *Principles of Microeconomics* and illustrate that consumption gains of the type that arise here can also result if one of the individuals is absolutely more efficient in producing **both** goods, but that the degree of such advantage

The foregoing example illustrates that trade is not a **zero-sum game**; it has a positive net value because both parties to the trade can gain. A zero-sum gain is where the gains to one party exactly offset the losses to another. This is an extraordinarily important principle in trade negotiations, whether international or domestic.

> **Zero-sum game**: an interaction where the gain to one party equals the loss to another party.

Market design

In the preceding example we have shown that specialization provides scope for gains that can accrue to those participating in the exchange. But this tells us little about how a market for these products comes into being: how does the exchange take place, and how is information transmitted? The answer is that while some markets have evolved historically to their current state, many markets are designed by an institution or a firm. Fruit and vegetable markets have been with us for thousands of years — since we ceased being purely a hunter-gatherer society. They exist in every community in the world economy. In contrast, the Dutch tulip auction was designed in the early 1600s and exists in basically the same form to this day: the auctioneer begins with a high price, lowers it at known time intervals (measured in seconds or minutes) until some buyer signals that she is willing to purchase the lot on offer. Supermarkets in contrast offer goods at a fixed price. Government contracts are normally signed after a tendering process, in which interested suppliers submit bids. Amazon Inc. is currently experimenting with 'bricks and mortar' stores without cashiers which monitor all transactions electronically. Craig's List and E-Bay have their own sets of rules.

In each of these cases markets are designed, frequently with a specific objective on the part of the supplier or the mediating institution. Amazon wants to increase its share of all goods

differs across goods.

trades. Governments wish to limit costs. Markets do not all grow spontaneously and the structure of a market will influence how the gains from trade are distributed.

1.6 Production possibilities for the economy

The PPFs in Figures 1.1 and 1.2 define the amounts of the goods that each individual can produce while using all of their fixed productive capacity—time in this instance. The national or **economy-wide** PPF for this two-person economy reflects these individual possibilities combined. Such a frontier can be constructed using the individual frontiers as the component blocks.

First let us define this economy-wide frontier precisely. The economy-wide PPF is the set of goods and services combinations that can be produced in the economy when all available productive resources are in use. Figure 1.3 contains both of the individual frontiers plus the aggregate of these, represented by the kinked line *ace*. The point on the V axis, $a = 27$, represents the total amount of V that could be produced if both individuals devoted all of their time to it. The point $e = 30$ on the horizontal axis is the corresponding total for fish.

> **Economy-wide** PPF: the set of goods and services combinations that can be produced in the economy when all available productive resources are in use.

To understand the point c, imagine initially that all resources are devoted to V. From such a point, a, consider a reduction in V and an increase in F. The most efficient way to increase the production of F from point a is to use the individual whose opportunity cost is lower. Zoe can produce one unit of F by sacrificing just 0.5 units of V, whereas Amanda must sacrifice 1.5 units of V to produce 1 unit of F. Hence, at this stage Amanda should stick to V and Zoe should devote some time to fish. In fact as long as we want to produce more fish Zoe should be the one to do it, until she has exhausted her time resource. This occurs

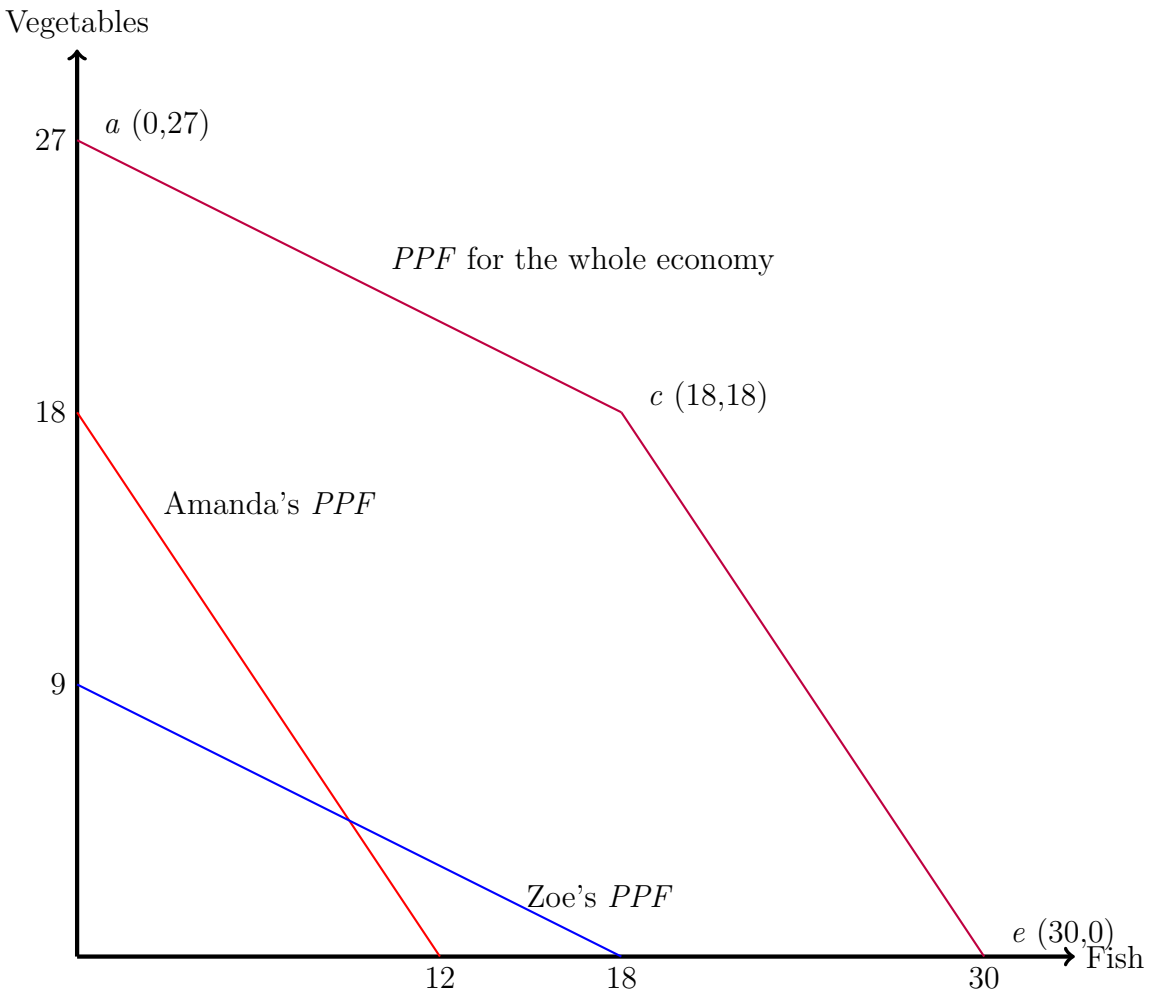


Figure 1.3: **Absolute advantage in production**

From a, to produce Fish it is more efficient to use Zoe because her opportunity cost is less (segment ac). When Zoe is completely specialized, Amanda produces (ce). With complete specialization this economy can produce either $27V$ or $30F$.

after she has produced $18F$ and has ceased producing V. At this point the economy will be producing $18V$ and $18F$ — the point c.

From this combination, if the economy wishes to produce more fish Amanda must become involved. Since her opportunity cost is 1.5 units of V for each unit of F, the next segment of the economy-wide PPF must see a reduction of 1.5 units of V for each additional unit of F. This is reflected in the segment ce. When both producers allocate all of their time to F the economy can produce 30 units. Hence the economy's PPF is the two-segment line ace.

Since this has an outward kink, we call it concave (rather than convex).

Production possibilities with many producers

As a final step consider what this PPF would resemble if the economy were composed of many persons with differing efficiencies. A little imagination suggests (correctly) that it will have a segment for each individual and continue to have its outward concave form. Hence, a four-person economy in which each person had a different opportunity cost could be represented by the segmented line *abcde*, in Figure 1.4. Furthermore, we could represent the PPF of an economy with a very large number of such individuals by a somewhat smooth PPF that accompanies the 4-person PPF. The logic for its shape continues to be the same: As we produce less V and more F we progressively bring into play resources, or individuals, whose opportunity cost in terms of reduced V is higher.

The outputs V and F in our economic model require just one input — time, but if other productive resources were required the result would still be a concave PPF. Furthermore, we generally interpret the PPF to define the output possibilities *when the economy is running at its normal capacity*. In this example, we consider a work week of 36 hours to be the 'norm'. Yet it is still possible that the economy's producers might work some additional time in exceptional circumstances, and this would increase total production possibilities. This event would be represented by an outward movement of the PPF.

The concept of PPF can also be generalized to the production of more than two different goods. Of course it is not possible to represent a more complex PPF using a two-dimensional graph, but the principles are similar. As production of a good is increased, it is efficient to first use the resources which are the most productive, that is to say the resources which have the lowest opportunity cost.

In the above example of a PPF, there was a single productive resource, time, and two

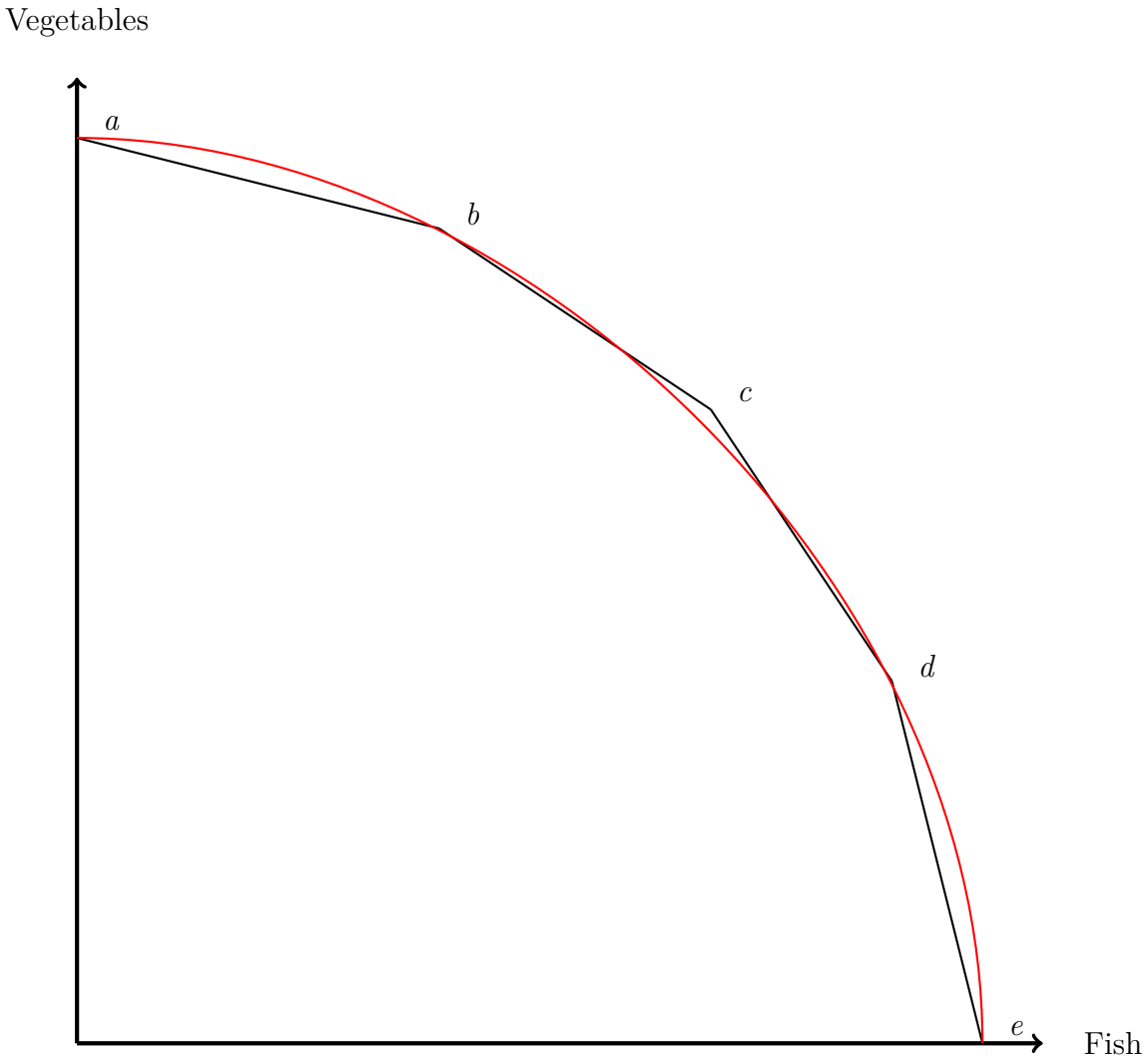


Figure 1.4: **A multi-person PPF**

The PPF for the whole economy, *abcde*, is obtained by allocating productive resources most efficiently. With many individuals we can think of the PPF as the concave envelope of the individual capabilities.

possible uses for that time (producing fish and producing vegetables). In real life, many different inputs (capital, buildings, factories, capital, intermediate goods, etc.) are used to produce goods and services.[6]

[6]In Chapter 11 of *Principles of Macroeconomics* we will look at **production functions** which relate productive inputs to outputs. These production functions are subject to the law of **diminishing returns**. Doubling the quantity of one of the inputs while holding all other inputs constant leads output to increase, but to less than double.

1.7 Aggregate output, growth and cycles

The PPF can be used to illustrate several aspects of macroeconomics: In particular, the level of an economy's output, the growth of national and per capita output over time, and short-run business-cycle fluctuations in national output and employment.

Aggregate output

An economy's capacity to produce goods and services depends on its endowment of resources and the productivity of those resources. The two-person, two-product examples in the previous section reflect this.

The **productivity of labour**, defined as output per worker or per hour, depends on the following factors:

- the skill, knowledge and experience of the labour force;
- the **capital stock** — buildings, machinery, equipment, and software the labour force has to work with; and
- the current state of technology.

> **Labour productivity**: the output of goods and services per labour hour.

> **Capital stock**: the buildings, machinery, equipment and software used in producing goods and services.

The economy's output, defined by Y, can be defined as the output per labour hour times the total number of hours worked by workers. We can write

$$Y = (\text{total hours worked}) \times (\text{output per hour worked}) .$$

When the employment of labour corresponds to "full employment" in the sense that everyone willing to work at current wage rates and normal hours of work is working, the economy's actual output is also its capacity output Y_c. We also term this capacity output as **full employment output**.

> **Full employment output**: defined as the total hours worked by workers at full employment multiplied by the output per hour worked.

Suppose the economy is operating with full employment of resources producing outputs of two types: goods and services. In Figure 1.5, PPF_0 shows the different combinations of goods and services the economy can produce in a particular year using all its labour, capital and the best technology available at the time.

An aggregate economy produces a large variety of outputs in two broad categories. Goods are the products of the agriculture, forestry, mining, manufacturing and construction industries. Services are provided by the wholesale and retail trade, transportation, hospitality, finance, health care, education, legal and other service sectors. As in the two-product examples used earlier, the shape of the PPF illustrates the opportunity cost of increasing the output of either product type. We are not concerned with who supplies the products for the moment: it may be the private sector or the government. Point X_0 on PPF_0 shows one possible structure of capacity output. This combination may reflect the pattern of demand and hence expenditures in this economy. Output structures and therefore the shapes of PPFs differ among economies with different income levels. High-income economies spend more on services than goods and produce higher ratios of services to goods. Middle-income countries produce lower ratios of services to goods, and low income countries much lower ratios of services to goods. For example, in 2017, the structure of national output in Canada was 70 percent services and 30 percent goods while in Mexico the structure was 48 percent services and 52 percent goods.

Different countries also have different PPFs and different output structures, depending

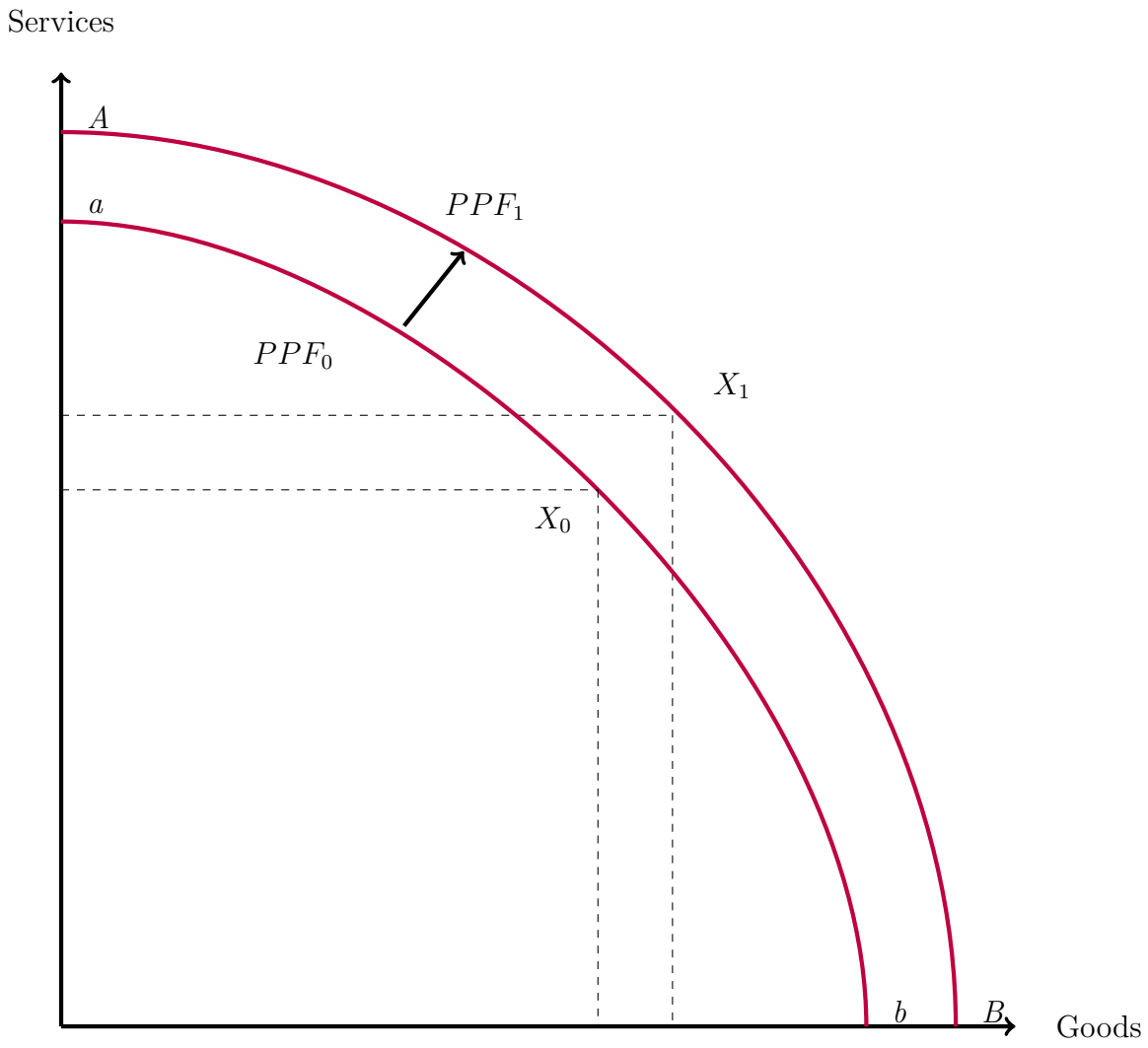


Figure 1.5: **Growth and the PPF**

The PPF for the whole economy, *abcde*, is obtained by allocating productive resources most efficiently. With many individuals we can think of the PPF as the concave envelope of the individual capabilities.

on their resource endowments, labour forces, capital stocks, technology and expenditure patterns.

Economic growth

Three things contribute to growth in the economy:

1. the labour supply grows as the population expands;

2. the stock of capital grows as spending by business (and government) on buildings, machinery, information technology and so forth increases (investment); and

3. labour-force productivity grows as a result of experience, the development of scientific knowledge combined with product and process innovations, and advances in the technology of production.

Combined, these developments expand capacity output over time. In Figure 1.5 economic growth shifts the PPF out from PPF_0 to PPF_1.

This basic description covers the key sources of growth in total output. Economies differ in their rates of overall economic growth as a result of different rates of growth in labour force, in capital stock, and improvements in technology. But improvements in standards of living require more than growth in total output. Increases in output *per worker* and *per person* are necessary. Sustained increases in living standards require sustained growth in labour productivity, which in turn is based on advances in the technology along with the amount of capital each worker has to work with. Furthermore, if the growth in output is to benefit society at large, workers across the board need to see an increase in their earnings.[7]

Recessions and booms

A prime objective of economic policy is to ensure that the economy operates on or near the PPF — it should use its resources to capacity and have minimal unemployment. However, economic conditions are seldom tranquil for long periods of time. Unpredictable changes in business expectations of future profits, in consumer confidence, in financial markets, in commodity and energy prices, in trade agreements and disputes, in economic conditions

[7] Chapter 13 of *Principles of Microeconomics* examines the distribution of income, and looks at several developed countries where the highest income earners have been the major beneficiaries of growth.

in major trading partners, in government policy and many other events disrupt patterns of expenditure and output. Some of these changes disturb the level of total expenditure and thus the demand for total output. Others disturb the conditions of production and thus the economy's production capacity. Whatever the exact cause, the economy may be pushed off its current PPF. If expenditures on goods and services decline, the economy may experience a **recession**. Output would fall short of capacity output and unemployment would rise. A recession occurs if there is a pronounced, persistent, and pervasive decline in aggregate economic activity. In other words, to identify a recession three dimensions need to be considered simultaneously: amplitude, duration, and scope — or how widespread a downturn is.[8]

> **Recession**: a pronounced, persistent and pervasive (widespread) decline in aggregate economic activity, typically involving a persistent and absolute decline in real output.

Alternatively, times of rapidly growing expenditure and output may result in an economic **boom**: output and employment expand beyond capacity levels.

> **Boom**: a period of high growth that raises output above normal capacity output.

Recent history provides examples.

Following the financial crisis of 2008-2009 that hit the US and many other developed economies, many economies were pushed into recessions. Expenditure on new residential construction collapsed for lack of income and secure financing, as did business investment, consumption spending and exports. Lower expenditures reduced producers' revenues, forcing cuts in output and employment and reducing household incomes. Lower incomes led to further cutbacks

[8]The C.D. Howe Institute's Business Cycle Council is the main arbiter of business cycle dates in Canada. A typical recession involves not just slow economic growth but an absolute decline in the level of output. A background document that explains the methodology the Council uses to declare the onset and end of recessions can be found on the web at https://www.cdhowe.org/business-cycle-council-methodology. See Cross and Bergevin (2012) for a chronology of Canadian recessions from the Great Depression to the Financial Crisis.

in spending. In Canada in 2009 aggregate output declined by 2.9 percent, employment declined by 1.6 percent and the unemployment rate rose from 6.1 percent in 2008 to 8.3 percent by 2010. The world's economies have been slow to recover, and even by 2019 the output in several developed economies was no higher than it was in 2008. Canada's recession was not nearly as severe as the recessions in economies such as Spain, Italy and Greece. However, output between 2009 and 2019 remained below the potential of the Canadian economy. In the third quarter of 2019 national output was about 0.7 percent below potential output and the unemployment rate was 5.5 percent.

As noted in Application Box 1.1, at the beginning of the pandemic governments (federal and provincial) imposed forced lockdowns which led to Canada's deepest economic recession since the Great Depression of the 1930s. Output declined by 17.5 percent between February 2020 and April 2020, the unemployment rate rose from 5.9 percent in February 2020 to 13.8 percent in May 2020, and inflation plunged from 2.2 percent in February 2020 to -0.4 percent in May 2020.[9]

An economy in a recession is operating inside its PPF. The fall in output from X to Z in Figure 1.6 illustrates the effect of a recession. Expenditures on goods and services have declined. Output is less than capacity output, unemployment is up and some plant capacity is idle. Labour income and business profits are lower. More people would like to work and business would like to produce and sell more output, but it takes time for interdependent product, labour and financial markets in the economy to adjust and increase employment and output. Monetary and fiscal policy may be productive in specific circumstances, to stimulate demand, increase output and employment and move the economy back to capacity output and full employment. The development and implementation of such policies form the core of macroeconomics.

[9]From Statistics Canada Tables 36-10-0434-01 (output), 14-10-0374-01 (unemployment rate), 18-10-0256-01 (inflation).

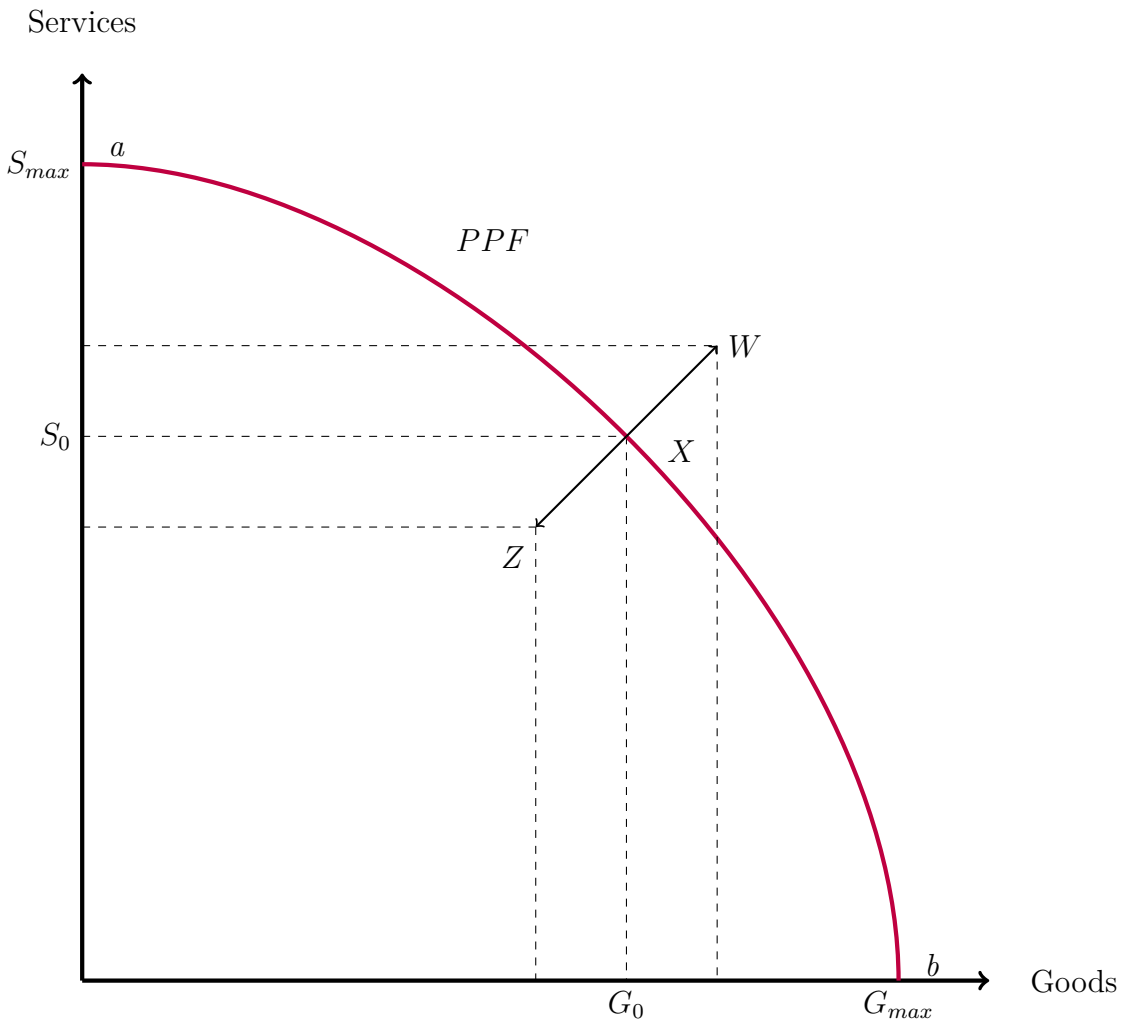


Figure 1.6: **Booms and Recessions**

Economic recessions leave the economy below its normal capacity; the economy might be driven to a point such as Z. Economic expansions, or booms, may drive capacity above its normal level, to a point such as W.

Alternatively, an unexpected increase in demand for exports would increase output and employment. Higher employment and output would increase incomes and expenditure, and in the process spread the effects of higher output sales to other sectors of the economy. The economy would move outside its PPF, for example to W in Figure 1.6, by using its resources more intensively than normal. Unemployment would fall and overtime work would increase. Extra production shifts would run plant and equipment for longer hours and work days than were planned when it was designed and installed. Output at this level may not be sustainable,

because shortages of labour and materials along with excessive rates of equipment wear and tear would push costs and prices up. Again, we will examine how the economy reacts to such a state in our macroeconomic analysis.

Output and employment in the Canadian economy over the past twenty years fluctuated about growth trend in the way Figure 1.6 illustrates. For several years prior to 2008 the Canadian economy operated slightly above its capacity. Once the recession arrived monetary and fiscal policy were used to fight it — to bring the economy back from a point such as Z towards a point such as X on the PPF.

Macroeconomic models and policy

The PPF diagrams illustrate the main dimensions of macroeconomics: capacity output, growth in capacity output and business cycle fluctuations in actual output relative to capacity. But these diagrams do not offer explanations and analysis of macroeconomic activity. We need a macroeconomic model to understand and evaluate the causes and consequences of business cycle fluctuations. As we shall see, these models are based on explanations of expenditure decisions by households and business, financial market conditions, production costs and producer pricing decisions at different levels of output. Models also capture the objectives of fiscal and monetary policies and provide a framework for policy evaluation. A full macroeconomic model integrates different sector behaviours and the feedbacks across sectors that can moderate or amplify the effects of changes in one sector on national output and employment.

Conclusions

We have covered a lot of ground in this introductory chapter. It is intended to open up the vista of economics to the new student in the discipline. Economics is powerful and challenging, and the ideas we have developed here will serve as conceptual foundations for our exploration of the subject.

Key Concepts

- **Macroeconomics** studies the economy as a system in which linkages and feedbacks among sectors determine national output, employment and prices.
- **Microeconomics** is the study of individual behaviour in the context of scarcity.
- **Mixed economy**: goods and services are supplied both by private suppliers and government.
- **Model**: a formalization of theory that facilitates scientific inquiry.
- **Theory**: a logical view of how things work, frequently formulated on the basis of observation.
- **Opportunity cost**: what must be sacrificed when a choice is made.
- **Production possibility frontier** (PPF): defines the combination of goods that can be produced using all of the resources available.
- **Consumption possibility frontier** (CPF): the combination of goods that can be consumed as a result of a given production choice.

- **Zero-sum game**: an interaction where the gain to one party equals the loss to another party.
- **Economy-wide** PPF: the set of goods that can be produced in the economy when all available productive resources are in use.
- **Labour productivity**: the output of goods and services per labour hour.
- **Capital stock**: the buildings, machinery, equipment and software used in producing goods and services.
- **Full employment output**: the output of the economy when everyone willing to work at current wage rates and normal hours of work is working.
- **Recession**: a pronounced, persistent and pervasive (widespread) decline in aggregate economic activity, typically involving a persistent and absolute decline in real output.
- **Boom**: a period of high growth that raises output above normal capacity output.

Exercises for Chapter 1

Exercise 1.1

An economy has 100 identical workers. Each one can produce four cakes or three shirts, regardless of the number of other individuals producing each good.

(a) How many cakes can be produced in this economy when all the workers are cooking?

(b) How many shirts can be produced in this economy when all the workers are sewing?

(c) On a diagram with cakes on the vertical axis, and shirts on the horizontal axis, join these points to form the PPF.

(d) Label the inefficient and unattainable regions on the diagram.

Exercise 1.2

In the table below lists a series of points that define an economy's production possibility frontier for two goods, Y and X.

Y	1000	900	800	700	600	500	400	300	200	100	0
X	0	1600	2500	3300	4000	4600	5100	5500	5750	5900	6000

(a) Plot these pairs of points to scale, on graph paper, or with the help of a spreadsheet.

(b) Given the shape of this PPF is the economy made up of individuals who are similar or different in their production capabilities?

(c) What is the opportunity cost of producing 100 more Y at the combination ($X = 5500, Y = 300$).

(d) Suppose next there is technological change so that at every output level of good Y the economy can produce 20 percent more X. Enter a new row in the table containing the new values, and plot the new PPF.

Exercise 1.3

Using the PPF that you have graphed using the data in Exercise 1.2, determine if the following combinations are attainable or not: $(X = 3000, Y = 720)$, $(X = 4800, Y = 480)$.

Exercise 1.4

You and your partner are highly efficient people. You can earn \$20 per hour in the workplace, while your partner can earn \$30 per hour.

(a) What is the opportunity cost of one hour of leisure for you?

(b) What is the opportunity cost of one hour of leisure for your partner?

(c) Now consider what a PPF would look like: You can produce/consume two things, leisure and income. Since income buys things you can think of the PPF as having these two "products" — leisure and consumption goods/services. So, with leisure on the horizontal axis and income in dollars is on the vertical axis, plot your PPF. You can assume that you have 12 hours per day to allocate to either leisure or income. [*Hint*: the leisure axis will have an intercept of 12 hours. The income intercept will have a dollar value corresponding to where all hours are devoted to work.]

(d) Draw the PPF for your partner.

Exercise 1.5

Louis and Carrie Anne are students who have set up a summer business in their neighbourhood. They cut lawns and clean cars. Louis is particularly efficient at cutting the grass — he requires one hour to cut a typical lawn, while Carrie Anne needs one and one half hours. In contrast, Carrie Anne can wash a car in a half hour, while Louis requires three quarters of an hour.

(a) If they decide to specialize in the tasks, who should cut the grass and who should wash cars?

(b) If they each work a twelve hour day, how many lawns can they cut and how many cars can they wash if they each specialize in performing the task where they are most efficient?

(c) Illustrate the PPF for each individual where lawns are on the horizontal axis and car washes on the vertical axis, if each individual has twelve hours in a day.

Exercise 1.6

Continuing with the same data set, suppose Carrie Anne's productivity improves so that she can now cut grass as efficiently as Louis; that is, she can cut grass in one hour, and can still wash a car in one half of an hour.

1. In a new diagram draw the PPF for each individual.

2. In this case does specialization matter if they are to be as productive as possible as a team?

3. Draw the PPF for the whole economy, labelling the intercepts and the "kink" point coordinates.

Exercise 1.7

Going back to the simple PPF plotted for Exercise 1.1 where each of 100 workers can produce either four cakes or three shirts, suppose a recession reduces demand for the outputs to 220 cakes and 129 shirts.

1. Plot this combination of outputs in the diagram that also shows the PPF.
2. How many workers are needed to produce this output of cakes and shirts?
3. What percentage of the 100 worker labour force is unemployed?

Chapter 2

Theories, data and beliefs

In this chapter we will explore the following topics.

- 2.1 Data analysis
- 2.2 Data, theory and economic models
- 2.3 Ethics, efficiency and beliefs

Economists, like other scientists and social scientists, observe and analyze behaviour and events. Economists are concerned primarily with the economic causes and consequences of what they observe. They want to understand an extensive range of human experience, including: money, government finances, industrial production, household consumption, inequality in income distribution, war, monopoly power, health, professional and amateur sports, pollution, marriage, the arts, and much more.

Economists approach these issues using theories and models. To present, explain, illustrate and evaluate their theories and models they have developed a set of techniques or tools. These

involve verbal descriptions and explanations, diagrams, algebraic equations, data tables and charts and statistical tests of economic relationships.

This chapter covers some of these basic techniques of analysis.

2.1 Data analysis

The analysis of behaviour necessarily involves data. Data may serve to validate or contradict a theory. Data analysis, even without being motivated by economic theory, frequently displays patterns of behaviour that merit examination. The terms *variables* and *data* are related. **Variables** are measures that can take on different magnitudes. The interest rate on a student loan, for example, is a variable with a certain value at a point in time but perhaps a different value at an earlier or later date. Economic theories and models explain the causal relationships between variables. In contrast, **data** are the recorded values of variables. Sets of data provide specific values for the variables we want to study and analyze. Knowing that gross domestic product (a variable) declined in 2009 is just a partial description of events. If the data indicate that it decreased by exactly 3 percent, we know a great deal more — that the decline was large.

> **Variables**: measures that can take on different values.

> **Data**: recorded values of variables.

Sets of data help us to test our models or theories, but first we need to pay attention to the economic logic involved in observations and modelling. For example, if sunspots or baggy pants were found to be correlated with economic expansion, would we consider these events a coincidence or a key to understanding economic growth? The observation is based on facts or data, but it need not have any economic content. The economist's task is to distinguish

between coincidence and economic causation. Merely because variables are associated or correlated does not mean that one causes the other.

While the more frequent wearing of loose clothing in the past may have been associated with economic growth because they both occurred at the same time (correlation), one could not argue on a logical basis that this behaviour causes good economic times. Therefore, the past association of these variables should be considered as no more than a coincidence. Once specified on the basis of economic logic, a model must be tested to determine its usefulness in explaining observed economic events.

2.1.1 Data types

Data come in several forms. One form is **time series**, which reflects a set of measurements made in sequence at different points in time. The first column in Table 2.1 reports the values for house prices in North Vancouver for the first quarter of each year, between 2001 and 2011. Evidently this is a time series. Annual data report one observation per year. We could, alternatively, have presented the data in monthly, weekly, or even daily form. The frequency we use depends on the purpose: If we are interested in the longer-term trend in house prices, then the annual form suffices. In contrast, financial economists, who study the behaviour of stock prices, might not be content with daily or even hourly prices; they may need prices minute-by-minute. Such data are called **high-frequency data**, whereas annual data are **low-frequency data**.

Table 2.1: **House prices and price indices**

Year	**House prices in dollars** (P_H)	**Percentage change in P_H** P_H	**Percentage change in consumer prices**	**Real percentage change in P_H**	**Index for price of housing**	**5-year mortgage rate**
2001	350,000				100	7.75
2002	360,000				102.9	6.85
2003	395,000	$\frac{35,000}{360,000} = 9.7\%$	3%	6.7%	112.9	6.7
2004	434,000				124.0	5.8
2005	477,000				136.3	6.1
2006	580,000				165.7	6.3
2007	630,000				180.0	6.65
2008	710,000				202.9	7.3
2009	605,000	$\frac{-105,000}{710,000} = -14.8\%$	1.6%	-16.4%	172.9	5.8
2010	740,000				211.4	5.4
2011	800,000				228.6	5.2

Note: Data on changes in consumer prices come from Statistics Canada, CANSIM series V41692930; data on house prices are for North Vancouver from Royal Le Page; data on mortgage rates from https://www.ratehub.ca. Index for house prices obtained by scaling each entry in column 2 by $100/350,000$. The real percentage change in the price of housing is: the percentage change in the price of housing minus the percentage change in consumer prices.

Time series: a set of measurements made sequentially at different points in time.

High (low) frequency data: series with short (long) intervals between observations.

In contrast to time-series data, **cross-section data** record the values of different variables at a point in time. Table 2.2 contains a cross-section of unemployment rates for Canada and Canadian provincial economies. For January 2012 we have a snapshot of the provincial economies at that point in time, likewise for the months until June. This table therefore contains **repeated cross-sections**.

Table 2.2: **Unemployment rates, Canada and Provinces, 2012, seasonally adjusted**

	Jan	Feb	Mar	Apr	May	Jun
Canada	7.6	7.4	7.2	7.3	7.3	7.2
Newfoundland	13.5	12.9	13.0	12.3	12.0	13.0
Prince Edward Island	12.2	10.5	11.3	11.0	11.3	11.3
Nova Scotia	8.4	8.2	8.3	9.0	9.2	9.6
New Brunswick	9.5	10.1	12.2	9.8	9.4	9.5
Quebec	8.4	8.4	7.9	8.0	7.8	7.7
Ontario	8.1	7.6	7.4	7.8	7.8	7.8
Manitoba	5.4	5.6	5.3	5.3	5.1	5.2
Saskatchewan	5.0	5.0	4.8	4.9	4.5	4.9
Alberta	4.9	5.0	5.3	4.9	4.5	4.6
British Columbia	6.9	6.9	7.0	6.2	7.4	6.6

Source: Statistics Canada CANSIM Table 282-0087.

When the unit of observation is the same over time such repeated cross sections are called **longitudinal data**. For example, a health survey that followed and interviewed the same individuals over time would yield longitudinal data. If the individuals differ each time the survey is conducted, the data are repeated cross sections. Longitudinal data, also known as **panel data**, therefore follow the same units of observation through time.

> **Cross-section data**: values for different variables recorded at a point in time.

> **Repeated cross-section data**: cross-section data recorded at regular or irregular intervals.

> **Longitudinal data** or **panel data**: follow the same units of observation through time.

Graphing the data

Data can be presented in graphical as well as tabular form. Figure 2.1 plots the house price data from the second column of Table 2.1. Each asterisk in the figure represents a price value and a corresponding time period. The horizontal axis reflects time, the vertical axis price

in dollars. The graphical presentation of data simply provides a visual rather than numeric perspective. It is immediately evident that house prices increased consistently during this 11-year period, with a single downward "correction" in 2009. We have plotted the data a second time in Figure 2.2 to illustrate the need to read graphs carefully. The greater apparent slope in Figure 2.1 might easily be interpreted to mean that prices increased more steeply than suggested in Figure 2.2. But a careful reading of the axes reveals that this is not so; using different scales when plotting data or constructing diagrams can mislead the unaware viewer.

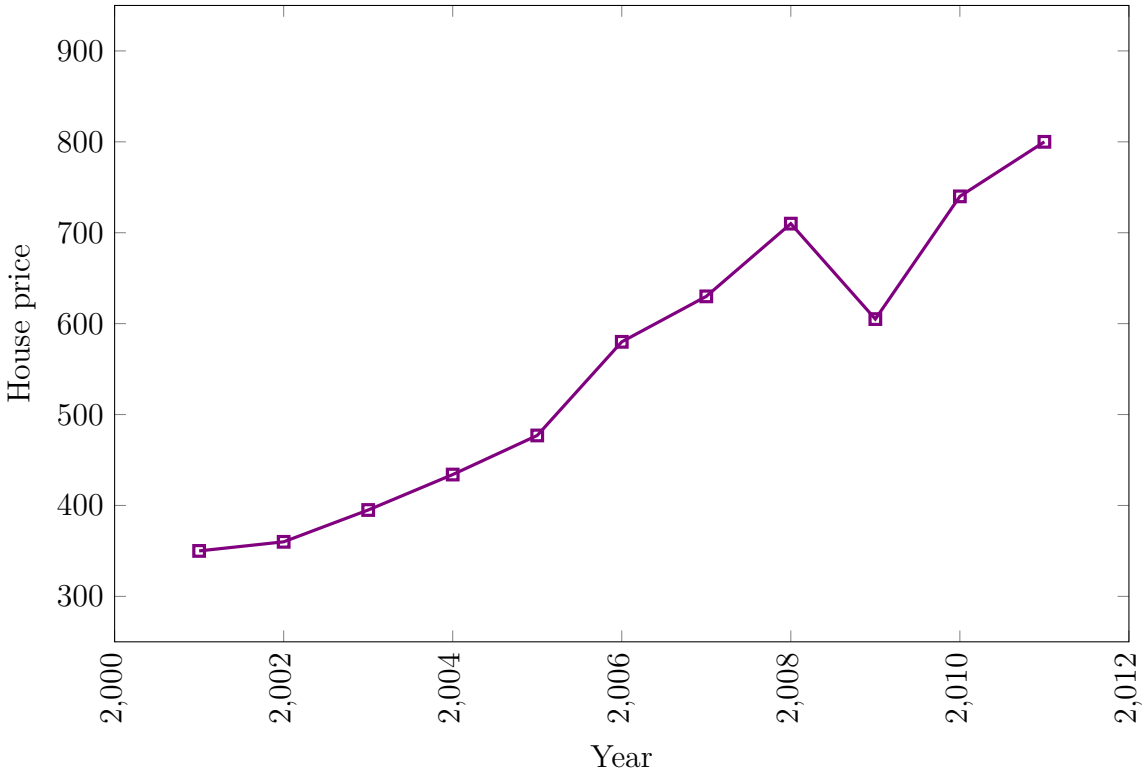


Figure 2.1: **House prices (thousands of dollars) 2001-2011**

Percentage changes

The use of percentages makes the analysis of data particularly simple. Suppose we wanted to compare the prices of New York luxury condominiums with the prices of homes in rural

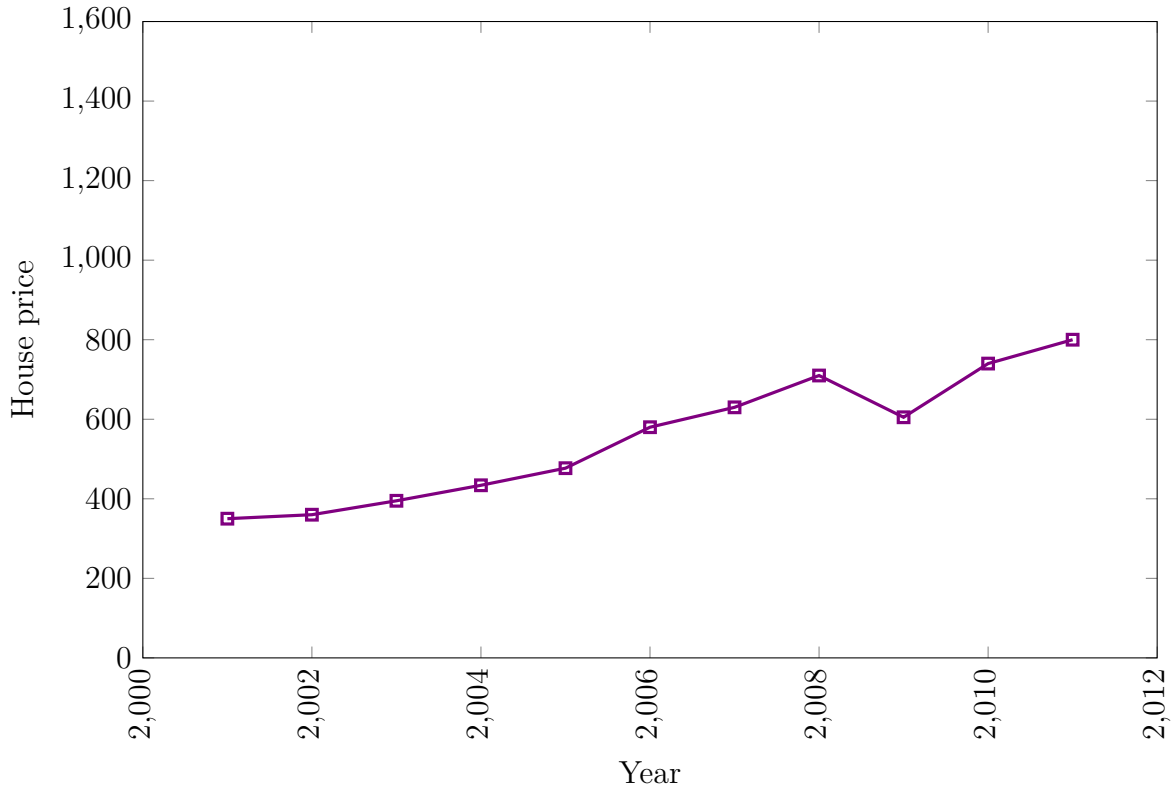


Figure 2.2: **House prices (thousands of dollars) 2001-2011**

Mississippi. In the latter case, a change in average prices of $10,000 might be considered enormous, whereas a change of one million dollars in New York might be pretty normal — because the average price in New York is so much higher than in Mississippi. To make comparisons between the two markets, we can use the concept of a **percentage change**. This is defined as the change in the value of the variable, relative to its initial value, multiplied by 100.

> **Percentage change**: defined as the change in values divided by the original value and then multiplied by 100, or [(change in values) / (original value)] $\times$ 100.

The third column of Table 2.1 contains the values of the percentage change in house prices for two pairs of years. Between 2002 and 2003 the price change was $35,000. Relative to the price in the first of these two years this change was the fraction $\frac{35{,}000}{395{,}000} = 0.097$. If we

multiply this fraction by 100 we obtain a percentage price change of 9.7 percent. Evidently we could calculate the percentage price changes for all pairs of years. A second price change is calculated for the 2008-2009 pair of years. Here price declined and the result is thus a negative percentage change.

Consumer prices

Most variables in economics are averages of the components that go into them. When variables are denominated in dollar terms it is important to be able to interpret them correctly. While the house price series above indicates a strong pattern of price increases, it is vital to know if the price of housing increased more or less rapidly that other prices in the economy. If all prices in the economy were increasing in line with house prices there would be no special information in the house price series. However, if house prices increased more rapidly than prices in general, then the data indicate that something special took place in the housing market during the decade in question. To determine an answer to this we need to know the degree to which the general price level changed each year.

Statistics Canada regularly surveys the price of virtually every product produced in the economy. One such survey records the prices of goods and services purchased by consumers. *Statistics Canada* then computes an average price level for all of these goods combined for each time period the survey is carried out (monthly), called the **consumer price index**. Once *Statistics Canada* has computed the average consumer price, it can compute the change in the price level from one period to the next. In Table 2.1 two such values are entered in the following data column: Consumer prices increased by 3 percent between 2002 and 2003, and by 1.6 percent between 2008 and 2009. These percentage changes in the general price level represent **inflation** if prices increase, and **deflation** if prices decline.

In this market it is clear that housing price changes were substantially larger than the changes

in consumer prices for these two pairs of years. The next column provides information on the difference between the house price changes and changes in the general consumer price level, in percentage terms. This is (approximately) the change in the relative price of housing, or what economists call the **real price** of housing.

> **Consumer price index**: the average price level for consumer goods and services.

> **Inflation (deflation) rate**: the annual percentage increase (decrease) in the level of consumer prices.

> **Real price**: the actual price adjusted by the general (consumer) price level in the economy.

Index numbers

Statistics Canada and other statistical agencies frequently present data in **index number** form. An index number provides an easy way to read the data. For example, suppose we wanted to compute the percentage change in the price of housing between 2001 and 2007. We could do this by entering the two data points in a spreadsheet or calculator and do the computation. But suppose the prices were entered in another form. In particular, by dividing each price value by the first year value and multiplying the result by 100 we obtain a series of prices that are all relative to the initial year — which we call the base year. The resulting series in column 6 is an index of house price values. Each entry is the corresponding value in column 2, divided by the first entry in column 2. The key characteristics of indexes are that they are *not dependent upon the units of measurement of the data in question*, and they are easy to interpret with reference to a given base value. To illustrate, suppose we wish to know how prices behaved between 2001 and 2007. The index number column immediately tells us that prices increased by 80 percent, because relative to 2001, the 2007 value is 80 percent higher.

Index number: value for a variable, or an average of a set of variables, expressed relative to a given base value.

Furthermore, index numbers enable us to make *comparisons with the price patterns for other goods* much more easily. If we had constructed a price index for automobiles, which also had a base value of 100 in 2001, we could make immediate comparisons without having to compare one set of numbers defined in thousands of dollars with another defined in hundreds of thousands of dollars. In short, index numbers simplify the interpretation of data.

2.2 Data, theory and economic models

Let us now investigate the interplay between economic theories on the one hand and data on the other. We will develop two examples. The first will be based upon the data on house prices, the second upon a new data set.

House prices — theory

Remember from Chapter 1 that a theory is a logical argument regarding economic relationships. A theory of house prices would propose that the price of housing depends upon a number of elements in the economy. In particular, if borrowing costs are low then buyers are able to afford the interest costs on larger borrowings. This in turn might mean they are willing to pay higher prices. Conversely, if borrowing rates are higher. Consequently, the borrowing rate, or mortgage rate, is a variable for an economic model of house prices. A second variable might be available space for development: if space in a given metropolitan area is tight then the land value will reflect this, and consequently the higher land price should be reflected in higher house prices. A third variable would be the business climate: If there is a high volume of high-value business transacted in a given area then buildings will

be more in demand, and that in turn should be reflected in higher prices. For example, both business and residential properties are more highly priced in San Francisco and New York than in Moncton, New Brunswick. A fourth variable might be environmental attractiveness: Vancouver may be more enticing than other towns in Canada. A fifth variable might be the climate.

House prices — evidence

These and other variables could form the basis of a theory of house prices. A model of house prices, as explained in Chapter 1, focuses upon what we would consider to be the most important subset of these variables. In the limit, we could have an extremely simple model that specified a dependence between the price of housing and the mortgage rate alone. To test such a simple model we need data on house prices and mortgage rates. The final column of Table 2.1 contains data on the 5-year fixed-rate mortgage for the period in question. Since our simple model proposes that prices depend (primarily) upon mortgage rates, in Figure 2.3 we plot the house price series on the vertical axis, and the mortgage rate on the horizontal axis, for each year from 2001 to 2011. As before, each point (shown as a '+') represents a pair of price and mortgage rate values.

The resulting plot (called a scatter diagram) suggests that there is a negative relationship between these two variables. That is, higher prices are correlated with lower mortgage rates. Such a correlation is consistent with our theory of house prices, and so we might conclude that changes in mortgage rates cause changes in house prices. Or at least the data suggest that we should not reject the idea that such causation is in the data.

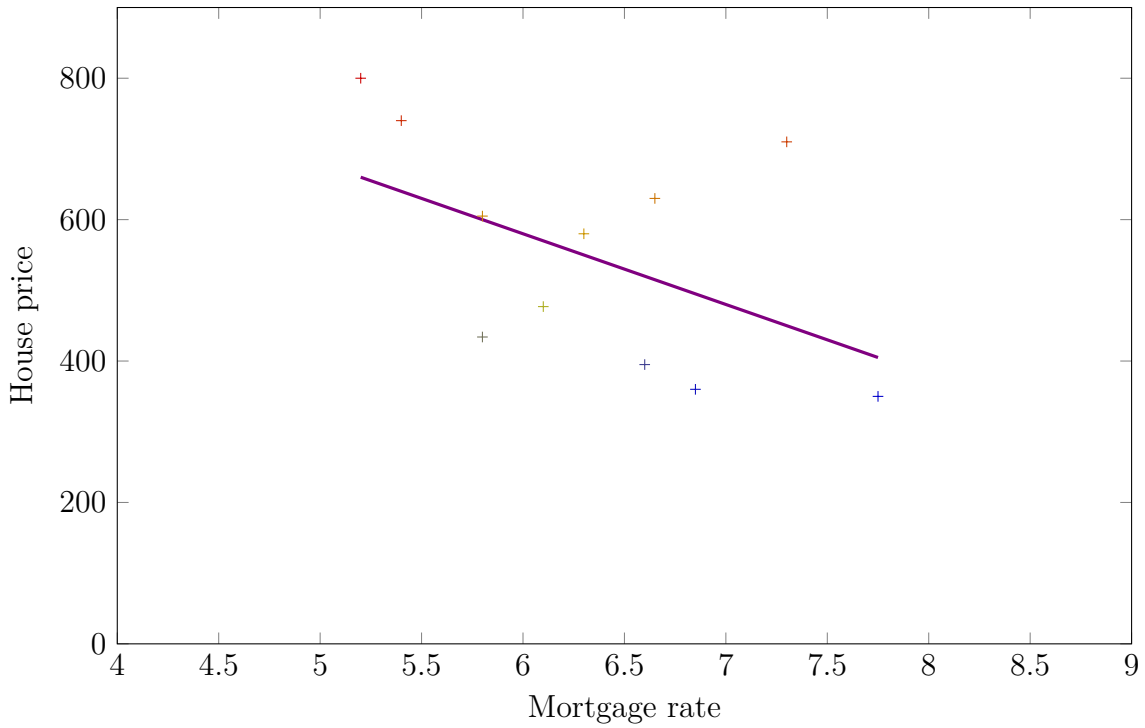


Figure 2.3: **Price of housing vs. mortgage rates**

House prices — inference

To summarize the relationship between these variables, the pattern suggests that a straight line through the scatter plot would provide a reasonably good description of the relationship between these variables. Obviously it is important to define the most appropriate line — one that 'fits' the data well.[1] The line we have drawn through the data points is informative, because it relates the two variables in a *quantitative manner*. It is called a **regression line**. It predicts that, on average, if the mortgage rate increases, the price of housing will respond in the downward direction. This particular line states that a one point change in the mortgage rate will move prices in the opposing direction by $105,000. This is easily verified by considering the dollar value corresponding to say a mortgage value of 6.5, and then the

[1]This task is the job of econometricians, who practice econometrics. Econometrics is the science of examining and quantifying relationships between economic variables. It attempts to determine the separate influences of each variable, in an environment where many things move simultaneously. Computer algorithms that do this are plentiful. Computers can also work in many dimensions in order to capture the influences of several variables simultaneously if the model requires that.

value corresponding to a mortgage value of 7.5. Projecting vertically to the regression line from each of these points on the horizontal axis, and from there across to the vertical axis will produce a change in price of $105,000.

Note that the line is not at all a "perfect" fit. For example, the mortgage rate declined between 2008 and 2009, but the price declined also — contrary to our theory. The model is not a perfect predictor; it states that *on average* a change in the magnitude of the x-axis variable leads to a change of a specific amount in the magnitude of the y-axis variable.

In this instance the slope of the line is given by $-105,000/1$, which is the vertical distance divided by the corresponding horizontal distance. Since the line is straight, this slope is unchanging.

> **Regression line**: the representation of the average relationship between two variables in a scatter diagram.

Road fatalities — theory, evidence and inference

Table 2.3 contains data on annual road fatalities per 100,000 drivers for various age groups. In the background, we have a theory, proposing that driver fatalities depend upon the age of the driver, the quality of roads and signage, speed limits, the age of the automobile stock and perhaps some other variables. Our model focuses upon a subset of these variables, and in order to present the example in graphical terms we specify fatalities as being dependent upon a single variable — age of driver.

Table 2.3: **Non-linearity: Driver fatality rates Canada, 2009**

Age of driver	**Fatality rate per 100,000 drivers**
20-24	9.8
25-34	4.4
35-44	2.7
45-54	2.4
55-64	1.9
65+	2.9

Source: Transport Canada, Canadian motor vehicle traffic collision statistics, 2009.

The scatter diagram is presented in Figure 2.4. Two aspects of this plot stand out. First, there is an exceedingly steep decline in the fatality rate when we go from the youngest age group to the next two age groups. The decline in fatalities between the youngest and second youngest groups is 5.4 points, and between the second and third age groups is 1.7 points. The decline between the third and fourth age groups is minimal - just 0.3 points. Hence, behaviour is not the same throughout the age distribution. Second, we notice that fatalities increase for the oldest age group, perhaps indicating that the oldest drivers are not as good as middle-aged drivers.

These two features suggest that the relationship between fatalities and age differs across the age spectrum. Accordingly, a straight line would not be an accurate way of representing the behaviours in these data. A straight line through the plot implies that a given change in age should have a similar impact on fatalities, no matter the age group. Accordingly we have an example of a *non-linear relationship*. Such a non-linear relationship might be represented by the curve going through the plot. Clearly the slope of this line varies as we move from one age category to another.

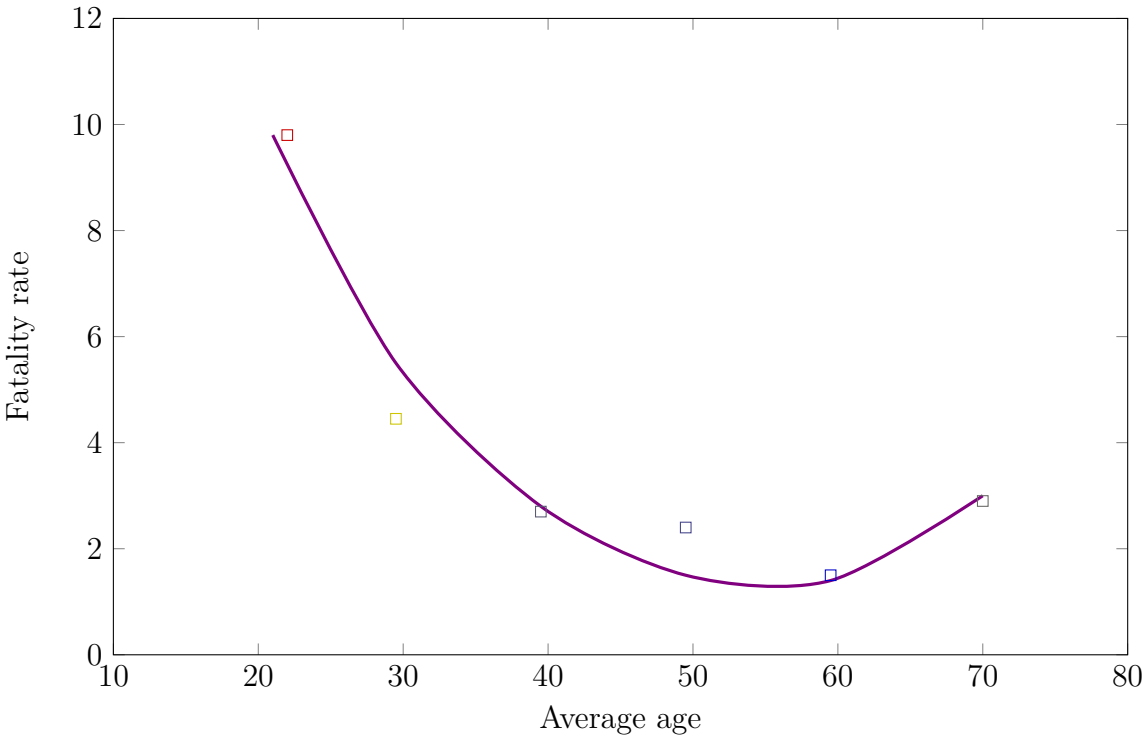


Figure 2.4: **Non-linearity: Driver fatality rates Canada, 2009**

2.3 Ethics, efficiency and beliefs

Positive economics studies objective or scientific explanations of how the economy functions. Its aim is to understand and generate predictions about how the economy may respond to changes and policy initiatives. In this effort economists strive to act as detached scientists, regardless of political sympathies or ethical code. Personal judgments and preferences are (ideally) kept apart. In this particular sense, economics is similar to the natural sciences such as physics or biology. Up to now in this chapter we have been exploring economics primarily from a positive standpoint.

In contrast, **normative economics** offers recommendations based partly on value judgments. While economists of different political persuasions can agree that raising the income tax rate would lead to some reduction in the number of hours worked, they may yet differ in their views on the advisability of such a rise. One economist may believe that the additional

revenue that may come in to government coffers is not worth the disincentives to work; another may think that, if such monies can be redistributed to benefit the needy, or provide valuable infrastructure, the negative impact on the workers paying the income tax is worth it.

> **Positive economics** studies objective or scientific explanations of how the economy actually functions.

> **Normative economics** offers recommendations that incorporate value judgments about how the economy *should* function.

Scientific research can frequently resolve differences that arise in positive economics — not so in normative economics. For example, if we claim that "the elderly have high medical bills, and the government should cover all of the bills," we are making both a positive and a normative statement. The first part is positive, and its truth is easily established. The latter part is normative, and individuals of different beliefs may reasonably differ. Some people may believe that the money would be better spent on the environment and have the aged cover at least part of their own medical costs. Positive economics does not attempt to show that one of these views is correct and the other false. The views are based on value judgments, and are motivated by a concern for **equity**. Equity is a vital guiding principle in the formation of policy and is frequently, though not always, seen as being in competition with the drive for economic growth. Equity is driven primarily by normative considerations. Few economists would disagree with the assertion that a government should implement policies that improve the lot of the poor — but to what degree?

> **Economic equity** is concerned with the distribution of well-being among members of the economy.

Application Box 2.1: Wealth tax

US Senator Elizabeth Warren, in seeking her (Democratic) Party's nomination as candidate for the Presidency in 2020, proposed that individuals with high wealth *should* pay a wealth tax. Her proposal was to levy a tax of 2 percent on individual wealth holdings above $50 million and a 6 percent tax on wealth above one billion dollars. This is clearly a normative approach to the issue of wealth concentration; it represented her ethical solution to what she perceived as socially unjust inequality.

In contrast, others in her party (Professor Larry Summers of Harvard for example) argued that the impact of such a tax would be to create incentives for wealthy individuals to reclassify their wealth, or to give it to family members, or to offshore it, in order to avoid such a tax. If individuals behaved in this way the tax take would be far less than envisaged by Senator Warren. Such an analysis by Professor Summers is *positive* in nature; it attempts to define what might happen in response to the normative policy of Senator Warren. If he took the further step of saying that wealth **should not** be taxed, then he would be venturing into normative territory. Henry Aaron of the Brookings Institution argued that a more progressive inheritance tax than currently exists would be easier to implement, and would be more effective in both generating tax revenue and equalizing wealth holdings. Since he also advocated implementing such a proposal, as an alternative to Senator Warren's proposals, he was being both *normative* and *positive*.

Most economists hold normative views, sometimes very strongly. They frequently see themselves, not just as coldhearted scientists, but as champions for their (normative) cause in addition. Conservative economists see a smaller role for government than left-leaning economists.

Many economists see a conflict between equity and the efficiency considerations developed

in Chapter 1. For example, high taxes may provide disincentives to work in the marketplace and therefore reduce the efficiency of the economy: Plumbers and gardeners may decide to do their own gardening and their own plumbing because, by staying out of the marketplace where monetary transactions are taxed, they can avoid the taxes. And avoiding the taxes may turn out to be as valuable as the efficiency gains they forgo.

In other areas the equity-efficiency trade-off is not so obvious: If taxes (that may have disincentive effects) are used to educate individuals who otherwise would not develop the skills that follow education, then economic growth may be higher as a result of the intervention.

2.3.1 Revisiting the definition of economics — core beliefs

This is an appropriate point at which to return to the definition of economics in Chapter 1 that we borrowed from Nobel Laureate Christopher Sims: Economics is a set of ideas and methods for the betterment of society.

If economics is concerned about the betterment of society, clearly there are ethical as well as efficiency considerations at play. And given the philosophical differences among scientists (including economists), can we define an approach to economics that is shared by the economics profession at large? Most economists would answer that the profession shares a set of beliefs, and that differences refer to the extent to which one consideration may collide with another.

- First of all we believe that *markets are critical* because they facilitate exchange and therefore encourage efficiency. Specialization and trade creates benefits for the trading parties. For example, Canada has not the appropriate climate for growing coffee beans, and Colombia has not the terrain for wheat. If Canada had to be self-sufficient, we might have to grow coffee beans in green-houses — a costly proposition. But with trade we can specialize, and then exchange some of our wheat for Colombian coffee.

Similar benefits arise for the Colombians.

A frequent complaint against trade is that its modern-day form (globalization) does not benefit the poor. For example, workers in the Philippines may earn only a few dollars per day manufacturing clothing for Western markets. From this perspective, most of the gains from trade go to the Western consumers and capitalists, come at the expense of jobs to western workers, and provide Asian workers with meagre rewards.

- A corollary of the centrality of markets is that *incentives matter*. If the price of business class seats on your favourite airline is reduced, you may consider upgrading. Economists believe strongly that the price mechanism influences behaviour, and therefore favour the use of price incentives in the marketplace and public policy more generally. Environmental economists, for example, advocate the use of pollution permits that can be traded at a price between users, or carbon taxes on the emission of greenhouse gases.[2]

- In saying that economists believe in incentives, we are not proposing that human beings are purely mercenary. People have many motivations: Self-interest, a sense of public duty, kindness, etc. Acting out of a sense of self-interest does not imply that people are morally empty or have no altruistic sense.

- Economists believe universally in the *importance of the rule of law*, no matter where they sit on the political spectrum. Legal institutions that govern contracts are critical to the functioning of an economy. If goods and services are to be supplied in a market economy, the suppliers must be guaranteed that they will be remunerated. And this requires a developed legal structure with penalties imposed on individuals or groups who violate contracts. Markets alone will not function efficiently.

  Modern development economics sees the implementation of the rule of law as perhaps the central challenge facing poorer economies. There is a strong correlation between

[2]Chapter 5 of *Principles of Microeconomics* will develop these ideas more fully.

economic growth and national wealth on the one hand, and an effective judicial and policing system on the other. The consequence on the world stage is that numerous 'economic' development projects now focus upon training jurists, police officers and bureaucrats in the rule of law!

- Finally, economists believe in the centrality of government. Governments can solve a number of problems that arise in market economies that cannot be addressed by the private marketplace. For example, governments can best address the potential abuses of monopoly power. [3] Governments are also best positioned to deal with environmental or other types of *externalities* — the impact of economic activity on sectors of the economy that are not directly involved in the activity under consideration.

Conclusions

In summary, governments have a variety of roles to play in the economy. These roles involve making the economy more equitable and more efficient by using their many powers.

[3] Chapter 10 of *Principles of Microeconomics* looks at monopoly, which not only has equity impacts but may also reduce economic efficiency.

KEY CONCEPTS

- **Variables**: measures that can take on different sizes.
- **Data**: recorded values of variables.
- **Time series data**: a set of measurements made sequentially at different points in time.
- **High (low) frequency data series** have short (long) intervals between observations.
- **Cross-section data**: values for different variables recorded at a point in time.
- **Repeated cross-section data**: cross-section data recorded at regular or irregular intervals.
- **Longitudinal data** or **panel data** follow the same units of observation through time.
- **Percentage change** is calculated as [(change in values) / (original value)] $\times$ 100.
- **Consumer price index**: the average price level for consumer goods and services.
- **Inflation (deflation) rate**: the annual percentage increase (decrease) in the level of consumer prices.
- **Real price**: the actual price adjusted by the general (consumer) price level in the economy.
- **Index number**: value for a variable, or an average of a set of variables, expressed relative to a given base value.

- **Regression line**: representation of the average relationship between two variables in a scatter diagram.
- **Positive economics** studies objective or scientific explanations of how the economy functions.
- **Normative economics** offers recommendations that incorporate value judgments.
- **Economic equity** is concerned with the distribution of well-being among members of the economy.

Exercises for Chapter 2

Exercise 2.1

An examination of a country's recent international trade flows yields the data in the table below.

Year	National Income ($b)	Imports ($b)
2011	1,500	550
2012	1,575	573
2013	1,701	610
2014	1,531	560
2015	1,638	591

(a) Based on an examination of these data do you think the national income and imports are not related, positively related, or negatively related?

(b) Plot each pair of observations in a two-dimensional line diagram to illustrate your view of the import/income relationship. Measure income on the horizontal axis and imports on the vertical axis. This can be done using graph paper or a spreadsheet-cum-graphics software.

Exercise 2.2

The average price of a medium coffee at Wakeup Coffee Shop in each of the past ten years is given in the table below.

2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
$1.05	$1.10	$1.14	$1.20	$1.25	$1.25	$1.33	$1.35	$1.45	$1.49

(a) Construct an annual "coffee price index" for this time period using 2005 as the base year. [*Hint*: follow the procedure detailed in the chapter — divide each yearly price by the base year price.]

(b) Based on your price index, what was the percentage change in the price of a medium coffee from 2005 to 2012?

(c) Based on your index, what was the average annual percentage change in the price of coffee from 2005 to 2010?

(d) Assuming the inflation rate in this economy was 2 percent every year, what was the real change in the price of coffee between 2007 and 2008; and between 2009 and 2010?

Exercise 2.3

The following table shows hypothetical consumption spending by households and income of households in billions of dollars.

Year	**Income**	**Consumption**
2006	476	434
2007	482	447
2008	495	454
2009	505	471
2010	525	489
2011	539	509
2012	550	530
2013	567	548

(a) Plot the scatter diagram with consumption on the vertical axis and income on the horizontal axis.

(b) Fit a line through these points.

(c) Does the line indicate that these two variables are related to each other?

(d) How would you describe the causal relationship between income and consumption?

Exercise 2.4

Using the data from Exercise 2.3, compute the percentage change in consumption and the percentage change in income for each pair of adjoining years between 2006 and 2013.

Exercise 2.5

You are told that the relationship between two variables, X and Y, has the form $Y = 10+2X$. By trying different values for X you can obtain the corresponding predicted value for Y (e.g., if $X = 3$, then $Y = 10+2Ö3 = 16$). For values of X between 0 and 12, compute the matching value of Y and plot the scatter diagram.

Exercise 2.6

For the data below, plot a scatter diagram with variable Y on the vertical axis and variable X on the horizontal axis.

X	40	33	29	56	81	19	20
Y	5	7	9	3	1	11	10

(a) Is the relationship between the variables positive or negative?

(b) Do you think that a linear or non-linear line better describes the relationship?

Chapter 3

The classical marketplace — demand and supply

In this chapter we will explore the following topics.

- 3.1 The marketplace — trading
- 3.2 The market's building blocks
- 3.3 Demand curves and supply curves
- 3.4 Non-price determinants of demand
- 3.5 Non-price determinants of supply
- 3.6 Simultaneous demand and supply movements
- 3.7 Free and managed markets — interventions
- 3.8 From individuals to markets
- 3.9 Useful techniques — demand and supply equations

3.1 The marketplace — trading

The marketplace in today's economy has evolved from earlier times. It no longer has a unique form – one where buyers and sellers physically come together for the purpose of exchange. Indeed, supermarkets require individuals to be physically present to make their purchases. But when purchasing an airline ticket, individuals simply go online and interact with perhaps a number of different airlines (suppliers) simultaneously. Or again, individuals may simply give an instruction to their stock broker, who will execute a purchase on their behalf – the broker performs the role of a middleman, who may additionally give advice to the purchaser. Or a marketing agency may decide to subcontract work to a translator or graphic artist who resides in Mumbai. In pure auctions (where a single work of art or a single residence is offered for sale) buyers compete one against the other for the single item supplied. Accommodations in private homes are supplied to potential visitors (buyers) through *Airbnb*. Taxi rides are mediated through *Lyft* or *Uber*. These institutions are all different types of markets; they serve the purpose of facilitating exchange and trade.

Not all goods and services in the modern economy are obtained through the marketplace. Schooling and health care are allocated in Canada primarily by government decree. In some instances the market plays a supporting role: Universities and colleges may levy fees, and most individuals must pay, at least in part, for their pharmaceuticals. In contrast, broadcasting services may carry a price of zero – as with the Canadian Broadcasting Corporation. Furthermore, some markets have no price, yet they find a way of facilitating an exchange. For example, graduating medical students need to be matched with hospitals for their residencies. Matching mechanisms are a form of market in that they bring together suppliers and demanders. We explore their operation in Chapter

The importance of the marketplace springs from its role as an allocating mechanism. Elevated prices effectively send a signal to suppliers that the buyers in the market place a high

value on the product being traded; conversely when prices are low. Accordingly, suppliers may decide to cease supplying markets where prices do not remunerate them sufficiently, and redirect their energies and the productive resources under their control to other markets – markets where the product being traded is more highly valued, and where the buyer is willing to pay more.

Whatever their form, the marketplace is central to the economy we live in. Not only does it facilitate trade, it also provides a means of earning a livelihood. Suppliers must hire resources – human and non-human in order to bring their supplies to market and these resources must be paid a return – income is generated.

In this chapter we will examine the process of price formation – how the prices that we observe in the marketplace come to be what they are. We will illustrate that the price for a good is inevitably linked to the quantity of a good; price and quantity are different sides of the same coin and cannot generally be analyzed separately. To understand this process more fully, we need to *model* a typical market. The essentials are demand and supply.

3.2 The market's building blocks

In economics we use the terminology that describes trade in a particular manner. Non-economists frequently describe microeconomics by saying "it's all about supply and demand." While this is largely true we need to define exactly what we mean by these two central words. **Demand** is the quantity of a good or service that buyers wish to purchase at each conceivable price, with all other influences on demand remaining unchanged. It reflects a multitude of values, not a single value. It is not a single or unique quantity such as two cell phones, but rather a full description of the quantity of a good or service that buyers would purchase at various prices.

Demand: the quantity of a good or service that buyers wish to purchase at each possible price, with all other influences on demand remaining unchanged.

As a hypothetical example, the first column of Table **??** shows the price of natural gas per cubic foot. The second column shows the quantity that would be purchased in a given time period at each price. It is therefore a schedule of quantities demanded at various prices. For example, at a price \$6 per unit, buyers would like to purchase 4 units, whereas at the lower price of \$3 buyers would like to purchase 7 units. Note also that this is a homogeneous good. A cubit foot of natural gas is considered to be the same product no matter which supplier brings it to the market. In contrast, accommodations supplied through *Airbnb* are heterogeneous – they vary in size and quality.

Table 3.1: Demand and supply of natural gas

Price (\$)	**Demand (thousands of cubic feet)**	**Supply (thousands of cubic feet)**	**Excess**
10	0	18	
9	1	16	
8	2	14	**Excess supply**
7	3	12	
6	4	10	
5	5	8	
4	6	6	**Equilibrium**
3	7	4	
2	8	2	
1	9	0	**Excess demand**
0	10	0	

Supply is interpreted in a similar manner. It is not a single value; we say that **supply** is the quantity of a good or service that sellers are willing to sell at each possible price, with all other influences on supply remaining unchanged. Such a supply schedule is defined in the third column of the table. It is assumed that no supplier can make a profit (on account of their costs) unless the price is at least \$2 per unit, and therefore a zero quantity is supplied

below that price. The higher price is more profitable, and therefore induces a greater quantity supplied, perhaps by attracting more suppliers. This is reflected in the data. For example, at a price of $3 suppliers are willing to supply 4 units, whereas with a price of $7 they are willing to supply 12 units. There is thus a positive relationship between price and quantity for the supplier — a higher price induces a greater quantity; whereas on the demand side of the market a higher price induces a lower quantity demanded — a negative relationship.

> **Supply** is the quantity of a good or service that sellers are willing to sell at each possible price, with all other influences on supply remaining unchanged.

We can now identify a key difference in terminology — between the words demand and **quantity demanded**, and between supply and **quantity supplied**. While the words demand and supply refer to the complete schedules of demand and supply, the terms quantity demanded and quantity supplied each define a single value of demand or supply at a particular price.

> **Quantity demanded** defines the amount purchased at a particular price.

> **Quantity supplied** refers to the amount supplied at a particular price.

Thus while the non-economist may say that when some fans did not get tickets to the Stanley Cup it was a case of demand exceeding supply, as economists we say that the quantity demanded exceeded the quantity supplied *at the going price of tickets*. In this instance, had every ticket been offered at a sufficiently high price, the market could have generated an excess supply rather than an excess demand. A higher ticket price would reduce the *quantity demanded*; yet would not change *demand*, because demand refers to the whole schedule of possible quantities demanded at different prices.

Other things equal — ceteris paribus

The demand and supply schedules rest on the assumption that all other influences on supply and demand remain the same as we move up and down the possible price values. The expression *other things being equal*, or its Latin counterpart **ceteris paribus**, describes this constancy of other influences. For example, we assume on the demand side that the prices of other goods remain constant, and that tastes and incomes are unchanging. On the supply side we assume, for example, that there is no technological change in production methods. If any of these elements change then the market supply or demand schedules will reflect such changes. For example, if coal or oil prices increase (decline) then some buyers may switch to (away from) gas or solar power. This will be reflected in the data: at any given price more (or less) will be demanded. We will illustrate this in graphic form presently.

> **Ceteris paribus**: how an economic variable (such as quantity demanded) depends on changes in another economic variable (such as the price of the good) while holding constant all of the other possible influences on that economic variable.

Market equilibrium

Let us now bring the demand and supply schedules together in an attempt to analyze what the marketplace will produce — will a single price emerge that will equate supply and demand? We will keep other things constant for the moment, and explore what materializes at different prices. At low prices, the data in Table 3.1 indicate that the quantity demanded exceeds the quantity supplied — for example, verify what happens when the price is $3 per unit. The opposite occurs when the price is high — what would happen if the price were $8? Evidently, there exists an intermediate price, where the quantity demanded equals the quantity supplied. At this point we say that the market is in equilibrium. The **equilibrium price** equates demand and supply — it clears the market.

> The **equilibrium price** equilibrates the market. It is the price at which quantity demanded equals the quantity supplied.

In Table 3.1 the equilibrium price is $4, and the equilibrium quantity is 6 thousand cubic feet of gas (we will use the notation 'k' to denote thousands). At higher prices there is an **excess supply** — suppliers wish to sell more than buyers wish to buy. Conversely, at lower prices there is an **excess demand**. Only at the equilibrium price is the quantity supplied equal to the quantity demanded.

> **Excess supply** exists when the quantity supplied exceeds the quantity demanded at the going price.

> **Excess demand** exists when the quantity demanded exceeds the quantity supplied at the going price.

Does the market automatically reach equilibrium? To answer this question, suppose initially that the sellers choose a price of $10. Here suppliers would like to supply 18k cubic feet, but there are no buyers — a situation of extreme excess supply. At the price of $7 the excess supply is reduced to 9k, because both the quantity demanded is now higher at 3k units, and the quantity supplied is lower at 12k. But excess supply means that there are suppliers willing to supply at a lower price, and this willingness exerts continual downward pressure on any price above the price that equates demand and supply.

At prices below the equilibrium there is, conversely, an excess demand. In this situation, suppliers could force the price upward, knowing that buyers will continue to buy at a price at which the suppliers are willing to sell. Such upward pressure would continue until the excess demand is eliminated.

In general then, above the equilibrium price excess supply exerts downward pressure on price, and below the equilibrium excess demand exerts upward pressure on price. This

process implies that the buyers and sellers have information on the various elements that make up the marketplace.

We will explore later in this chapter some specific circumstances in which trading could take place at prices above or below the equilibrium price. In such situations the quantity actually traded always corresponds to the short side of the market: At high prices the quantity demanded is less than the quantity supplied, and it is the quantity demanded that is traded because buyers will not buy the amount suppliers would like to supply. At low prices the quantity demanded exceeds quantity supplied, and it is the amount that suppliers are willing to sell that is traded. In sum, when trading takes place at prices other than the equilibrium price it is always the lesser of the quantity demanded or supplied that is traded. Hence we say that at non-equilibrium prices the **short side of the market** dominates. We will return to this in a series of examples later in this chapter.

> The **short side of the market** determines outcomes at prices other than the equilibrium.

Supply and the nature of costs

Before progressing to a graphical analysis, we should add a word about costs. The supply schedules are based primarily on the cost of producing the product in question, and we frequently assume that all of the costs associated with supply are incorporated in the supply schedules. Chapter 6 of *Principles of Microeconomics* will explore cases where costs additional to those incurred by producers may be relevant. For example, coal burning power plants emit pollutants into the atmosphere; but the individual supplier may not take account of these pollutants, which are costs to society at large, in deciding how much to supply at different prices. Stated another way, the private costs of production would not reflect the total, or full social costs of production. Conversely, if some individuals immunize themselves against a rampant virus, other individuals gain from that action because they become less

likely to contract the virus — the social value thus exceeds the private value. For the moment the assumption is that no such additional costs are associated with the markets we analyze.

3.3 Demand curves and supply curves

The **demand curve** is a graphical expression of the relationship between price and quantity demanded, holding other things constant. Figure 3.1 measures price on the vertical axis and quantity on the horizontal axis. The curve D represents the data from the first two columns of Table 3.1. Each combination of price and quantity demanded lies on the curve. In this case the curve is *linear* — it is a straight line. The demand curve slopes downward (technically we say that its slope is negative), reflecting the fact that buyers wish to purchase more when the price is less.

[Figure 3.1 here.]

To derive this demand curve we take each price-quantity combination from the demand schedule in Table 3.1 and insert a point that corresponds to those combinations. For example, point h defines the combination $\{P = \$8, Q_d = 2\}$, the point l denotes the combination $\{P = \$3, Q_d = 7\}$. If we join all such points we obtain the demand curve in Figure 3.2. In this particular case the demand schedule results in a straight-line, or linear, demand curve. The same process yields the supply curve in Figure 3.2.

> The **demand curve** is a graphical expression of the relationship between price and quantity demanded, with other influences remaining unchanged.

The **supply curve** is a graphical representation of the relationship between price and quantity supplied, holding other things constant. The supply curve S in Figure 3.2 is based on the data from columns 1 and 3 in Table 3.1. It, too, is linear, but has a positive slope indicating that suppliers wish to supply more at higher prices.

The **supply curve** is a graphical expression of the relationship between price and quantity supplied, with other influences remaining unchanged.

[Figure 3.2 here.]

The demand and supply curves intersect at point E_0, corresponding to a price of \$4 which, as illustrated above, is the equilibrium price for this market. At any price below this the horizontal distance between the supply and demand curves represents excess demand, because demand exceeds supply. Conversely, at any price above \$4 there is an excess supply that is again measured by the horizontal distance between the two curves. Market forces tend to eliminate excess demand and excess supply as we explained above. In the final section of the chapter we illustrate how the supply and demand curves can be 'solved' for the equilibrium price and quantity.

3.4 Non-price determinants of demand

We have emphasized several times the importance of the ceteris paribus assumption when exploring the impact of different prices on the quantity demanded: we assume all other influences on the purchase decision are unchanged (at least momentarily). These other influences fall into several broad categories: The prices of related goods; the incomes of buyers; buyer tastes; and expectations about the future. Before proceeding, note that we are dealing with *market* demand rather than demand by one *individual* (the precise relationship between the two is developed later in this chapter).

The prices of related goods — oil and gas, Kindle and paperbacks

We expect that the price of other forms of energy would impact the price of natural gas. For example, if hydro-electricity, oil or solar becomes less expensive we would expect some buyers to switch to these other products. Alternatively, if gas-burning furnaces experience a technological breakthrough that makes them more efficient and cheaper we would expect some users of other fuels to move to gas. Among these examples, oil and electricity are substitute fuels for gas; in contrast a more fuel-efficient new gas furnace complements the use of gas. We use these terms, **substitutes** and **complements**, to describe products that influence the demand for the primary good.

> **Substitute goods**: when a price reduction (rise) for a related product reduces (increases) the demand for a primary product, it is a substitute for the primary product.

> **Complementary goods**: when a price reduction (rise) for a related product increases (reduces) the demand for a primary product, it is a complement for the primary product.

Clearly electricity is a substitute for gas in the power market, whereas a gas furnace is a complement for gas as a fuel. The words substitutes and complements immediately suggest the nature of the relationships. Every product has complements and substitutes. As another example, electronic readers and tablets are substitutes for printed books. A rise in the price of paper books should increase the demand for electronic readers at any given price for electronic readers. In graphical terms, the demand curve *shifts* in response to changes in the prices of other goods — an increase in the price of printed books shifts the demand for electronic readers outward, because more electronic readers will be demanded at any price.

Buyer incomes — which goods to buy

The demand for most goods increases in response to income growth. Given this, the demand curve for gas will shift outward if household incomes in the economy increase. Household incomes may increase either because there are more households in the economy or because the incomes of the existing households grow.

Most goods are demanded in greater quantity in response to higher incomes at any given price. But there are exceptions. For example, public transit demand may decline at any price when household incomes rise, because some individuals move to cars. Or the demand for laundromats may decline in response to higher incomes, as households purchase more of their own consumer durables — washers and driers. We use the term inferior good to define these cases: An **inferior good** is one whose demand declines in response to increasing incomes, whereas a **normal good** experiences an increase in demand in response to rising incomes.

> An **inferior good** is one whose demand falls in response to higher incomes.

> A **normal good** is one whose demand increases in response to higher incomes.

There is a further sense in which consumer incomes influence demand, and this relates to how the incomes are *distributed* in the economy. In the discussion above we stated that higher total incomes shift demand curves outwards when goods are normal. But think of the difference in the demand for electronic readers between Portugal and Saudi Arabia. These economies have roughly the same average per-person income, but incomes are distributed more unequally in Saudi Arabia. It does not have a large middle class that can afford electronic readers or *iPads*, despite the huge wealth held by the elite. In contrast, Portugal has a relatively larger middle class that can afford such goods. Consequently, the *distribution of income* can be an important determinant of the demand for many commodities and services.

Tastes and networks — hemlines, lapels and homogeneity

While demand functions are drawn on the assumption that tastes are constant, in an evolving world they are not. We are all subject to peer pressure, the fashion industry, marketing, and a desire to maintain our image. If the fashion industry dictates that lapels on men's suits or long skirts are *de rigueur* for the coming season, some fashion-conscious individuals will discard a large segment of their wardrobe, even though the clothes may be in perfectly good condition: their demand is influenced by the dictates of current fashion.

Correspondingly, the items that other individuals buy or use frequently determine our own purchases. Businesses frequently decide that all of their employees will have the same type of computer and software on account of *network economies*: it is easier to communicate if equipment is compatible, and it is less costly to maintain infrastructure where the variety is less.

Expectations — betting on the future

In our natural gas example, if households expected that the price of natural gas was going to stay relatively low for many years — perhaps on account of the discovery of large deposits — then they would be tempted to purchase a gas burning furnace rather than one based upon an alternative fuel. Conversely, if some individuals immunize themselves against a rampant virus, other individuals gain from that action because they become less likely to contract the virus — the social value thus exceeds the private value. In this example, it is more than the current price that determines choices — *the prices that are expected to prevail in the future* also determine current demand.

Expectations are particularly important in stock markets. When investors anticipate that corporations will earn high rewards in the future they will buy a stock today. If enough

people believe this, the price of the stock will be driven upward on the market, even before profitable earnings are registered.

Shifts in demand

The demand curve in Figure 3.2 is drawn for a given level of other prices, incomes, tastes, and expectations. Movements along the demand curve reflect solely the impact of different prices for the good in question, holding other influences constant. But changes in any of these other factors will change the position of the demand curve. Figure 3.3 illustrates a shift in the demand curve. This shift could result from a rise in household incomes that increase the quantity demanded *at every price*. This is illustrated by an outward shift in the demand curve. With supply conditions unchanged, there is a new equilibrium at E_1, indicating a greater quantity of purchases accompanied by a higher price. The new equilibrium reflects *a change in quantity supplied and a change in demand*.

[Figure 3.3 here.]

We may well ask why so much emphasis in our diagrams and analysis is placed on the relationship between *price* and quantity, rather than on the relationship between quantity and its other determinants. The answer is that we could indeed draw diagrams with quantity on the horizontal axis and a measure of one of these other influences on the vertical axis. But the price mechanism plays a very important role. *Variations in price are what equilibrate the market*. By focusing primarily upon the price, we see the self-correcting mechanism by which the market reacts to excess supply or excess demand.

In addition, this analysis illustrates the method of **comparative statics** — examining the impact of changing one of the other things that are assumed constant in the supply and demand diagrams.

Comparative static analysis compares an initial equilibrium with a new equilibrium, where the difference is due to a change in one of the other things that lie behind the demand curve or the supply curve.

'Comparative' obviously denotes the idea of a comparison, and static means that we are not in a state of motion. Hence we use these words in conjunction to indicate that we compare one outcome with another, without being concerned too much about the transition from an initial equilibrium to a new equilibrium. The transition would be concerned with dynamics rather than statics. In Figure 3.3 we explain the difference between the points E_0 and E_1 by indicating that there has been a change in incomes or in the price of a substitute good. We do not attempt to analyze the details of this move or the exact path from E_0 to E_1.

Application Box 3.1: Corn prices and demand shift

In the middle of its second mandate, the Bush Administration in the US decided to encourage the production of ethanol — a fuel that is less polluting than gasoline. The target production was 35 billion gallons for 2017 — from a base of 1 billion gallons in 2000. Corn is the principal input in ethanol production. It is also used as animal feed, as a sweetener and as a food for humans. The target was to be met with the help of a subsidy to producers and a tariff on imports of Brazil's sugar-cane based ethanol.

The impact on corn prices was immediate; from a farm-gate price of $2 per bushel in 2005, the price reached the $4 range two years later. In 2012 the price rose temporarily to $7. While other factors were in play — growing incomes and possibly speculation by commodity investors, ethanol is seen as the main price driver: demand for corn increased and the supply could not be increased to keep up with the demand without an increase in price.

The wider impact of these developments was that the prices of virtually all grains increased in tandem with corn: the prices of sorghum and barley increased because of a switch in land use towards corn on account of its profitability.

While farmers benefited from the price rise, consumers – particularly those in less developed economies — experienced a dramatic increase in their basic living costs. Visit the site of the United Nations' Food and Agricultural Organization for an assessment. Since hitting $7 per bushel in 2012, the price has dropped and averaged $3.50 in 2016.

In terms of supply and demand shifts: the demand side has dominated, particularly in the short run. The ethanol drive, combined with secular growth in the demand for food, means that the demand for grains shifted outward faster than the supply. In the period 2013–2016, supply has increased and the price has moderated.

3.5 Non-price determinants of supply

To date we have drawn supply curves with an upward slope. Is this a reasonable representation of supply in view of what is frequently observed in markets? We suggested earlier that the various producers of a particular good or service may have different levels of efficiency. If so, only the more efficient producers can make a profit at a low price, whereas at higher prices more producers or suppliers enter the market — producers who may not be as lean and efficient as those who can survive in a lower-price environment. This view of the world yields a positively-sloping supply curve.

As a second example, consider *Uber* or *Lyft* taxi drivers. Some drivers may be in serious need of income and may be willing to drive for a low hourly rate. For other individuals driving may be a secondary source of income, and such drivers are less likely to want to

drive unless the hourly wage is higher. Consequently if these ride sharing services need a large number of drivers at any one time it may be necessary to pay a higher wage — *and charge a higher fare to passengers*, to induce more drivers to take their taxis onto the road. This phenomenon corresponds to a positively-sloped supply curve.

In contrast to these two examples, some suppliers simply choose a unique price and let buyers purchase as much as they want at that price. This is the practice of most retailers. For example, the price of *Samsung*'s *Galaxy* is typically fixed, no matter how many are purchased — and tens of millions are sold at a fixed price when a new model is launched. *Apple* also sets a price, and buyers purchase as many as they desire at that price. This practice corresponds to a horizontal supply curve: The price does not vary and the market equilibrium occurs where the demand curve intersects this supply curve.

In yet other situations supply is fixed. This happens in auctions. Bidders at the auction simply determine the price to be paid. At a real estate auction a given property is put on the market and the price is determined by the bidding process. In this case the supply of a single property is represented by a vertical supply at a quantity of 1 unit.

Regardless of the type of market we encounter, however, it is safe to assume that supply curves rarely slope downward. So, for the moment, we adopt the stance that supply curves are generally upward sloping — somewhere between the extremes of being vertical or horizontal — as we have drawn them to this point.

Next, we examine those other influences that underlie supply curves. Technology, input costs, the prices of competing goods, expectations and the number of suppliers are the most important.

Technology — computers and fracking

A technological advance may involve an idea that allows more output to be produced with the same inputs, or an equal output with fewer inputs. A good example is *just-in-time* technology. Before the modern era, virtually all manufacturers kept large stocks of components in their production facilities, but developments in communications and computers at that time made it possible for manufacturers to link directly with their input suppliers. Nowadays auto assembly plants place their order for, say, seat delivery to their local seat supplier well ahead of assembly time. The seats swing into the assembly area hours or minutes before assembly — just in time. The result is that the assembler reduces her seat inventory (an input) and thereby reduces production cost.

Such a technology-induced cost saving is represented by moving the supply curve downward or outward: The supplier is now able and willing to supply the same quantity at a lower price because of the technological innovation. Or, saying the same thing slightly differently, suppliers will supply more at a given price than before.

A second example relates to the extraction of natural gas. The development of 'fracking' means that companies involved in gas recovery can now do so at a lower cost. Hence they are willing to supply any given quantity at a lower price. A third example concerns aluminum cans. Today they weigh a fraction of what they weighed 20 years ago. This is a technology-based cost saving.

Input costs

Input costs can vary independently of technology. For example, a wage negotiation that grants workers a substantial pay raise will increase the cost of production. This is reflected in a leftward, or upward, supply shift: Any quantity supplied is now priced higher; alternatively,

suppliers are willing to supply less at the going price.

Production costs may increase as a result of higher required standards in production. As governments implement new safety or product-stress standards, costs may increase. In this instance the increase in costs is not a 'bad' outcome for the buyer. She may be purchasing a higher quality good as a result.

Competing products — Airbnb versus hotels

If competing products improve in quality or fall in price, a supplier may be forced to follow suit. For example, *Asus* and *Dell* are constantly watching each other's pricing policies. If Dell brings out a new generation of computers at a lower price, *Asus* may lower its prices in turn—which is to say that *Asus*' supply curve will shift downward. Likewise, *Samsung* and *Apple* each responds to the other's pricing and technology behaviours. The arrival of new products in the marketplace also impacts the willingness of suppliers to supply goods at a given price. New intermediaries such as *Airbnb* and *Vacation Rentals by Owner* have shifted the supply curves of hotel rooms downward.

These are some of the many factors that influence the position of the supply curve in a given market.

Application Box 3.2: The price of light

Technological developments have had a staggering impact on many price declines. Professor William Nordhaus of Yale University is an expert on measuring technological change. He has examined the trend in the real price of lighting. Originally, light was provided by whale oil and gas lamps and these sources of lumens (the scientific measure of the

amount of light produced) were costly. In his research, Professor Nordhaus pieced together evidence on the actual historic cost of light produced at various times, going all the way back to 1800. He found that light in 1800 cost about 100 times more than in 1900, and light in the year 2000 was a fraction of its cost in 1900. A rough calculation suggests that light was five hundred times more expensive at the start of this 200-year period than at the end, and this was before the arrival of LEDs.

In terms of supply and demand analysis, light has been subject to very substantial downward supply shifts. Despite the long-term growth in demand, the technologically-induced supply changes have been the dominant factor in its price determination.

For further information, visit Professor Nordhaus's website in the Department of Economics at Yale University. [link]

Shifts in supply

Whenever technology changes, or the costs of production change, or the prices of competing products adjust, then one of our *ceteris paribus* assumptions is violated. Such changes are generally reflected by shifting the supply curve. Figure 3.4 illustrates the impact of the arrival of just-in-time technology. The supply curve shifts, reflecting the ability of suppliers to supply the same output at a reduced price. The resulting new equilibrium price is lower, since production costs have fallen. At this reduced price more gas is traded at a lower price.

[Figure 3.4 here.]

3.6 Simultaneous supply and demand impacts

In the real world, demand and supply frequently shift at the same time. We present such a case in Figure 3.5. It is based upon real estate data describing the housing market in a small Montreal municipality. Vertical curves define the supply side of the market. Such vertical curves mean that a given number of homeowners decide to put their homes on the market, and these suppliers just take whatever price results in the market. In this example, fewer houses were offered for sale in 2002 (less than 50) than in 1997 (more than 70). We are assuming in this market that the houses traded were similar; that is, we are not lumping together mansions with row houses.

During this time period household incomes increased substantially and, also, mortgage rates fell. Both of these developments shifted the demand curve upward/outward: Buyers were willing to pay more for housing in 2002 than in 1997, both because their incomes were on average higher and because they could borrow more cheaply.

The shifts on both sides of the market resulted in a higher average price. And each of these shifts compounded the other: The outward shift in demand would lead to a higher price on its own, and a reduction in supply would do likewise. Hence both forces acted to push up the price in 2002. If, instead, the supply had been greater in 2002 than in 1997 this would have acted to reduce the equilibrium price. And with the demand and supply shifts operating in opposing directions, it is not possible to say in general whether the price would increase or decrease. If the demand shift were strong and the supply shift weak then the demand forces would have dominated and led to a higher price. Conversely, if the supply forces were stronger than the demand forces.

[Figure 3.5 here.]

3.7 Market interventions — governments and interest groups

The freely functioning markets that we have developed certainly do not describe all markets. For example, minimum wages characterize the labour market, most agricultural markets have supply restrictions, apartments are subject to rent controls, and blood is not a freely traded market commodity in Canada. In short, price controls and quotas characterize many markets. **Price controls** are government rules or laws that inhibit the formation of market-determined prices. **Quotas** are physical restrictions on how much output can be brought to the market.

> **Price controls** are government rules or laws that inhibit the formation of market-determined prices.

> **Quotas** are physical restrictions on output.

Price controls come in the form of either *floors* or *ceilings*. Price floors are frequently accompanied by *marketing boards*.

Price ceilings — rental boards

Ceilings mean that suppliers cannot legally charge more than a specific price. Limits on apartment rents are one form of ceiling. In times of emergency — such as flooding or famine, price controls are frequently imposed on foodstuffs, in conjunction with rationing, to ensure that access is not determined by who has the most income. The problem with price ceilings, however, is that they leave demand unsatisfied, and therefore they must be accompanied by some other allocation mechanism.

Consider an environment where, for some reason – perhaps a sudden and unanticipated growth in population — rents increase. Let the resulting equilibrium be defined by the point E_0 in Figure 3.6. If the government were to decide that this is an unfair price because it places hardships on low-and middle-income households, it might impose a price limit, or ceiling, of P_c. The problem with such a limit is that excess demand results: Individuals want to rent more apartments than are available in the city. In a free market the price would adjust upward to eliminate the excess demand, but in this controlled environment it cannot. So some other way of allocating the available supply between demanders must evolve.

[Figure 3.6 here.]

In reality, most apartments are allocated to those households already occupying them. But what happens when such a resident household decides to purchase a home or move to another city? In a free market, the landlord could increase the rent in accordance with market pressures. But in a controlled market a city's rental tribunal may restrict the annual rent increase to just a couple of percent and the demand may continue to outstrip supply. So how does the stock of apartments get allocated between the potential renters? One allocation method is well known: The existing tenant informs her friends of her plan to move, and the friends are the first to apply to the landlord to occupy the apartment. But that still leaves much unmet demand. If this is a student rental market, students whose parents live nearby may simply return 'home.' Others may chose to move to a part of the city where rents are more affordable.

However, rent controls sometimes yield undesirable outcomes. Rent controls are widely studied in economics, and the consequences are well understood: Landlords tend not to repair or maintain their rental units in good condition if they cannot obtain the rent they believe they are entitled to. Accordingly, the residential rental stock deteriorates. In addition, builders realize that more money is to be made in building condominium units than rental units, or in converting rental units to condominiums. The frequent consequence is thus a

reduction in supply and a reduced quality. Market forces are hard to circumvent because, as Chapter 1 emphasized, economic players react to the incentives they face. These outcomes are examples of what we call the law of unintended consequences.

Price floors — minimum wages

An effective price floor sets the price above the market-clearing price. A minimum wage is the most widespread example in the Canadian economy. Provinces each set their own minimum, and it is seen as a way of protecting the well-being of low-skill workers. Such a floor is illustrated in Figure 3.7. The free-market equilibrium is again E_0, but the effective market outcome is the combination of price and quantity corresponding to the point E_f at the price floor P_f. In this instance, there is excess supply equal to the amount E_fC.

[Figure 3.7 here.]

Note that there is a similarity between the outcomes defined in the floor and ceiling cases: The quantity actually traded is *the lesser of the supply quantity and demand quantity at the going price: the short side dominates.*

If price floors, in the form of minimum wages, result in some workers going unemployed, why do governments choose to put them in place? The excess supply in this case corresponds to unemployment — more individuals are willing to work for the going wage than buyers (employers) wish to employ. The answer really depends upon the magnitude of the excess supply. In particular, suppose, in Figure 3.7 that the supply and demand curves going through the equilibrium E_0 were more 'vertical.' This would result in a smaller excess supply than is represented with the existing supply and demand curves. This would mean in practice that a higher wage could go to workers, making them better off, without causing substantial unemployment. This is the trade-off that governments face: With a view to increasing the purchasing power of generally lower-skill individuals, a minimum wage is set,

hoping that the negative impact on employment will be small. We will return to this in the next chapter, where we examine the responsiveness of supply and demand curves to different prices.

Quotas — agricultural supply

A quota represents the right to supply a specified quantity of a good to the market. It is a means of keeping prices higher than the free-market equilibrium price. As an alternative to imposing a price floor, the government can generate a high price by restricting supply.

Agricultural markets abound with examples. In these markets, farmers can supply only what they are permitted by the quota they hold, and there is usually a market for these quotas. For example, in several Canadian provinces it currently costs in the region of $30,000 to purchase a quota granting the right to sell the milk of one cow. The cost of purchasing quotas can thus easily outstrip the cost of a farm and herd. Canadian cheese importers must pay for the right to import cheese from abroad. Restrictions also apply to poultry. The impact of all of these restrictions is to raise the domestic price above the free market price.

In Figure 3.8, the free-market equilibrium is at E_0. In order to raise the price above P_0, the government restricts supply to Qq by granting quotas, which permit producers to supply a limited amount of the good in question. This supply is purchased at the price equal to P_q. From the standpoint of farmers, a higher price might be beneficial, even if they get to supply a smaller quantity, provided the amount of revenue they get as a result is as great as the revenue in the free market.

[Figure 3.8 here.]

Marketing boards — milk and maple syrup

A marketing board is a means of insuring that a quota or price floor can be maintained. Quotas are frequent in the agriculture sector of the economy. One example is maple syrup in Quebec. The Federation of Maple Syrup Producers of Quebec has the sole right to market maple syrup. All producers must sell their syrup through this marketing board. The board thus has a particular type of power in the market: it has control of the market at the wholesale end, because it is a sole buyer.

The Federation increases the total revenue going to producers by artificially restricting the supply to the market. The Federation calculates that by reducing supply and selling it at a higher price, more revenue will accrue to the producers. This is illustrated in Figure 3.8. The market equilibrium is given by E_0, but the Federation restricts supply to the quantity Q_q, which is sold to buyers at price P_q. To make this possible the total supply must be restricted; otherwise producers would supply the amount given by the point C on the supply curve, and this would result in excess supply in the amount E_qC. In order to restrict supply to Q_q in total, individual producers are limited in what they can sell to the Federation; they have a quota, which gives them the right to produce and sell no more than a specified amount. This system of quotas is necessary to eliminate the excess supply that would emerge at the above-equilibrium price P_q.

Chapter 4 in *Principles of Microeconomics* will return to this topic. For the moment, to see that this type of revenue-increasing outcome is possible, examine Table 3.1 again. At this equilibrium price of \$4 the quantity traded is 6 units, yielding a total expenditure by buyers (revenue to suppliers) of \$24. However, if the supply were restricted and a price of \$5 were set, the expenditure by buyers (revenue to suppliers) would rise to \$25.

3.8 Individual and market functions

Markets are made up of many individual participants on the demand and supply side. The supply and demand functions that we have worked with in this chapter are those for the total of all participants on each side of the market. But how do we arrive at such market functions when the economy is composed of individuals? We can illustrate how, with the help of Figure 3.9.

[Figure 3.9 here.]

To concentrate on the essentials, imagine that there are just two buyers of chocolate cookies in the economy. A has a stronger preference for cookies than B, so his demand is greater. To simplify, let the two demands have the same intercept on the vertical axis. The curves D_A and D_B indicate how many cookies A and B, respectively, will buy at each price. The market demand indicates how much they buy together at any price. Accordingly, at P_1, A and B purchase the quantities Q_{A1} and Q_{B1} respectively. Thus $Q_1 = Q_{A1} + Q_{B1}$. At a price P_2, they purchase Q_{A2} and Q_{B2} . Thus $Q2 = Q_{A2} + Q_{B2}$. The **market demand** is therefore the horizontal sum of the individual demands at these prices. In the figure this is defined by D_{market}.

> **Market demand**: the horizontal sum of individual demands.

3.9 Useful techniques — demand and supply equations

The supply and demand functions, or equations, underlying Table 3.1 and Figure 3.2 can be written in their mathematical form:

$$\text{Demand: } P = 10 - Q.$$

$$\text{Supply: } P = 1 + \frac{1}{2}Q.$$

A straight line is represented completely by the intercept and slope. In particular, if the variable P is on the vertical axis and Q on the horizontal axis (which is customary in economics when P signifies price and Q signifies quantity), the straight-line equation relating P and Q is defined by $P = a + bQ$. Where the line is negatively sloped, as in the demand equation, the parameter b must take a negative value. By observing either the data in Table 3.1 or Figure 3.2 it is clear that the vertical intercept a takes a value of \$10. The vertical intercept corresponds to a zero value for the Q variable. Next we can see from Figure 3.2 that the slope (given by the rise over the run) is $\frac{10}{10}$ and hence has a value of -1. Accordingly the demand equation takes the form $P = 10 - Q$.

On the supply side the price-axis intercept, from either the figure or the table, is clearly 1. The slope is one half, because a two-unit change in quantity is associated with a one-unit change in price. This is a positive relationship obviously so the supply curve can be written as $P = 1 + \frac{1}{2}Q$.

Where the supply and demand curves intersect is the market equilibrium; that is, the price-quantity combination is the same for both supply and demand where the supply curve takes on the same values as the demand curve. This unique price-quantity combination is obtained by equating the two curves: If Demand equals Supply, then

$$10 - Q = 1 + \frac{1}{2}Q.$$

Gathering the terms involving Q to one side and the numerical terms to the other side of the equation results in $9 = 1.5Q$. This implies that the equilibrium quantity must be 6 units. And this quantity must trade at a price of \$4. That is, when the price is \$4 both the quantity demanded and the quantity supplied take a value of 6 units.

Modelling market interventions using equations

To illustrate the impact of market interventions examined in Section 3.7 on our numerical market model for natural gas, suppose that the government imposes a minimum price of \$6 — above the equilibrium price obviously. We can easily determine the quantity supplied and demanded at such a price. Given the supply equation

$$P = 1 + \frac{1}{2}Q,$$

it follows that at $P = 6$ the quantity supplied is 10. This follows by solving the relationship $6 = 1 + \frac{1}{2}Q$ for the value of Q. Accordingly, suppliers *would like to supply* 10 units at this price.

Correspondingly on the demand side, given the demand curve

$$P = 10 - Q,$$

with a price given by $P = \$6$, it must be the case that $Q = 4$. So buyers *would like to buy* 4 units at that price: There is excess supply. But we know that the short side of the market will win out, and so the actual amount traded at this restricted price will be 4 units.

Conclusions

This chapter has covered a lot of ground. It is intended to open up the vista of economics to the new student in the discipline. Economics is powerful and challenging, and the ideas developed here will serve as conceptual foundations for our exploration of the subject. The next chapter deals with measurement and responsiveness.

KEY CONCEPTS

- **Demand** is the quantity of a good or service that buyers wish to purchase at each possible price, with all other influences on demand remaining unchanged.
- **Supply** is the quantity of a good or service that sellers are willing to sell at each possible price, with all other influences on supply remaining unchanged.
- **Quantity demanded** defines the amount purchased at a particular price.
- **Quantity supplied** refers to the amount supplied at a particular price.
- **Equilibrium price**: the price which equilibrates the market. It is the price at which quantity demanded equals the quantity supplied.
- **Excess supply** exists when the quantity supplied exceeds the quantity demanded at the going price.
- **Excess demand** exists when the quantity demanded exceeds quantity supplied at the going price.
- The **short side of the market** determines outcomes at prices other than the equilibrium.
- **Demand curve**: a graphical expression of the relationship between price and quantity demanded, with other influences remaining unchanged.
- **Supply curve**: a graphical expression of the relationship between price and quantity supplied, with other influences remaining unchanged.

- **Substitute goods**: when a price reduction (rise) for a related product reduces (increases) the demand for a primary product, it is a substitute for the primary product.
- **Complementary goods**: when a price reduction (rise) for a related product increases (reduces) the demand for a primary product, it is a complement for the primary product.
- An **inferior good** is one whose demand falls in response to higher incomes.
- A **normal good** is one whose demand increases in response to higher incomes.
- **Comparative static analysis** compares an initial equilibrium with a new equilibrium, where the difference is due to a change in one of the other things that lie behind the demand curve or the supply curve.
- **Price controls** are government rules or laws that inhibit the formation of market-determined prices.
- **Quotas** are physical restrictions on output.
- **Market demand**: the horizontal sum of individual demands.

Exercises for Chapter 3

Exercise 3.1

The supply and demand for concert tickets are given in the table below.

Price ($)	0	4	8	12	16	20	24	28	32	36	40
Quantity demanded	15	14	13	12	11	10	9	8	7	6	5
Quantity supplied	0	0	0	0	0	1	3	5	7	9	11

(a) Plot the supply and demand curves to scale and establish the equilibrium price and quantity.

(b) What is the excess supply or demand when price is $24? When price is $36?

(c) Describe the market adjustments in price induced by these two prices.

(d) *Optional*: The functions underlying the example in the table are linear and can be presented as $P = 18 + 2Q$ (supply) and $P = 60 - 4Q$ (demand). Solve the two equations for the equilibrium price and quantity values.

Exercise 3.2

Illustrate in a supply/demand diagram, by shifting the demand curve appropriately, the effect on the demand for flights between Calgary and Winnipeg as a result of the following changes. Explain in words why the demand curve shifts as you have illustrated.

(a) Increasing the annual government subsidy to Via Rail.

(b) Improving the Trans-Canada highway between the two cities.

(c) The arrival of a new budget airline on the scene.

Exercise 3.3

A new trend in US high schools is the widespread use of chewing tobacco. A recent survey indicates that 15 percent of males in upper grades now use it — a figure not far below the use rate for cigarettes. This development came about in response to the widespread implementation by schools of regulations that forbade cigarette smoking on and around school property. Draw a supply-demand equilibrium for each of the cigarette and chewing tobacco markets before and after the introduction of the regulations.

Exercise 3.4

The following table describes the demand and supply conditions for labour.

Wage rate ($)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170
Quantity demanded	1020	960	900	840	780	720	660	600	540	480	420	360	300	240	180	120	60	0
Quantity offered	0	0	0	0	0	0	30	60	90	120	150	180	210	240	270	300	330	360

(a) Graph the functions and find the equilibrium price and quantity by equating demand and supply.

(b) Suppose a price ceiling is established by the government at a price of $120. This price is below the equilibrium price that you have obtained in part (a). Calculate the amount that would be demanded and supplied and then calculate the excess demand.

Exercise 3.5

In Exercise 3.4, suppose that the supply and demand describe an agricultural market rather than a labour market, and the government implements a price floor of $140. This is greater than the equilibrium price.

(a) Estimate the quantity supplied and the quantity demanded at this price, and calculate the excess supply.

(b) Suppose the government instead chose to maintain a price of $140 by implementing a system of quotas. What quantity of quotas should the government make available to the suppliers?

Exercise 3.6

In Exercise 3.5, suppose that, at the minimum price, the government buys up all of the supply that is not demanded, and exports it at a price of $80 per unit. Compute the cost to the government of this operation.

Exercise 3.7

Let us sum two demand curves to obtain a 'market' demand curve. We will suppose there are just two buyers in the market. Each of the individual demand curves has a price intercept of $42. One has a quantity intercept of 126, the other 84.

(a) Draw the demands either to scale or in an Excel spreadsheet, and label the intercepts on both the price and quantity axes.

(b) Determine how much would be purchased in the market at prices $10, $20, and $30.

(c) *Optional*: Since you know the intercepts of the market (total) demand curve, can you write an equation for it?

Exercise 3.8

In Exercise 3.7 the demand curves had the same price intercept. Suppose instead that the first demand curve has a price intercept of \$36 and a quantity intercept of 126; the other individual has a demand curve defined by a price intercept of \$42 and a quantity intercept of 84. Graph these curves and illustrate the market demand curve.

Exercise 3.9

Here is an example of a demand curve that is not linear.

Price (\$)	4	3	2	1	0
Quantity demanded	25	100	225	400	625

(a) Plot this demand curve to scale or in Excel.

(b) If the supply function in this market is $P = 2$, plot this function on the same diagram.

(c) Determine the equilibrium quantity traded in this market.

Exercise 3.10

The football stadium of the University of the North West Territories has 30 seats. The demand curve for tickets has a price intercept of \$36 and a quantity intercept of 72.

(a) Draw the supply and demand curves to scale in a graph or in Excel. (This demand curve has the form $P = 36 - 0.5 \times Q$.)

(b) Determine the equilibrium admission price, and the amount of revenue generated from ticket sales for each game.

(c) A local alumnus and benefactor offers to install 6 more seats at no cost to the University. Compute the price that would be charged with this new supply and compute the revenue that would accrue at this new equilibrium price. Should the University accept the offer to install the seats?

(d) Redo the previous part of this question, assuming that the initial number of seats is 40, and the University has the option to increase capacity to 46 at no cost to itself. Should the University accept the offer in this case?

Exercise 3.11

Suppose farm workers in Mexico are successful in obtaining a substantial wage increase. Illustrate the effect of this on the price of lettuce in the Canadian winter, using a supply and demand diagram, on the assumption that all lettuce in Canada is imported during its winter.

Part Two

Introduction to Macroeconomics

4. Economic activity and performance
5. Output, business cycles and employment
6. Aggregate expenditure and aggregate demand
7. The government sector

The four chapters in this part of the text introduce and develop the expenditure side of a basic traditional macroeconomic model. Chapter 4 explains the measurement of macroeconomic activity and performance. Then Chapter 5 introduces an aggregate demand and supply model of national output, inflation and business cycles. Market based aggregate expenditure components that determine aggregate demand, when inflation, interest rates and exchange rates are constant, are modelled in Chapter 6. Chapter 7 extends the expenditure model to include government expenditure, taxes, budgets, public debt and basic fiscal policy.

Chapter 4

Economic activity and performance

In this chapter we will explore the following topics.

- 4.1 Indicators of macroeconomic activity and performance
- 4.2 Employment and unemployment
- 4.3 Measuring gross domestic product (GDP)
- 4.4 The consumer price index (CPI), and inflation
- 4.5 Nominal and real rates of interest
- 4.6 Recent Canadian economic performance

4.1 Indicators of macroeconomic activity and performance

Macroeconomics is focused on three main indicators of the economy's performance and the underlying explanations for their behaviour. The indicators are:

1. the rate of growth of real output and national income;
2. the rate of inflation; and
3. the rate of unemployment.

Other aspects of the economy like interest rates, foreign exchange rates, wage rates, government budgets, capital investment, commodity prices, housing and so forth are important to macroeconomic analysis because they work to determine performance as measured by these three indicators.

Output is a measure of the total quantity of goods and services produced in the economy. It is also a measure of the incomes generated by that production. Inflation in macroeconomics is the rate of change of the price level. The latter is the weighted average of the market prices of all final goods and services (section 4.3 defines the concept of *final* goods and services) produced. Employment is a measure of the number of jobs involved in the production of goods and services, or, in more refined terms, the number of hours of labour input required to produce the economy's output. Unemployment measures the number of people who are not employed but are available for and actively seeking work. Economic performance is judged by how these measures change over time.

There are, however, longer term perspectives, decades and beyond, that involve important but different economic issues. The sustained growth of real income per person is of major interest. But underlying that growth are questions raised by: climate change and energy

sources; demographic trends that change labour force participation, dependency ratios, social policies, and immigration policy; changes in the industrial structure of employment and incomes; changing national patterns of economic activity and international trade policy and patterns; and that list is not exhaustive. We look at the determinants of economic growth in Chapter 13.

Macroeconomics involves complex linkage and feedback effects that tie economic conditions and economic policy to economic performance. Macroeconomic theories and models attempt to capture this complexity. They seek to understand and explain the causes of short run changes in economic performance and the role for economic policy.

For example, the persistent effects of what seemed to be a short term local crisis in the US housing and financial markets triggered the **Great Recession** of 2008-2009. International linkages among financial markets spread the effects across European and other financial markets. Government bailouts of major banks and monetary and fiscal stimulus used to fight falling output and employment resulted in unprecedented government deficits and historically low interest rates. International financial and fiscal linkages were much stronger than expected initially.

> **Great Recession**: a period of marked general decline observed in national economies globally (including Canada), i.e. a recession, that occurred from late 2007 to 2009.

In Canada, the interest rate set by the Bank of Canada was reduced to its lowest historical level. After running budget surpluses for the preceding ten years, Canada's federal government ran a deficit in 2008, which reached 3.8 percent of GDP in 2009, before moving back into balance by 2014.[1]

Because of a steep drop in the world prices of oil and other commodities in 2014, output growth in Canada turned negative for the first two quarters of 2015. Positive output growth

[1] See https://tradingeconomics.com/canada/government-budget

resumed in the last half of 2015, but the economy still remained below "full employment" in the third quarter of 2019. The federal government budget was in deficit from 2015 on, but because GDP was growing the ratio of the federal government debt to GDP fell between 2016 and 2019, from 91.8 percent to 86.8 percent.[2] Then the Covid-19 pandemic hit, with the effects summarized in Application Box 1.1 in Chapter 1. We take a look at recent indicators of Canadian macroeconomic performance in Section 4.6 below.

Macroeconomic theory and models emerged from an earlier major financial collapse and crisis followed by the Great Depression of the 1930s. Although today's economies are larger and more complex they still behave following the same basic principles.

To understand the different dimensions of economic activity, economic conditions and macroeconomic policies, we need a framework that captures how they are related and how they interact. Macroeconomics provides that framework, using consistent and comprehensive system of definitions for the measurement of economic activity provided by the national accounts.

4.2 Employment and unemployment

Employment is defined as the number of adults (15 years of age and older) employed full time and part time as well as self-employed. **Unemployment** covers those not working but available for and seeking work. The civilian **labour force** is those adults who are employed plus those not employed but actively looking for jobs. Based on these concepts, and data on the surveyed population, Statistics Canada reports three key labour market indicators, namely: the participation rate; the unemployment rate and; the employment rate. Employment and unemployment receive most of the media attention and have become familiar indicators of economic conditions. However, there are two other underlying labour market measures that deserve attention when interpreting the employment and unemployment rates.

[2]See https://tradingeconomics.com/canada/government-debt-to-gdp

Labour force: adults who are employed plus those who are not employed but who are actively looking for work.

Employment: the number of adults who are employed full time or part time plus those who are self-employed. The **employment rate** is

Unemployment: the number of adults who are not working but actively seeking for work. The **unemployment rate** is the ratio of unemployment and the labour force expressed as a percentage.

The **participation rate** is the proportion of the surveyed population that is either working or unemployed (expressed as a percentage). It measures the size of the labour force relative to the total adult population. The participation rate changes as people become more optimistic about finding employment, or discouraged by periods without employment. Discouraged workers want to work but are no longer looking for work because they believe suitable work is not available. As a result they are excluded from the measurement of the labour force and reduce the participation rate. *Changes in the participation rate change the size of the labour force and the unemployment rate even if employment and the population are constant.* The other main reason for an adult to be excluded from the labour force is retirement.

Participation rate: the percent of the (adult) population who are either working or unemployed.

The **unemployment rate** is the number of unemployed persons expressed as a percentage of the labour force. The size of the labour force depends on the participation rate, which reflects the choices people make about looking for work. The unemployment rate will rise if people become more optimistic about job prospects and begin to look for work, increasing the participation rate and the labour force. On the other hand, the unemployment rate will decline if some people become discouraged and give up looking for work, reducing the participation rate and the labour force.

Unemployment rate: the number of unemployed persons as a percentage of the labour force.

The unemployment rate is calculated as follows.

$$\text{Unemployment Rate} = \frac{\text{Labour Force} - \text{Employment}}{\text{Labour Force}} \times 100.$$

Unemployment as measured by the broad unemployment rate has three important components. **Cyclical unemployment** is unemployment that would be eliminated by a higher level of economic activity without putting increased pressure on wage rates and inflation. **Frictional unemployment** comes from the dynamics of the labour market as changing labour force participation and employment opportunities mean that it takes time to match job openings with job candidates. **Structural unemployment** reflects differences in labour force characteristics and employment opportunities as the structure of the economy changes. In combination, frictional and structural unemployment make up the "full employment" level of unemployment. The corresponding unemployment rate is defined as the **natural unemployment rate**. In recent years in Canada, estimates of frictional and structural unemployment suggest a natural unemployment rate of approximately 6.0 percent. An unemployment rate persistently below 6.0 percent might create inflationary pressure in the labour market and the economy.

Cyclical unemployment: unemployment that would be eliminated by higher levels of economic activity.

Frictional unemployment: the unemployment that results from the time involved in adjusting to changing labour force and employment opportunities.

Structural unemployment: caused by changes in economic structure relative to labour characteristics.

Natural unemployment rate: the unemployment rate compatible with full employment.

The **employment rate** provides a different perspective on labour market conditions because it is not affected by changes in the participation rate, which can affect unemployment rates. If some unemployed people become discouraged and stop looking for work, then the participation rate, the labour force and the unemployment rate decline, but the employment rate is unchanged. The employment rate is calculated as follows:

$$\text{Employment Rate} = \frac{\text{Employment}}{\text{Adult Population}} \times 100,$$

where the adult population is the number of persons of age 15 or older.

Employment rate: the percent of the population 15 years of age and over that is employed.

Table 4.1 gives data on the Canadian labour force and labour market conditions in 2013, 2019 and 2022 in terms of the participation rate, employment rate and unemployment rate concepts.[3]

[3]The "Q" after the year refers to the quarter.

Table 4.1: Canadian Labour Market(thousands of persons and percent)

	2013Q1	2019Q2	2022Q1
1. Adult population	28,504	30,626	
2. Labour force	18,978	20,188	
3. Employment	17,623	19,029	
4. Unemployment	1,355	1,159	
5. Participation rate [(2)/(1) × 100]	66.7%	65.9%	
6. Employment rate [(3)/(1) × 100]	61.8%	62.1%	
7. Unemployment rate [(4)/(2) × 100]	7.2%	5.7%	

Source: Statistics Canada, Table 14-10-0287-01 and authors' calculations.

4.3 Measuring gross domestic product (GDP)

Nominal **gross domestic product** (GDP) is measured using market prices and over a specific time period. It is not possible to add up the final physical outputs of many different businesses and arrive at a meaningful result. Instead, since we have a market economy, we let current market prices determine the money values of these different outputs. Then, the total market value can be found by adding up the monetary values. **Nominal GDP** is the market value at current prices of all final goods and services.

> **Nominal gross domestic product (GDP)**: the monetary value of all final goods and services produced by the economy in a specified time period.

What is "gross" about the gross domestic product? The goods and services produced by the economy include investment goods like structures, machinery, and infrastructure. These goods **depreciate** (wear out) over time and either become less productive or are scrapped, causing a loss in value. This depreciation can be measured. **Net domestic product** subtracts this loss in value from gross domestic product.

> **Depreciation**: the loss in economic value of investment goods due to wear and tear.

> **Nominal net domestic product (NDP)**: the monetary value of all final goods and services produced by the economy in a specific time period, after subtracting the monetary value of the depreciation of the economy's productive assets.

What is "domestic" about the gross domestic product? GDP measures the quantity of goods and services produced *within the borders* of a country, whether or not the output produced belongs to a citizen or permanent resident of the country. **Gross national product** (GNP) measures the quantity of goods and services belonging to citizens or permanent residents of a country, no matter where the production takes place.[4]

> **Nominal gross national product (GNP)**: the monetary value of all final goods and services which belongs to citizens and permanent residents of a country, no matter where the production takes place.

What is "final" about the quantity of final goods and services? The goods and services produced by firms are often used by other firms as inputs into their production processes. These are called **intermediate inputs**. For example, a producer of frozen pizzas may buy cheese, tomato sauce, flour, and other ingredients from other firms. Firms also buy services like accounting, advertising, and transportation in order to produce and deliver their output.

Counting the value of the cheese once when it is sold to the pizza producer and again when it is part of the frozen pizza sold to a consumer would be **double counting**. To avoid this, we subtract the value of intermediate inputs when measuring the value of a firm's output for the purposes of calculating GDP. We say that we only count the **value added** by firms. As a result, only the value of **final goods and services** are included in GDP.

[4]There can be significant differences between GDP and GNP for some countries. For example, a large number of South Asians work in Middle Eastern countries such as Qatar and the United Arab Emirates, and they remit a substantial fraction of their incomes to family members back home. As a result, the GNPs of Pakistan and Bangladesh are substantially larger than their GDPs.

Final goods and services: the goods and services are purchased by their ultimate users.

Intermediate inputs: services, materials, and components purchased from other businesses and used in the production of final goods.

Value added: the value of the output of a production process, minus the value of the goods used as intermediate inputs in the production process.

Output-based GDP

Value added is the basis of **output-based GDP**. Ihis measures the value added by all firms and industries in the economy. By using the concept of value added we avoid counting the value of an output multiple times, once as the output of a firm and again when it is purchased and used as an intermediate input by another firm.

Output-based GDP: the sum of value added by all industries.

Consider a simple example. A coffee shop sells 100 cups of coffee an hour at a price, before tax, of \$1.50. To make 100 cups of coffee the shop uses 2 kilos of ground coffee costing \$10.00 per kilo, 25 litres of pure spring water costing \$0.40 a litre, and electricity and dairy products costing \$20 in total. The coffee shop's sales per hour are \$150 using inputs costing \$50. Its value added per hour is $\$150 - \$50 = \$100$.

Income-based GDP

The \$100 of value added from the example in the previous subsection covers the labour costs, rent, interest expenses, and management costs of the business in order to produce 100 cups of coffee an hour.

What's left over after deducting the value of intermediate goods and services from the value of a firm's output? The firm pays salaries and wages to its employees. What is left over after paying wages and salaries are its operating profits. Salaries, wages and profits represent income to individuals, and this is the second principal way to measure GDP.

> **Income-based GDP**: the total earnings generated by the production of goods and services and paid to individual wage and salary earners and to shareholders.

Expenditure-based GDP

Income accruing to Canadian households must be spent on final goods and services or saved. When income is saved, it is available to be used by firms to finance productive investments. The financial sector channels the available savings to the firms who undertake the investment spending.

Investment in the national income accounts means the purchase of productive capital goods, which also include housing. Financial "investments" and the sale of existing assets are excluded from this measure.

> **Expenditure-based GDP**: the total expenditure on final goods and services produced.

> **Investment**: in the national income accounts, the purchase of productive capital goods.

The expenditure-baaed GDP accounts classify expenditure on final goods and services into five main categories: consumption, investment, government expenditure, exports, and imports. We have

$$GDP = \text{consumption} + \text{investment} + \text{government expenditure} + \text{exports} - \text{imports}.$$

Applying the standard notation used to represent these categories (which is used throughout the rest of this book) gives

$$GDP = C + I + G + X - IM.$$

Expenditure-based GDP is the foundation of the theory of aggregate demand introduced in Chapter 5 and developed in detail in later chapters.

Why do we need to subtract the value of imports from the measure of GDP? The C, I and G components include all spending, including on imported goods and services. Since we want to measure expenditure on goods and services produced in Canada, the value of these imports must be netted out.

The circular flows and the equality of the three measures of GDP

The total market value of output as measured by value added must be distributed as income to remunerate productive inputs. In turn, the total income of Canadians is spent on one of the categories of expenditure. Consequently, the three different ways of measuring GDP (value added, income, and expenditure) must be equal. (In practice, there are small discrepancies due to statistical errors.)

The circular flow is illustrated by Figure 4.1 below, for a simple economy without governments and without trading relationships with the rest of the world. It shows how the value of final goods and services produced, the incomes generated by this production, and the expenditures on these goods and services, must be equal.

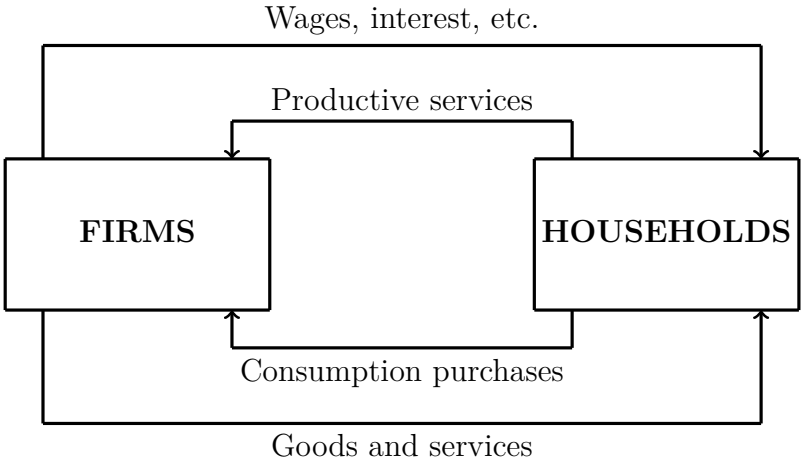


Figure 4.1: **Circular flows in a simple economy**

Nominal GDP, real GDP and the GDP deflator

We have defined nominal GDP as the money or market value of final output in the economy. This means that nominal GDP can increase either because the quantities of goods and services produced by firms increases or simply because their prices increase. It is physical quantities of goods and services that yield satisfaction or **utility**. In order to arrive at a measure of the levels and changes in these physical quantites, we use the concept of **real gross domestic product** GDP.

> **utility**: the subjective satisfaction provided to an individual by the consumption of a good or service.

What is "real" about real GDP? In order to measure the **volume** of goods and services produced, they are valued at constant prices from a base year, as we will see in more detail below. Nominal GDP uses current prices to value output.

Real gross domestic product (GDP): the quantity of final goods and services produced by the economy over a specified time period, valued at constant prices from a base year.

To illustrate this important point, Table 4.2 shows a simple economy that produces both consumer goods, blue jeans, and capital goods, solar panels. In this economy nominal GDP rises from $300,000 to $525,000 between 2008 and 2018, a 63 percent increase measured in current prices as a result of changes in both quantities and prices. If we take 2008 as the base year, we can measure real GDP in 2018 by valuing output quantities in 2018 using 2008 prices. This gives real GDP in 2018 of $525,000 in prices of the base year. In the example in the table, quantities of both products rise over the period but the price of blue jeans rises while the price of solar panels falls. As a result the rise of about 75 percent in real GDP gives a true picture of the extra quantity of goods available in the economy in 2018 compared with 2008. It eliminates the change in nominal GDP that was the result of the fall in the average price level by 6.7 percent between 2008 and 2018 as a result of the fall in the price of solar panels.

Table 4.2: **Nominal and Real GDP**

		2008	2018	% change
Quantity	jeans	4,000	5,000	25
	solar panels	2,000	4,000	100
Price in current $	jeans	25	50	100
	solar panels	100	60	-40
Current value	jeans	100,000	250,000	150
	solar panels	200,000	240,000	20
Nominal GDP		**300,000**	**490,000**	**63**
Value in 2008 $	jeans	100,000	125,000	25
	solar panels	200,000	400,000	100
Real GDP		**300,000**	**525,000**	**75**
GDP deflator		**100**	**93.3**	**-6.7**

To convert nominal GDP to real GDP we use an index that includes what is happening to

the prices of all these different goods and services. This index is called the **GDP deflator**.

> **GDP deflator**: an index of current final output prices relative to base year prices.

If we have data for both nominal and real GDP, we can calculate the GDP deflator as the ratio of nominal GDP to real GDP expressed as an index with a value of 100 in the base year, as follows.

$$\text{GDP deflator} = \frac{\text{Nominal GDP}}{\text{Real GDP}} \times 100$$

Drawbacks of GDP as a measure of economic wellbeing

GDP measures economic activities which are exchanged in markets. It does not and cannot measure outputs which are not sold to a buyer. It also does not measure some market transactions if they are paid in cash and not recorded or declared as income by the recipient of the cash.

If you hire a landscaping company, you would pay them to have your lawn mowed. The company's wage bill and profits will be counted as part of measured GDP. If you hire a 15-year-old kid from down the street, you would pay to have your lawn mowed but unless the kid declared the income to Revenue Canada it would not show up in the national accounts. If you mow the lawn yourself, there is no market transaction and will not be measured in the national accounts.

Some types of economic activity which lead to a measured increase in GDP can actually be associated with situations which result in a lower level of economic welfare. The classic (and very Canadian) example is snow clearance. A major urban snowfall leads to a decrease in wellbeing as travel becomes more difficult and time-consuming, but also to an increase in GDP as contractors are hired to clear and remove the snow. Of course wellbeing would be even lower if the snow was not cleared. For similar reasons, war, disease, and natural disasters can all lead to increases in GDP.

GDP does not account for the depletion of nonrenewable resources used up in production processes. In principle, the market value of the extracted resources should be subtracted from measured GDP. Conversely, when resources are expended that lead to a major new nonrenewable resource discovery, the estimated market value of the additional resources should be added to measured GDP.

4.4 The consumer price index (CPI) and inflation

The **price level** in the economy is a measure of the weighted average of prices of a wide variety of goods and services. Whereas real GDP measures the value of the output of goods and services using a constant set of prices, the **Consumer Price Index (CPI)** compares the cost of a fixed basket of goods and services bought by the typical household at a specific time with the cost of that same basket of goods and services in a base year. It is the most widely used indicator of prices in Canada and is often referred to as the "cost of living."

> **Price level**: a measure of the average prices of all goods and services produced in the economy.

> **Consumer Price Index (CPI)**: a measure of the cost of living in any one year compared to the cost of living in a base year.

The CPI is a more comprehensive measure of the change in prices from one year to the next, but the simple example in Example Box 4.1 illustrates the how such an index is constructed and what it tells us. It is a simple example of the construction of a **price index**.

> **Price index**: a measure of the price level in one year compared with prices in a base year.

Example Box 4.1: Constructing a price index

Suppose a survey of expenditures by university students in the year 2015 gives the information reported in the first three columns of the table below. The cost of weekly expenditures on a basket of five items and the weight of each item in the total expenditure was $80.50. Using 2015 as our base year, the cost of the basket in 2015 prices, $80.50, has an index value of 100 [($80.50/$80.50) × 100].

University student weekly expenditure basket (Base year 2015)					
	Quantity	2015 Price	2015 Cost	2019 Price	2019 Cost
Pizza	5	$7.50	$37.50	$8.50	$42.50
Hamburger	5	$2.50	$12.50	$2.25	$11.25
Coffee	10	$1.00	$10.00	$1.25	$12.50
Movies	1	$10.00	$10.00	$8.00	$8.00
Bus fare	7	$1.50	$10.50	$1.85	$12.95
Total			$80.50		$87.20

In other words we have a Student Price Index in 2015 of

$$\text{SPI}_{2015} = 100.$$

From the last two columns of the table this same basket of goods and services would cost $87.20 in 2019. So our SPI in 2019 would be

$$\frac{\text{Cost of basket in 2019}}{\text{Cost of basket in 2015}} \times 100 = \frac{\$87.20}{\$80.50} \times 100 = 108.3.$$

The index tells us that even though the prices of some things went up and others went down the Student Price Index increased by 8.3%. This was the weighted average increase in prices and the increase in the cost of student expenditures over a period of four years.

Calculating the rate of inflation

The consumer price index is updated every month by Statistics Canada. The CPI number for a given month is typically released within three weeks from the end of that month. Based on the CPI, it is then possible to calculate the rate of inflation, which is the rate of increase in prices over a given time period.

> **Inflation**: the rate of increase of prices (as measured by a price index such as the CPI) over a given time period.

The rate most commonly reported in the media, and also given prominence by *Statistics Canada* when it publishes monthly data on the CPI, is so-called "headline" inflation. It measures how quickly the CPI has increased over the past twelve months (for that reason it is also known as year-over-year inflation). The way to calculate headline inflation in percentage terms can be written as

$$\frac{\text{CPI}_t - \text{CPI}_{t-12}}{\text{CPI}_{t-12}} \times 100,$$

where CPI_t is the consumer price index in month t and CPI_{t-12} is the consumer price index from twelve months before.

The Bank of Canada's 2 percent inflation target is defined in terms of year-over-year inflation.[5]

Why the CPI is an imperfect measure of the cost of living

We noted above that the CPI gives the cost (relative to a base year) of buying a given basket of goods.

[5] Chapter 8 examines the objectives and conduct of monetary policy in detail.

The basket is supposed to reflect the consumption habits of the "representative" or "average" consumer. It cannot possibly reflect the habits of each individual consumer or household. The CPI is an imperfect measure of the cost of living for the following reasons.

1. Different consumers and households have different consumption habits. For example, poorer households spend a higher fraction of their incomes on food. Increases in the price of food will affect them more strongly than it will affect rich households who spend a much smaller fraction of their incomes on food.

2. Spending habits changes slowly over time as relative prices change, new and previously-unavailable goods are introduced to the market. Statistics Canada periodically revises the weights of goods in the CPI to reflect these changes, but the weights are revised irregularly. Statistics Canada (2015) describes the methodology of recalculating the weights of the basket of goods in the CPI.

3. Prices can differ across different geographical locations. It is possible to calculate CPIs for different Canadian regions and cities (Statistics Canada does this), but the overall CPI cannot take these variations into account.

4. Not only are new consumer goods introduced all the time, the quality of existing goods changes as well. For example, a typical laptop computer purchased in 2022 is vastly more powerful than one from the 1990s.

5. If the price of an individual good increases, it is almost always possible to purchase less of it and shift spending to a substitute which is less expensive. Because of this, measured inflation tends to overstate the increase in the cost of attaining a given level of satisfaction or utility.

The difference between the CPI and the GDP deflator

As we noted above, the GDP deflator is an index which uses a constant set of prices to weight different quantities, while the CPI uses a constant set of quantities to weight different prices.

Also, the set of goods consumed by Canadian households is very different from the set of goods produced by the Canadian economy (real GDP). GDP includes goods and services purchased by governments and investment goods purchased by firms.

The economic costs of inflation

Inflation is, by definition, a fall in the purchasing power of the Canadian dollar. This is a cost for the buyers of goods and services whose prices have increased. On the other hand, as the section on measuring GDP showed, an expenses for one individual is an income for another individual or individuals in the economy. If prices increase, so do their incomes. On the other hand, there is a transfer of resources from the buyers to those who receive the incomes.

Here are some of the other costs of inflation.[6]

1. Inflation acts like a tax on the holdings of money and other assets which have a fixed nominal (dollar) value. This gives people an incentive to alter their behaviour in order to avoid paying at least some of the tax. As inflation increases, people hold less in the form of money balances. For those who use cash, this can mean going to the bank more frequently: for example, withdrawing $100 every week to finance cash purchases instead of $200 every two weeks. This costs real resources (time).

2. Most firms do not adjust their prices every day because it is costly to do so: price tags on

[6] See Ambler (2008) for a detailed review of the costs of inflation.

goods must be replaced or the prices associated with bar codes must be reprogrammed. In the case of restaurants with printed menus, those menus must be reprinted. As inflation increases, the firms change their prices more frequently and bear higher costs in order to do so. To highlight the analogy with restaurants who must reprint their menus, the costs of changing prices are known as **menu costs**.

> **Menu costs**: the costs to firms of changing their prices.

3. Given that most firms changes their prices only periodically, increased inflation means that consumers face more uncertainty concerning what prices they will face when they go to the store, and more uncertainty concerning the relative prices of competing goods. They must spend more time and effort gathering information to make informed decisions. Also, when inflation rises, and because not all firms change their prices at the same time or with the same frequency, relative prices between different goods become more variable, leading to shifts in demand across different types of goods.

4. Unexpected inflation leads to an unanticipated redistribution of resources between borrowers and savers. Consider taking out a loan for $10,000 at an interest rate of 5 percent, with payment of the interest and repayment of the principal at the end of one year. The amount of real resources that have to be repaid depends on the realized rate of inflation over the course of the year. If both parties to the loan expected an inflation rate of 3 percent, then if realized inflation turns out to be 6 percent, the borrower must pay back less in real resources than anticipated: the borrower gains and the lender loses. If inflation turns out to be less than 3 percent, the lender makes an unexpected gain while the borrower suffers a loss.

4.5 Nominal and real interest rates

The **interest rate** is the amount charged by lenders when they lend money. It is expressed as a percentage of the amount loaned. If you borrow $100 from the bank for a year at an interest rate of 5 percent, at the end of the year you must repay the principal ($100) plus 5 percent of that amount, i.e. $5.

> The **interest rate** is the amount of money charged, as a percentage of the principal, to borrow money.

Different types of interest rates

Money is lent in different forms and at different maturities. Among the different types of interest rates in the Canadian economy are the following.

1. The mortgage interest rate is the rate on loans to purchase a house.

2. Savings deposit interest rates are paid to depositors by banks on savings accounts.

3. The Treasury bill rate is the rate of interest paid by governments (including the federal government) to borrow at maturities of less than a year.

4. Government bond rates are paid by governments to borrow at maturities of longer than a year.

5. The overnight rate is the rate of interest that major banks and other large financial institutions charge to lend funds to other financial institutions on a very short term basis. This is the interest rate that the Bank of Canada uses to implement its monetary policy. We will look at this in more detail in Chapter 8.

Interest rates and compounding

Imagine that you deposit \$100 in a savings account which earns a 2 percent rate of interest. At the end of the first year, with no withdrawals or deposits during the year, you will have \$102 in the account. If you leave that amount in the account for another year, you will earn interest on the initial deposit *and* interest on the \$2 of interest accrued in the first year. At the end of the second year, you will have $1.02 \times 1.02 \times \$100 = \$104.04$, slightly more than \$104.

It is easy to verify with a calculator that with an interest rate of 2 percent it would take 35 years for the initial deposit of \$100 to be worth \$200 if the savings deposit rate remains constant at 2 percent.

Interest rates are most often expressed in percent and are **annualized**. Suppose the Canadian federal government borrows \$100 for 6 months by issuing a Treasury bill of that maturity and with an interest payment of \$1 (1 percent of \$100) at maturity. The *annualized* interest rate on the Treasury bill would be $1.01 \times 1.01 = 1.0201$, or approximately 2 percent. We would say that the government is borrowing at a 2 percent *annualized* rate of interest.

Interest rates depend on the term of the loan or investment as well as the assessment by the lender that the borrower will be unable to repay the loan and will therefore default.

This means that most loans (investments from the point of view of the lender) are risky. Interest rates on risky loans include a **risk premium** to compensate the lender for the risk of default.

Nominal versus real interest rates

The last point in the discussion of the costs of inflation in the previous section highlights the point that, when taking out a loan or making a **fixed income investment**, which pay fixed interest or dividend payments until their maturity date, the important consideration is not the nominal rate of interest or the nominal rate of return, but the nominal rate of return **less** the depreciation of the value of the currency (i.e. inflation) over the term of the loan or investment. This leads to the important distinction between nominal and real interest rates.

> **Fixed income investment**: an asset which pays fixed (in dollar terms) interest payments or dividends until its maturity date.

Imagine that you deposit $100 in the bank, in an account that earns an annual interest rate of 2 percent. At the end of the year you will have $102 in your account. Imagine that the inflation rate over the course of the same year is 4 percent. Because of this increase in prices, the amount of goods you can buy with the $102 is actually less than you could have purchased with the $100 at the beginning of the year. Your nominal gain of $2 has been more than offset by the decline in the purchasing power of your dollars because of inflation.

For this reason, economists the **real interest rate** as the nominal interest rate less the inflation rate that lenders and borrowers expect to prevail over the term of a loan or investment.

> The **real interest rate** is the interest rate on a loan less the expected rate of inflation over the term of the loan.

Realized versus expected real interest rates

The *realized* real rate of return on a loan (which is only known after the fact) is the interest rate less the actual rate of inflation.

The *ex ante* (Latin for "before the fact") real rate of return on a loan is the interest rate less the inflation rate that is expected to prevail over the life of the loan.

Because predicting inflation involves uncertainty, the real rate of return is unknown in advance. As a consequence, interest rates on loans often incorporate an inflation risk premium as well as a risk premium to compensate for the possibility of default.

4.6 Recent Canadian economic performance

Figures 4.2 to 4.6 provide a more detailed look at the following macroeconomic indicators for the Canadian economy since 2000: the level of real GDP; its rate of growth; the rate of inflation; the unemployment rate, and; the Bank of Canada's overnight rate target. The graphs use quarterly data, with sources indicated in the individual figures. Each figure shows (in grey shading) the two recessions that occurred during this period.[7] The graphs show the variations in these measures of economic performance and, in the case of Figure 4.2, the overall trend in economic growth. Understanding the causes of these short-term fluctuations in economic performance, their effects on standards of living and the economic policy questions they raise, are major reasons for studying macroeconomics.

Figure 4.2 shows the substantial growth in real GDP over the 2000–2019 period. It also shows that growth was not steady. Real GDP did increase from 2000–2008 with annual growth rates ranging from 1.5 percent to 3.0 percent. Then the GDP declined sharply by 2.9 percent in 2009. GDP growth was mildly negative over the first two quarters of 2015. Because the fall in GDP was not very pronounced (0.4 percent from peak to trough), not very persistent (monthly GDP growth turned positive in June 2015, before the end of the second quarter) and not very pervasive (the decline in output was mostly restricted to the

[7]Each shaded area extends from the previous business cycle peak (the quarter before GDP started to decline) to the trough of the recession (the quarter before GDP started to grow again).

petroleum and energy sectors), the Business Cycle Council of the C.D. Howe Institute judged that the period did not qualify as a recession.[8] As noted in Chapter 1, the recession that resulted from the forced lockdowns at the beginning of the pandemic led to a drop in real GDP of 17.5 percent, by far the largest decline since the Great Depression of the 1930s.

[XX Figure 4.2 about here using data from Table 36-10-0104-01.]

Figure 4.3 plots the same data, but in terms of growth rates rather than levels. It brings out the short-run fluctuations in GDP growth more clearly.

Since the figure is based on quarterly data, it shows that growth in the first two quarters of 2020 was negative. This obscures the fact that the fall in output was confined to *two months*, March (the last month of the first quarter) and April (the first month of the second quarter). The duration between the peak of the previous business cycle in February 2020 and the trough of the recession in April 2020 was therefore only two months. This made the recession of 2020 not only the deepest since the Great Depression but also the shortest.[9]

[XX Figure 4.3 about here using data from Table 36-10-0104-01.]

Figure 4.4 shows the rates of headline inflation since 2000.[10] The numbers show the relative stability of Canadian inflation with the exception of two periods of negative inflation during the Great Recession and the pandemic recession and its aftermath. After the dip in inflation during the Great Recession, inflation rebounded to a level just above target in 2010 before declining again in 2012 and remaining below target for most of the rest of the decade. After plunging at the beginning of the pandemic, inflation soared as demand increased during 2021 while supply was not able to keep up. By the end of the second quarter of 2022 inflation was at its highest level since January 1983.[11]

[8] See https://www.cdhowe.org/cpc-communique/business-cycle-council-communique-december-2018.

[9] See https://www.cdhowe.org/council-reports/cd-howe-institute-business-cycle-council-declares-end-cov

[10] Because data on headline inflation is published each month, the values used are for the last month in each quarter. Source: Statistics Canada Table 18-10-0004-01.

[11] See https://www150.statcan.gc.ca/n1/daily-quotidien/220720/dq220720a-eng.htm

[XX Figure 4.4 about here using data from Table 18-10-0004-01 or Bank of Canada series v41690973.]

Figure 4.5 shows the evolution of the unemployment rate since 2000.[12] During the Great Recession, unemployment peaked at 8.7 percent (in May, June and July 2009) before gradually declining below 6 percent by September 2018. During the Covid-19 pandemic, it peaked at 13.4 percent in May 2020. The decline since then has been much more rapid than after the Great Recession. The figure for June 2022 was 4.9 percent, a rate not seen since the beginning of the 1970s.

[XX Figure 4.5 about here using data from Table 14-10-0287-02.]

Figure 4.6 shows the evolution of the Bank of Canada's overnight rate target since 2000. Until the onset of the Great Recession in the fourth quarter of 2008, this interest rate was most often above 2 percent, and often quite a bit above 2 percent. Since then it has been consistently below 2 percent until the Bank raised it to 2.5 percent in July 2022. The Bank of Canada lowered the overnight rate target to 0.25 percent in April 2009 in order to counter weak demand and falling output, kept it relatively low during the decade that followed because of the slow recovery from the Great Recession, and only raised it above 2 percent to combat the surge in inflation since 2021.

[XX Figure 4.6 about here using data from Table 10-10-0139-01.]

Conclusions

In this chapter we have looked at indicators of macroeconomic activity and performance, the measurement of macroeconomic activity using the national accounts, and the calculation of the consumer price index and inflation. We have not examined the conditions that determine

[12]The values are for the last month in each quarter. Source: Statistics Canada Table 14-10-0287-02.

the level of economic activity and fluctuations in that level. An economic model is required for that work. In the next chapter we introduce the framework of a basic macroeconomic model.

KEY CONCEPTS

- **Macroeconomics** studies the whole national economy as a system. It examines expenditure decisions by households, businesses, and governments, and the total flows of goods and services produced and incomes earned.
- **Real Gross Domestic Product** (GDP), prices and **inflation rates**, and employment and **unemployment rates** are indicators of macroeconomic activity and performance.
- **Fluctuations** in the growth rate of real GDP, in inflation rates, and in unemployment rates are important aspects of recent economic performance in Canada.
- **Circular flow diagram**: illustrates the flow of real resources and money payments in terms of: the expenditures of households, firms and governments; the production of goods and services by business and; the incomes that result from this production.
- **Investment** in the national accounts includes expenditures on capital (productive) goods, including new housing. Financial "investments" and sales of existing assets are not included.
- The **National Accounts** provide a framework for the measurement of the output of the economy and the incomes earned in the economy.
- **Nominal GDP** measures the output of final goods and services at market prices in the economy, and the money incomes earned by the factors of production.
- **Real GDP** measures the output of final goods and services produced, and incomes earned at *constant prices*.

- The **GDP deflator** is a measure of the price level for all final goods and services in the economy.
- The **Consumer Price Index (CPI)** measures the cost of a representative basket of consumer goods relative to a base year. The inflation rate calculated using the CPI is targeted by the Bank of Canada's monetary policy.
- **Inflation** is the rate of change of a price index like the CPI over a given time period.
- **Real GDP** and **per capita real GDP** are crude measures of national and individual welfare. They ignore non-market activities, the composition of output, and the distribution of income among industries and households.

Exercises for Chapter 4

Exercise 4.1

You have the following data for an economy.

Year	Real GDP (2009 $)	GDP Deflator (2009=100)	CPI (2009=100)	Labour Force (000)	Employment (000)
2017	1,307	110.6	111.9	17.857	16.696
2018	1,288	112.9	113.9	18.125	16.856

(a) What was the rate of growth of real GDP from 2017 to 2018?

(b) What was the rate of inflation in 2018?

Exercise 4.2

Suppose the economy represented by the table in Exercise 4.1 above had a population of 27.885 thousand in 2018.

(a) What were the participation and employment rates in the economy in that year?

(b) Suppose a mild recession in that year discouraged some unemployed workers and they stop looking for work. As a result the participation rate fell to 64.5 per cent. How would the unemployment rate and the employment rate be affected? Why?

Exercise 4.3

If brewers buy barley and hops from agricultural producers, natural gas to fire their brew kettles from gas companies and bottles from glass manufacturers as in the following table,

what is the value added of the brewing industry? If brewers also wholesale some of their output to pubs, is that output counted in GDP? Explain your answer.

Costs (millions of current $) of:			
Brewery retail sales	**Barley and hops**	**Natural gas**	**Bottles**
1000	350	125	150

Exercise 4.4

The economy has two main industries. One produces services and the other produces goods. The services industries produce services for households and businesses with a total market value of $10,000. The goods industries produce goods for the use of both households and businesses with a total market value of $5,000. The service industries spend $1,000 on computers and paper and envelopes supplied by the goods industries. The goods industries spend $1,000 to buy financial, insurance, advertising and custodial services supplied by the service industries. Explain how you measure nominal GDP in this economy and the value of output you find?

Exercise 4.5

Suppose you are given the following data on incomes and expenditures for the economy of Westland, in current prices for factors of production and outputs.

Consumption expenditures	2,500
Employment compensation	2,800
Government expenditure	800
Net indirect taxes	150
Exports	1,200
Gross corporate surplus and mixed income	1,050
Investment expenditure	600
Imports	1,100

(a) What is the value of nominal GDP measured by expenditures?

(b) What is net domestic income?

(c) What is the value of nominal GDP measured by the income approach?

Exercise 4.6

Suppose GDP is $2,000, consumption expenditure is $1,700, government expenditure is $50, and net exports are $40.

(a) What is business investment expenditure?

(b) If exports are $350, what are imports?

(c) In this example, net exports are positive. Could they be negative?

Exercise 4.7

Consider the following information about a hypothetical economy:

Year	**Nominal GDP** **billions \$**	**GDP deflator** (2000 = 100)	**Population** **millions**
2017	750	104.0	25.0
2018	825	112.0	30.0

Chapter 5

Output, business cycles, growth and employment

In this chapter we will explore the following topics.

- 5.1 Aggregate demand and aggregate supply: a simple model
- 5.2 Equilibrium output and potential output
- 5.3 Growth in potential output
- 5.4 Business cycles and output gaps
- 5.5 Inflation adjustment to output gaps
- 5.6 The impact of macroeconomic policy

The national accounts we studied in Chapter 4 describe economic activity in terms of an accounting framework used to measure aggregate expenditures, outputs, and incomes. But

the accounting framework simply measures what has happened in the recent past. It does not explain the level of economic activity and inflation or the reasons for changes in output and the inflation rate.

For that we need an analytical framework that looks at cause and effect.

In this chapter we will develop such an analytical framework, a simple version of an aggregate demand and aggregate supply model (AD/AS model).

Much more sophisticated versions of models like the one developed here are used by central banks like the Bank of Canada both for forecasting and to make decisions about monetary policy. Analysts in private business also use versions of these models to make their own forecasts and predict central bank decisions.

The model is analogous to a model of supply and demand in a competitive market for an individual good. A graphic model of supply and demand contains three main elements:

- a demand curve;
- a supply curve; and
- an equilibrium where the supply and demand curves intersect, and which determines the equilibrium price of the good and the quantity of the good bought and sold.

Our simple aggregate demand and supply model also has three elements:

- an **aggregate demand (AD) curve**;
- an **aggregate supply (AS) curve** or **inflation adjustment (IA) curve**; and
- an equilibrium where the supply and demand curves interact, and which determines the equilibrium rate of inflation and the equilibrium level of real GDP.

Aggregate demand curve (AD): a curve which illustrates the negative relationship between inflation and planned expenditures on goods and services.

Aggregate supply curve (AS) or **Inflation adjustment curve (IA)**: a curve which illustrates the positive relationship between inflation and the desired quantity of goods and services supplied by firms.

We use the model to explain fluctuations in real GDP and inflation, much like we use supply and demand models to explain fluctuations in quantities and prices of individual goods sold. Figure 5.1 illustrates the basic structure of an AD/AS model.

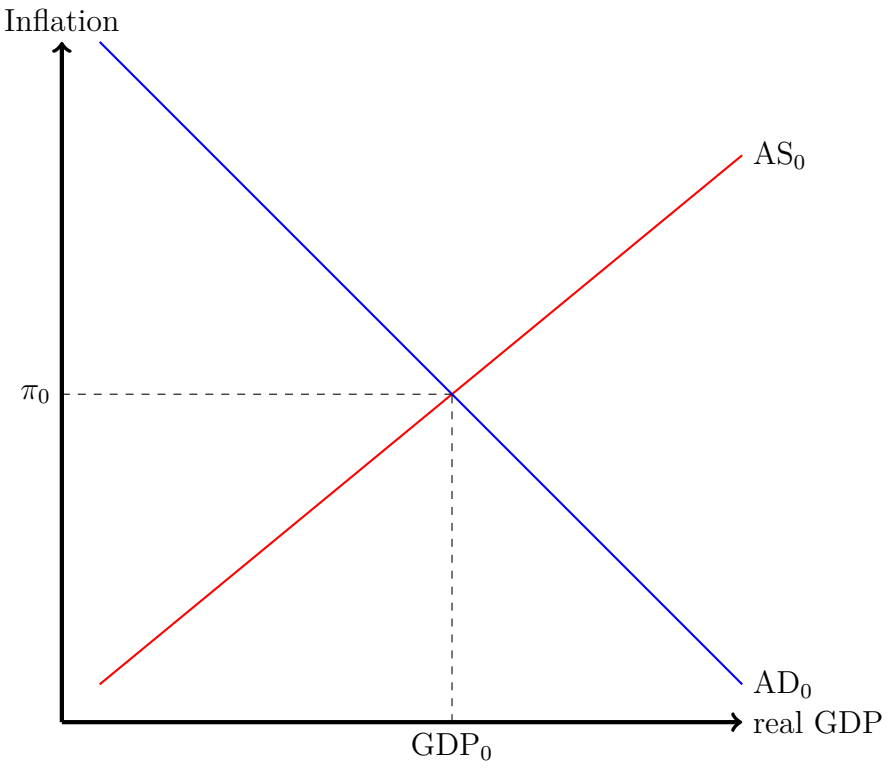


Figure 5.1: A basic aggregate demand and aggregate supply model

The AD and AS lines show planned expenditures on, and the output of, final goods and services at different rates of inflation, with all other conditions held constant. At the intersection of AD_0 and AS_0, planned expenditures on final goods and services are equal to real GDP given by GDP_0, and inflation is given by π_0.

However, the reasoning behind aggregate supply and demand curves is quite different than the reasoning behind supply and demand curves for individual goods. Aggregate demand is the total quantity of goods and services (valued in constant or base-year dollars) that households, firms and governments wish to spend for the purposes of consumption and investment at a given rate of inflation. Aggregate supply is the total quantity of goods and services that firms are willing to supply to markets, also valued in constant dollars.

Rather than depending on a **relative price**, aggregate demand and supply depend on the rate of change of a **price index**, the Consumer Price Index (CPI). The rate of change of the CPI is just inflation.

5.1 Aggregate demand and aggregate supply: a simple model

We will develop a simple AD/AS model of how planned expenditure on goods and services and production of goods and services by firms both depend in the **short run** on the rate of inflation.

> **Short run**: a time frame in which the rate of inflation is constant.

> **AD/AS model**: a framework used to explain the behaviour of real output and inflation in the national economy.

> **Aggregate demand**: planned expenditure on final goods and services given the current rate of inflation, all other things being equal.

Aggregate supply: the production of final goods and services by firms at a given rate of inflation.

Aggregate demand

First of all, we relate the demand for goods and services to the real interest rate. Next, the central bank chooses the real interest rate to achieve its inflation target: higher inflation leads the central bank to increase the real interest rate in order to decrease aggregate demand and bring inflation back down. This reflects how most central banks, including the Bank of Canada, have conducted monetary policy for the past thirty years.[1] Chapters 8 and 10 will cover this in greater detail.

The aggregate demand schedule links inflation and demand. To do so, we will look at the demand for goods and services by the main actors in the economy: households, firms, and governments. (For the time being we will also ignore trade and financial exchanges with the rest of the world, so we can ignore the demand for goods and services by foreigners.) For an economy without an economic relationship with the rest of the world,[2] the basic national income accounting identity is given by

$$Y = C + I + G.$$

We will model the demand by households and firms as depending crucially on the real interest rate.

The economy consists of households that consume, firms that invest, a government that spends and imposes taxes, and a central bank that sets monetary policy. We take the level of government spending as given, and consider what determines consumption and invest-

[1] See Bank of Canada (2021b) for a concise explanation by the Bank of Canada of how its monetary policy works.

[2] Chapters 9 and 12 will integrate the foreign sector into the model.

ment spending.[3] Demand for exports by foreigners also affects the overall level of aggregate demand.

The aggregate demand curve depends on two important relationships.

First, demand for goods and services in the economy (by both households and firms) depends negatively on real interest rates. This is illustrated in Figure 5.2 below. The negative relationship between the real interest rate and aggregate demand is known as the **IS curve**. The following two subsections discuss this relationship in detail.

> **IS curve**: a curve that illustrates the negative relationship between the real interest rate and aggregate demand.

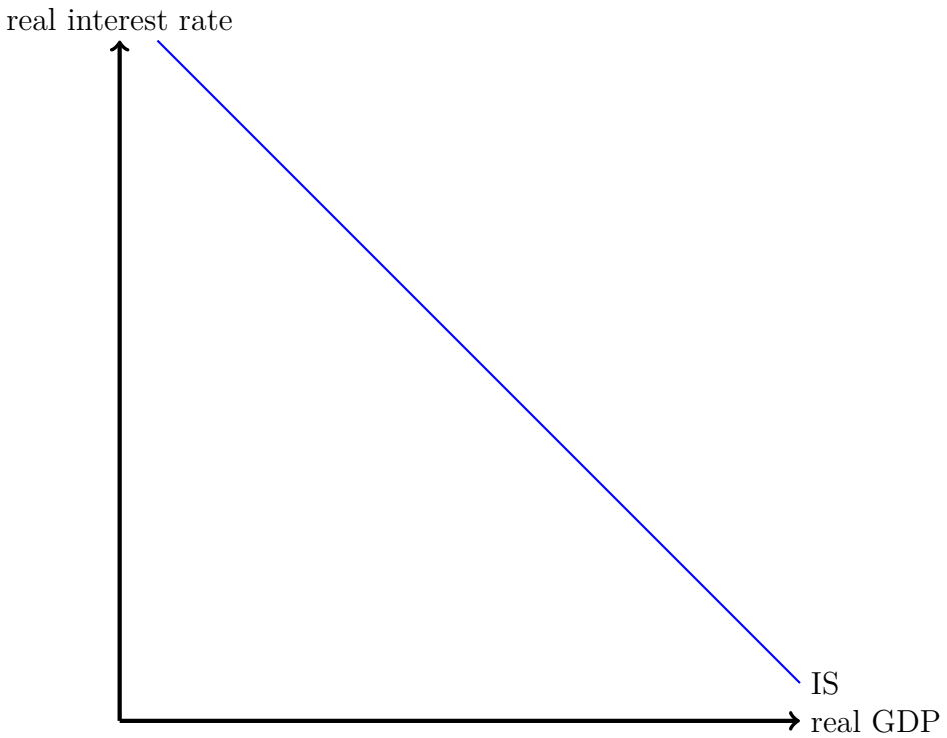


Figure 5.2: Aggregate demand as a function of the real interest rate

Planned spending by households and firms depends negatively on the real interest rate.

[3] Chapter 7 looks at government spending and taxation in detail.

Second, the central bank targets a given rate of inflation. In order to achieve its target, an increase in inflation leads the central bank to raise the real interest rate in order to reduce demand and lower the upward pressure on inflation. Figure 5.3 illustrates this positive relationship between inflation and the real interest rate (given by r).

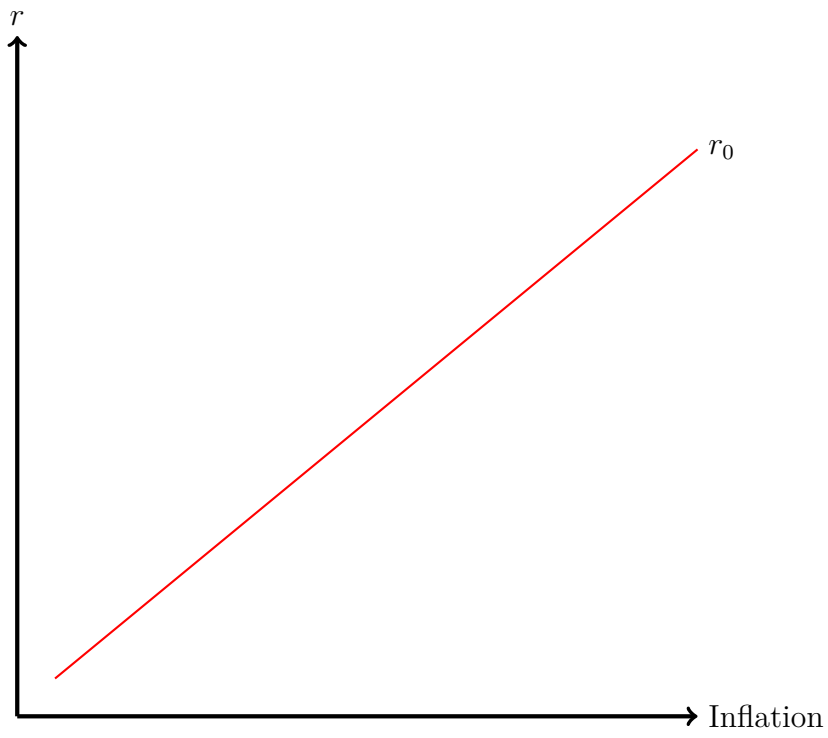


Figure 5.3: The central bank's reaction function

As inflation increases, the central bank raises the real interest rate to moderate aggregate demand and reduce pressures on inflation.

Because of the way monetary policy reacts to inflation, an increase in inflation leads to a higher real interest rate, which in turn leads to a lower demand for goods and services. This results in the negative relationship between inflation and aggregate demand illustrated in Figure 5.1.

Summarizing, when inflation increases the central bank reacts by increasing the real interest rate, which leads aggregate demand to decrease. Figure 5.4 illustrates this as a flow diagram.

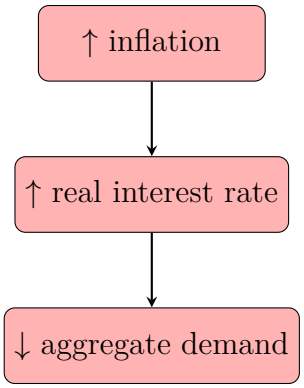


Figure 5.4: Inflation and aggregate demand

A change in inflation (in this case an increase) causes the central bank to react and modify the real interest rate, which affects the quantity of goods and services demanded by households and firms.

It is important to remember that, as we move along the aggregate demand curve in Figure 5.1, the real interest rate is changing in the background because of the reaction of the central bank to changes in inflation. The first three chapters stressed that, when analyzing supply and demand diagrams for individual markets, it is typical to assume that all other factors (prices in other markets, incomes, production costs, etc.) are held constant. This is usually not possible in macroeconomics because of the large number of moving parts. Different markets (good markets, financial markets, labour markets, etc.) interact with each other to determine the macroeconomic equilibrium.

Consumption

Both consumption spending and investment spending by firms depend on the real interest rate. They depend on other factors as well. Chapter 6 will explore these other factors in more detail. These factors will *shift* the relationship between aggregate demand and the real interest rate illustrated in Figure 5.2.

Why should there be a negative relationship between the real interest rate and planned spending?

First consider the relationship between consumption spending and the real interest rate. An increase in the real interest rate means that household savings earn a higher rate of return. Households who receive a higher rate of return on their savings have an incentive to save more. Saving more means spending less of their disposable income on goods and services. Therefore, consumption spending goes down.

Another way to think of the effect of a change in the real interest rate is to think of it as a relative price change: the price of future consumption in terms of current consumption. By consuming less in the current period and increasing saving, a higher rate of return means the household will be able to consume more goods in the future. This is just like a standard relative price change in basic microeconomics. Future consumption becomes less expensive relative to current consumption. The household can improve its utility by consuming less now and planning to consume more in the future. Consuming less now means saving more. This is just the standard substitution effect in microeconomics.

A second channel through which the real interest rate affects consumption spending is via the cost of financing the purchase of real estate and more expensive durable goods such as automobiles and major appliances. Purchases of these goods are often financed primarily by mortgages and other types of loans. As the real interest rate increases, it becomes more costly to finance these purchases and demand decreases.

Chapter 6 analyzes the aggregate consumption function in more detail.

Investment

Next, consider a firm planning to borrow in order to invest in increasing its productive capacity. A higher real interest rate increases the amount of real resources the firm will need to service its debt and to pay back the principal on that debt. This increases the marginal cost of the firm's capital, and will lead the firm to cut back on its investment plans if it aims

to maximize the present value of its profits.

Also, a higher real interest rate means that the firm's future expected profits are **discounted** at a higher rate. (Chapter 9 covers the concept of discounting in detail.) Higher interest rates reduce present values and make the firm seem less profitable, reducing its incentives to invest.

Chapter 6 discusses the aggregate investment function in detail.

Shifts in aggregate demand

Any exogenous change in consumption spending, investment spending, government purchases of goods and services, or export demand will cause a shift in the AD curve. By **exogenous** we mean changes which do not depend directly on the real interest rate, the determinant of private spending as illustrated in Figure 5.2. These include the other determinants of consumption and investment spending discussed in Chapter 6, the determinants of public spending discussed in Chapter 7, and the determinants of net exports discussed in Chapter 12.

Monetary policy

Chapter 10 looks in detail at the conduct of monetary policy by the Bank of Canada. Under Canada's inflation targeting regime, in vigour since 1992, the Bank of Canada and the Government of Canada reach an agreement, renewed every 5 years, on what inflation rate the Bank of Canada should target. Suppose that, when the agreement is renewed, the inflation target is increased from its current 2 percent to 3 percent. This means that at any given inflation rate the Bank of Canada will set a lower real rate of interest. This would be represented by a shift to the left of the central bank's reaction function in Figure 5.3.

A lower real interest rate for any given rate of inflation will encourage households to increase their consumption expenditure and firms to invest more, so the AD curve will shift to the right. Of course a reduction in the inflation target will have the opposite effect, leading to a leftward shift in the AD curve.

Fiscal policy

The basic model takes the behaviour of governments as given. Imagine an increase in government purchases. Because government spending is one of the main components of aggregate demand, overall aggregate demand must increase. This will shift the AD curve to the right. A reduction in government purchases will have the opposite effect, shifting the AD curve to the left.

Now imagine a decrease in personal income tax rates. This would increase the disposable income of households for any given real interest rate, and encourage them to spend more. Similarly, a cut in corporate tax rates would incentivize firms to undertake more investment spending. Increases in personal income taxes or corporate tax rates would have the opposite effect.

Expectations

Expectations of future growth are crucial for determining private spending. A household which estimates that its disposable income will grow more quickly will be more likely to dip into its savings in order to increase current consumption, because it reckons that a higher level of consumption spending is sustainable. A firm expecting higher growth will expect a higher level of demand for its product or products, and lead it to expand its production capacity by investing more. So if expectations of future growth increase, this will shift the AD curve to the right, while reduced expectations of future growth will shift the AD curve

to the left.

The link between interest rates and inflation: central bank behaviour

Since 1992, the Bank of Canada has targeted a positive rate of inflation. Since 1996, the targeted inflation rate has been equal to 2 percent.

In the simple model developed here, the central bank's policy instrument is the real interest rate. This is a shortcut because the interest rate that the central bank directly controls is the short-term *nominal* interest rate. Chapters 8 and 10 analyze how the central bank controls the real interest rate in more detail.

Aggregate supply

The aggregate supply schedule links inflation to the quantity of goods and services produced by firms.

Firms in our simple economy have the ability to set their prices in order to maximize their profits based on the cost of their inputs and based on the pricing decisions of their competitors. This means that firms are not selling in perfectly competitive markets in which they believe they can sell as much of their product as they want at a given market-clearing price. Rather, they have some degree of monopoly power and face downward-sloping demand curves for their products.

In our simple macroeconomic model, we will assume that in the very short run firms do not change the rate at which they adjust their prices. Instead, they supply the demand for their products from current production or from changes in their holdings of product inventories.

Why is the rate of inflation fixed in the very short run? There are two main reasons for this. First, not all firms change their prices and wages at the same time. Second, inflation

expectations change only gradually.

Prices and wages are changed in staggered fashion

The speed at which firms adjust their prices will depend on the relationship between actual and potential output. Furthermore, only a fraction of firms make these adjustments in any given time interval. Firms set their prices based on their costs, and the prices of the intermediate inputs they purchase change only slowly and in staggered fashion.

When a firm decides which price to charge, it must take the following considerations into account, among many others.

- Are there adequate supplies of the intermediate goods needed to produce the firm's output?
- Is the firm getting the best deal possible on those inputs?
- Have new firms entered the same market to sell close substitutes to the firm's product or products?
- Are firms about to enter the market?
- Is the firm's machinery and equipment in good working order, or will costly repairs be necessary?

Does this mean that firms adjust their prices every day, since their circumstances change every day? No, because in order to adjust their prices intelligently, firms must pay certain costs. These costs include the following.

- There are costs associated with gathering information.
- There are costs associated with computation.

- There is uncertainty related to the effects of the central bank's monetary policy. Are the changes in the prices of competitors' goods part of an overall increase in th price level, or a change in their relative prices?

- The firm has contractual obligations with suppliers of intermediate goods, and with its own employees, which are specified in nominal terms and not indexed to the price level.

- The very act of changing prices is costly. New prices must be programmed into computers. In the case of restaurants which use printed menus, new menus must be printed with the new prices.[4]

Inflation expectations change gradually

Chapter 11 considers the inflation adjustment process in detail. We will examine how inflation gradually converges to the central bank's target inflation rate and GDP converges to its long-run or full-employment level.

This means that, in our simple economy, the AS curve shown in Figure 5.1 is in fact *horizontal* at the current rate of inflation. This gives the modified AS/AD diagram given in Figure 5.5 below.

[4]For this reason, the cost of changing prices is often referred to by economists as **menu costs**.

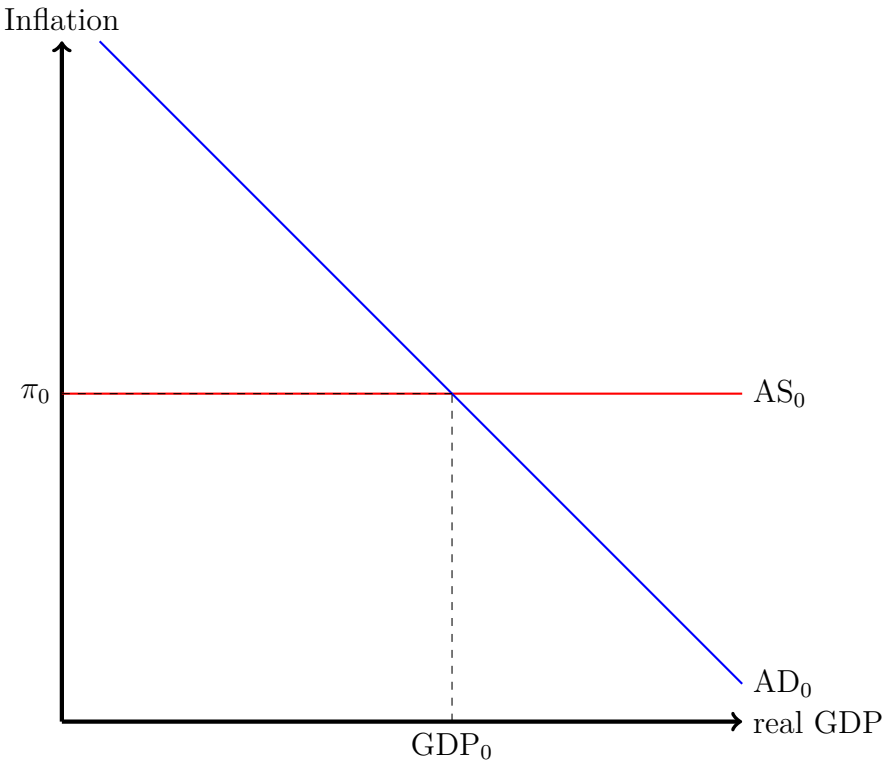


Figure 5.5: The simple aggregate demand and aggregate supply model with fixed inflation in the short run.

The AD and AS lines show planned expenditures on, and the output of, final goods and services at different rates of inflation all other conditions held constant. Here, firms supply the quantity of goods demanded at the current inflation rate π_0.

5.2 Equilibrium output and potential output

The equilibrium inflation rate and equilibrium output are at the point where the aggregate supply (inflation adjustment) curve intersects the aggregate demand curve.

The distinction between equilibrium output and **potential output** is very important to our study of the economy. In the short run, AD and AS determine equilibrium output. Potential output is determined by the size of the labour force, the stock of capital, and the state of technology. The general level of prices and short-run aggregate demand and supply

conditions do not affect potential output.

> **Potential output** is the real GDP the economy can produce on a sustained basis with current labour force, capital and technology without generating inflationary pressure on prices.

Short-run equilibrium real GDP is determined by AD and AS conditions. Fluctuations in real GDP and price are a result of short-run changes in economic conditions. To evaluate the economy's performance and understand how it behaves over time, we need a benchmark. Potential output is the output the economy can produce on a sustained basis using the current labour force, capital, and technology without putting continuous upward pressure on the price level or the inflation rate.

In the short run, the labour force, the capital stock, and technology are fixed by assumption. Potential output is the economy's output based on "full employment" of these inputs, but it is not the maximum output an economy can conceivably make. For short periods of time we could make more by using labour for longer hours and factories for extra production shifts. Just as a marathon runner can sprint from time to time but cannot sustain the sprint over the whole race, the economy can operate for short time periods at levels of output above potential. Potential output is the output the economy can produce on a sustained basis.

When the economy is at potential output, every worker wanting a job at the equilibrium wage rate can find a job, and every machine that can be profitably used at the equilibrium cost for capital is in use. Thus, potential output includes an allowance for "equilibrium unemployment" or structural unemployment and some excess capacity. Some people, who would work at higher wage rates, do not want to work at the equilibrium wage rate. Moreover, in a constantly changing economy, some people are joining the labour force, others are leaving, and still others are temporarily between jobs. Today, Canadian potential output means an unemployment rate of about 6 percent. This is usually called the **natural unemployment rate**.

Natural unemployment rate: the unemployment rate that corresponds to potential GDP.

Actual output can also fall below potential output. Workers who want jobs may be unemployed, and producers may have idle plant and equipment or excess capacity. The unemployment rate rises above the "full employment" rate.

A key issue in macroeconomics is the way differences between actual output and potential output affect unemployment rates, wage rates, and inflation rates. These effects are important to how the economy provides the standard of living and the way it might adjust equilibrium output to potential output without policy intervention.

Figure 5.6 illustrates potential real GDP (Y_P) with a vertical line. Changes in the inflation rate have no effect on Y_P. Changes in the supply of labour, the stock of capital, or the state of technology would increase potential output and shift the vertical Y_P line to the right or to the left.

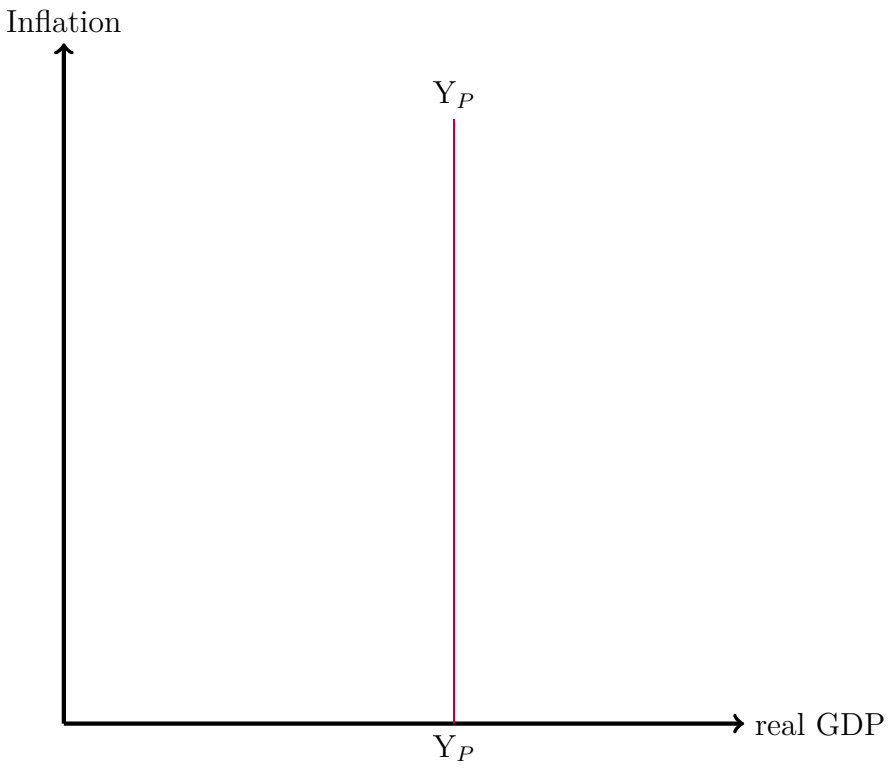


Figure 5.6: Potential GDP

Potential GDP (Y_P) is the real GDP the economy could produce on a sustained basis without putting pressure on costs and prices. Y_P is independent of the inflation rate.

5.3 Growth in potential output

Growth in the labour force and improvements in labour productivity increase the economy's potential output over time. Labour productivity grows as a result of advances in technology and knowledge coming from investments in capital equipment, education and training. Figure 5.6 shows estimated growth rates for potential and actual real GDP each year in Canada over the period from 1990 to 2018. Potential GDP grew over this period, reflecting the underlying growth in labour force, the stock of capital, and improved technology. But annual growth rates were not constant and in the period since 2000 have tended to decline. Part of this decline is attributed to lower rates of productivity growth in recent years as

compared to earlier periods.

Figure 5.7 shows growth rates in actual GDP and potential GDP using quarterly data from 1990 to the fourth quarter of 2022. It shows that GDP growth is more volatile than the growth of potential output. The negative growth rates in 1991, 2009, and 2020 mark the recessions of those years. Fluctuations in AD and AS cause business cycles in real GDP and employment. Unemployment rises when output growth is less than the growth in potential output and falls when it is greater.

[Figure 5.7 about here based on Bank of Canada MPRs. This will require some stitching together of data. XX]

Chapter 13 looks in detail at the determinants of long-run growth.

5.4 Business cycles and output gaps

In some years GDP grows very rapidly, and in other years it actually falls. Growth of potential GDP is also variable but to a lesser degree. These up and down fluctuations in the growth of real GDP are described as **business cycles** in economic activity.

> **Business cycles**: short-term fluctuations of actual real GDP.

Business cycles cause differences between actual and potential GDP. **Output gaps** measure these differences. In a short-run aggregate demand and supply model with a constant potential output, the gap is given by $Y - Y_P$.

> **Output gap**: the difference between actual output and potential output.

In an economy that grows over time the output gap $Y - Y_P$ is usually measured relative to potential output. This recognizes that a gap of $10 million is a more serious matter in

an economy with a potential output of $1,000 million than in an economy with a potential output of $5,000 million.

Figure 5.8 plots the Bank of Canada's estimates of the differences between actual and potential GDP for Canada, quarterly for each year from 1990Q1 to 2022Q2, expressed as a percentage of potential GDP, calculated as:

$$\text{Output Gap}(\%) = \frac{Y - Y_P}{Y_P} \times 100$$

[Figure 5.8 about here based on Bank of Canada MPRs. A long data series is available on the Bank's web site in CSV form. XX]

When we compared growth in actual real GDP and potential GDP in Canada from 1990 to 2018 in Figure 5.7, we see an example of the business cycle caused by the 2008-2009 financial crisis. Real GDP growth declined in 2008 to less than growth potential GDP and turned negative in 2009. This was a recession. It created the negative output gap in Figure 5.8 that starts in the first quarter of 2009 and persists in the most recent data to the first quarter of 2019.

As noted in Information Box 1.1, the Covid-19 pandemic led to the forced shutdowns of many businesses, particularly in the service sector which relied on face-to-face interactions with customers. Quarterly real GDP in Canada decreased by 1.7 percent in the first quarter of 2020 and by 11.2 percent in the second quarter of 2020. GDP growth was positive in the third quarter, but GDP did not regain its level in the last quarter of 2019 until the third quarter of 2021. The decline in GDP was the steepest and shortest recession in Canada since the Second World War.

Output gaps describe and measure short-run economic conditions, and indicate the strength or weakness of the economy's performance. High growth rates in the boom phase of the cycle

create positive output gaps, which are called **inflationary output gaps** because they put upward pressure on costs and inflation. Low or negative growth rates that result in **negative output gaps** and rising unemployment rate are called **recessionary output gaps**. They put downward pressure on costs and inflation. As economic conditions change over time, business cycle fluctuations move the economy through recessionary and inflationary gaps. However, Figure 5.6 shows that recessionary gaps in Canada have been deeper and more persistent than inflationary gaps over the past 30 years.

> **Inflationary output gap**: a measure of the amount by which actual GDP is greater than potential GDP.

> **Recessionary output gap**: a measure of the amount by which actual GDP is less than potential GDP.

The AD/AS model provides a basic explanation of the differences we see between actual real GDP and potential real GDP. Short-run AD and AS conditions determine equilibrium real GDP, which may be either greater or less than potential GDP. Furthermore, business cycles are the results of changes in the short-run AD and AS conditions.

Introduction to the AD/AS model is an important first step in the study of the performance of the macro economy. But there are more questions.

1. How does the economy react to inflationary and deflationary output gaps?

2. How quickly does it adjust?

3. How is the speed of adjustment affected by government policies?

5.5 Inflation adjustment

We can show output gaps in diagrams using the AD and AS curves from figure 5.5 and the potential output line introduced in Figure 5.6. The equilibrium level of output in the short term (for a given rate of inflation) is given by GDP_0. Figure 5.9 shows two different possible scenarios. The vertical line Y_{P_0} illustrates a recessionary gap, with equilibrium real GDP below the level of potential output. The vertical line Y_{P_1} illustrates an inflationary gap, with equilibrium real GDP above the level of potential output.

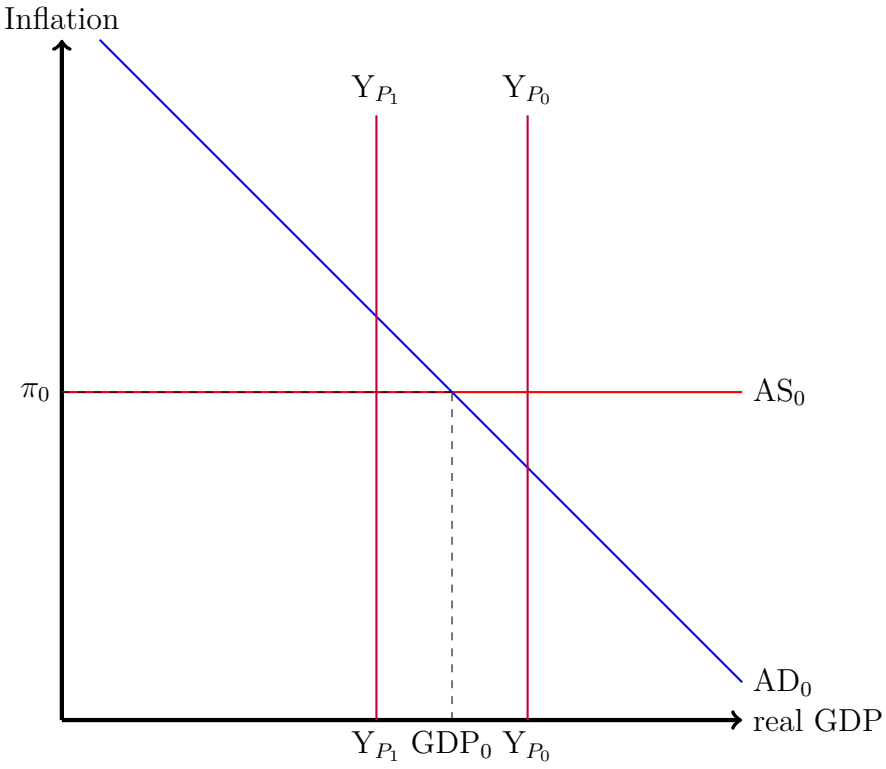


Figure 5.7: Recessionary and inflationary gaps

Equilibrium real GDP is given by GDP_0. With potential output equal to Y_{P_0}, there is a recessionary output gap. With potential output equal to Y_{P_1}, there is an inflationary output gap.

While inflation is fixed at a moment in time (the AS curve is horizontal), it changes gradually over time.

Potential output is real GDP when all markets are in equilibrium. This would in fact be the case if all prices (and wages) were free to adjust without frictions in order to ensure equality between supply and demand. Output gaps indicate disequilibrium in some markets. If we leave the short run and drop the assumption that factor prices are constant, we can ask: how does the economy react to persistent output gaps? The answer to this question depends in part on the flexibility of wage rates and prices and in part on how planned expenditure responds to the flexibility in wage rates and prices.

Expectations concerning the price and wage decisions of other firms influence a firm's pricing and wage setting decisions. If inflation has remained close to 2 percent for several years, a firm can expect its competitors' prices to increase by about 2 percent per year. To keep prices close to those of the competition, the firm will increase its price by about 2 percent per year. Since all firms are doing this, overall inflation will remain steady at 2 percent per year.

When real GDP deviates from potential GDP, this changes. If GDP is above potential, demand for firms' products will be strong. Firms may experience difficulty in hiring more workers to meet increased demand without raising wage rates. They may decide that they want to raise their prices relative to the competition in order to meet the costs of increasing production. If most firms do this, they will raise their prices by an amount greater than the current inflation rate, and inflation will increase. If GDP is below potential, demand for firms' products will be weak. They may decide to cut their prices by more than competitors in order not to lose market share. If most firms do this, inflation will decrease.

The bottom line is that inflationary gaps lead gradually to an increase in the rate of inflation as the AS curve shifts up, and recessionary gaps lead gradually to a decrease in the rate of inflation as the AS curve gradually shifts down.

5.6 The role of macroeconomic policy

In Chapter 4, performance of the economy was evaluated based on the standard of living, measured as the real GDP per capita, it provided. Recessionary gaps reduce the standard of living in the economy by reducing employment, real GDP, and per capita real GDP.

Inflationary gaps reduce standards of living in more subtle ways. They push up the rate of inflation, raising the cost of living more quickly. But the rise in the cost of living affects different people in different ways. Those on fixed money incomes suffer a reduction in their standards of living. People holding their wealth in fixed price financial assets like bank deposits and bonds suffer a loss in their real wealth. On the other hand, inflation reduces the real value of debt, whether it is mortgage debt used to finance the purchase of a house, or a student loan used to finance education. The money repaid in the future has a lower purchasing power than the money borrowed. In these and other ways, the costs of inflation are distributed unevenly in the economy, making decisions about employment, household expenditure, and investment more difficult.

We have also seen, in Figure 5.8, that output gaps have been persistent in the Canadian economy despite the possibility that flexible wages and prices might automatically eliminate gaps. These observations raise two questions.

1. Why are output gaps, especially recessionary gaps, persistent?

2. Can government policy work to eliminate output gaps?

To answer the first question, we need to think about two issues. The first is the flexibility or rigidity of wages and prices both up and down. The second is the strong possibility of asymmetry between adjustment effects of absolute increases and absolute decreases in wages and prices. These are topics for later discussion.

The important immediate policy question is: When wages and prices are sticky, should government wait for a self-adjustment process to work, accepting the costs of high unemployment or rising inflation that it produces? This was a very serious and widely debated question since 2008 in the face of growing international recessions as a consequence of serious government debt problems and continued international financial market uncertainty.

Government has policies it can use to reduce or eliminate output gaps. In Chapter 7 we will examine **fiscal policy**, the government expenditures and tax policy that establish the government's budget and its effect on aggregate demand. Government can use its fiscal policy to change the AD curve and eliminate an output gap without waiting for the economy to adjust itself. Chapters 8 and 10 discuss **monetary policy**, actions by the monetary authorities designed to change aggregate demand and eliminate output gaps by changing interest rates, money supply, and the availability of credit. Both fiscal and monetary policy work to change aggregate demand and eliminate output gaps, which reduce the standard of living the national economy provides for its citizens.

> **Fiscal policy**: government expenditure and tax changes designed to influence aggregate demand.

> **Monetary policy**: changes in interest rates and money supply designed to influence aggregate demand.

Application Box 5.1: The Impact of COVID-19 policies in AD/AS

[Major update needed here to account for the COVID-19 recession and recovery. XX]

Conclusions

This chapter has developed a basic model of the determination of aggregate supply and aggregate demand in the short run. It also looked at factors affecting aggregate demand that can cause GDP to fluctuate in the short run.

In order to simplify the exposition, we made the assumption that firms do not change the rate at which they adjust their prices in the short run in response to changes in aggregate demand. Instead, they supply the quantity of goods and services demanded at the going rate of inflation.

After looking in more detail at the components of aggregate demand in Chapters 6 (consumption and investment)and 7 (govenment spending and fiscal policy), and looking in more detail at money and how monetary policy operates in Chapters 8, 9 and 10, Chapter 11 returns to the question of aggregate supply and demand and looks at how the aggregate supply curve evolves over time in response to pressures in the goods and labour markets. This evolution gradually leads to a long-run equilibrium in which equilibrium real GDP is equal to potential output, and inflation is equal to the central bank's target rate of inflation. Chapter 11 will also look in detail at whether this adjustment process can be sped up by appropriate monetary and fiscal policies.

KEY CONCEPTS

- The **aggregate supply and demand (AD/AS)** model is a framework that allows us to explain and predict inflation and aggregate output in the economy in the short term, and allows us to analyze the adjustment of inflation to its target and output to its full-employment level.
- **Aggregate demand** is the negative relationship between planned expenditure on final goods and services and inflation, assuming all other conditions in the economy are constant.
- **Aggregate supply** is the quantity of goods and services produced by firms at a given rate of inflation, assuming all other conditions in the economy are constant.
- **Short-run equilibrium real GDP** is the quantity of goods and services produced given the current inflation rate.
- **Potential output** is the maximum quantity of real GDP that can be produced given the productive resources of the economy (labour, capital, land, entrepreneurial ability, etc.) without bringing rising inflation.
- **Growth in potential output** comes from growth in the labour force and growth in labour productivity coming from improvements in technology as a result of investment in fixed and human capital.
- **Business cycles** are the short-run fluctuations in real GDP and employment relative to potential output caused by short-run changes in aggregate demand and supply.

- **Output gaps** are the differences between actual real GDP and potential GDP that occur during business cycles. Unemployment rates fluctuate with output gaps.
- **Inflationary gaps and recessionary gaps** are the terms used to describe positive and negative output gaps based on the effects the gaps have on the rate of inflation.
- **Inflation** adjusts gradually over time in response to output gaps.
- In an **inflationary gap** inflation increases.
- In a **recessionary gap** inflation decreases.
- **Fiscal and monetary policy** are tools governments and monetary authorities can use to stabilize real output and employment or speed up the economy's adjustment to output gaps.

Exercises for Chapter 5

Exercise 5.1

Potential GDP is determined by the size of the labour force, the stock of capital and the state of technology used in the production process. Assume the labour force grows over time, and research and development lead to improvements in technology, and productivity. Use an AD/AS diagram to illustrate potential GDP both before and after the growth in labour force and the improvement in technology.

Exercise 5.2

Growth in potential output is determined by growth in the labour force and growth in labour productivity. Suppose the labour force grows by 1.5 percent a year and labour productivity, based on increased capital and improved technology, grows by 1.0 percent a year.

(a) What is the annual growth in potential output?

(b) Illustrate the growth in potential output in an AD/AS diagram.

(c) Aggregate demand is not changed by the change in potential output. Indicate any output gap caused by the change in potential output.

Exercise 5.1

[Redo. This supposes a non-horizontal supply curve.]

Suppose we have the following information for an economy:

Inflation rate (%)	Planned aggregate expenditure	Planned aggregate output
1.0	550	350
1.5	500	400
2.0	450	450
2.5	400	500
3.0	350	550

(a) Plot the AD and AS curves in a carefully labeled diagram.

(b) What are the short-run equilibrium values of real GDP and the rate of inflation?

Exercise 5.2

XX

Exercise 5.3

Suppose we have the following data for an economy:

Year	Potential output (Billions of 2007 $)	Real GDP (Billions of 2007 $)
2006	1,038	1,017
2007	1,069	1,030
2008	1,101	1,101
2009	1,134	1,160
2010	1,168	1,139
2011	1,203	1,130
2012	1,240	1,187
2013	1,277	1,163

Calculate the output gap for each year in this economy. Plot the output gap in a time series diagram. Date the timing of the phases of any business cycles you see in your plot of the output gap.

Exercise 5.4

XX

Chapter 6

Aggregate demand: consumption and investment

In this chapter we will explore the following topics.

- 6.1 The determinants of consumption and the aggregate consumption function
- 6.2 The determinants of investment by firms and the aggregate investment function
- 6.3 Induced and autonomous expenditure
- 6.4 Equilibrium output and spending multipliers

Chapter 5 discussed how consumption spending by households and investment spending by firms depends on real interest rates. It used the relationship between the real interest rate and spending to derive the aggregate demand curve.

In order to construct a simple AD/AS model, Chapter 5 ignored other factors which influence the desired level of spending on consumption goods by households and investment goods by

firms. In other words, the relationship between the real interest rate on the one hand, and desired consumption and investment spending on the other hand, is a *ceteris paribus* relationship as defined in Chapter 3.

This chapter takes a more detailed look at the other determinants of these two important components of aggregate demand.

6.1 The determinants of consumption and the aggregate consumption function

Consumption makes up the largest component of aggregate demand in Canada as well as in other countries.

Chapter 5 discussed why desired consumption expenditure depends on the real interest rate. This has to do with the fact that higher interest rates mean a greater rate of return on savings, and thereby make future consumption goods less expensive relative to current consumption goods (a substitution effect). Clearly, this is not the only factor influencing consumption demand.

Let's start with a distinction between two fundamentally different types of goods: durable goods and **nondurables**.

Types of consumer goods

Durable goods last a long time and yield services (*utility*) over their lifetimes. Typical examples would be cars, furniture, major appliances such as refrigerators, and small appliances such as toasters. Nondurable goods are typically consumed immediately or shortly after they are purchased. Typical examples would include perishable food items, restaurant

meals, movies enjoyed at the cinema, etc.

> **Durable good**: a good that does not quickly wear out or, more specifically, one that yields utility over time rather than being completely consumed in one use. Items like bricks could be considered perfectly durable goods because they should theoretically never wear out. Highly durable goods such as refrigerators or cars usually continue to be useful for several years.

> **Nondurable good**: a good which is typically used up (consumed) shortly after it is purchased.

Durables have many of the characteristics of investment goods. They provide services over a long period of time, and they depreciate by wearing out or by becoming obsolete. Desired spending on durables is much more sensitive to interest rates since their purchase is often financed by borrowing, either partially or completely.

Now, let's turn to factors other than the real interest rate which affect consumption spending by households.

Factors influencing consumption spending

- Disposable income: for most people, the single most powerful determinant of how much they consume is how much income they have in their take-home pay, also known as **disposable income**, which is income net of direct taxes and including transfer payments from governments. A **direct tax** is a tax imposed upon a person or property as distinct from a tax imposed upon a transaction (such as a sales tax), which is described as an **indirect tax**.
- Expected future income: consumer expectations about future income also are important in determining consumption. If consumers feel optimistic about the future, they

are more likely to spend and increase overall aggregate demand. News of recession and troubles in the economy will make them pull back on consumption.

- Wealth: when households experience a rise in wealth, they may be willing to consume a higher share of their income and to save less. When the U.S. stock market rose dramatically in the late 1990s, for example, U.S. rates of saving declined, probably in part because people felt that their wealth had increased and there was less need to save. How do people spend beyond their incomes when they perceive their wealth increasing? The answer is borrowing. On the other side, when the U.S. stock market declined about 40 percent from March 2008 to March 2009, people felt far greater uncertainty about their economic future, so rates of saving increased while consumption declined.

Disposable income: the income of an individual or household after deducting direct taxes and adding transfer payments received from governments.

Direct tax: a tax imposed on a person or property, such as a personal income tax or a property tax.

Indirect tax: a tax imposed on a transaction, such as a sales tax, a value-added tax, or a tariff on an imported good.

Aggregate consumption function

An **aggregate consumption function** gives the functional relationship between total desired consumption spending in an economy and the different factors which determine that spending. We can write

$$C = C\left(r, Y_d, Y^e, W\right).$$

Here, C is aggregate consumption spending as measured in the national accounts, r is the real interest rate, Y_d is aggregate disposable income, Y^e is expected future GDP, and W is a measure of aggregate wealth.

> **Aggregate consumption function**: a function which relates total consumption spending in the economy to different factors which determine that spending: these can include household disposable income, household wealth, interest rates, etc.

By definition, the difference between household disposable income and consumption spending must be equal to **household saving**. We can speak of an **aggregate savings function**, which can be written as

$$S = S\left(r, Y_d, Y^e, W\right) = Y_d - C\left(r, Y_d, Y^e, W\right).$$

> **Household saving**: the difference between households' total disposable income and total household consumption expenditure.

Using the notation developed in Chapter 4 for the decomposition of final expenditure, and ignoring the foreign sector (Chapter 13 examines the foreign sector in great detail), we can write

$$Y = C + I + G,$$

where Y denotes GDP. If T denotes governments' total tax revenues less their transfer payments (or net tax revenue), we can write

$$(Y - T) \equiv Y_d = C + I + (G - T).$$

This follows because disposable income Y_d is equal by definition to total income Y less net

tax revenues T. This can be rewritten as

$$(Y_d - C) \equiv S = I + (G - T)\,.$$

Here, we have defined S, aggregate private savings, as the difference between disposable income and aggregate consumption spending. Finally, we can write

$$S + (T - G) = I.$$

This is a fundamental consequence of the national accounting identity first seen in Chapter 4. It says that aggregate investment spending I has to be financed by private saving S or **public saving**, the difference between net tax revenue and government spending. (As Chapter 13 shows, it can also be financed by borrowing from abroad.)

> **Private saving**: the difference between households' total disposable income and their total spending on consumption goods.

> **Public saving**: the difference between governments' net tax revenues (total tax revenues less spending on transfer payments) and total government spending.

Current versus permanent income

It seems obvious that consumption choices should be affected by the expectations of income over a very long period. For example, when purchasing a car consumers will take into account the income they expect to receive over the period they expect to be making payments on the car. The amount people save for retirement (or for bequests to their offspring) depends on the income they expect to receive over the course of their lifetimes. Their saving, and therefore their consumption, depends on their **permanent income**, the average annual income people expect to receive for the rest of their lives.

> **Permanent income**: the average annual income (net of direct taxes) a consumer or household expects to receive over the course of their lifetime.

The idea that consumption spending depends primarily on permanent income rather than current disposable income was developed in detail by Milton Friedman (1957).

In Canada as well as all other developed economies, aggregate consumption fluctuates much less in percentage terms than GDP or household disposable income. This is incompatible with the idea that households consume a fixed fraction of their disposable incomes. If it were true that households consume a fixed fraction of their disposable income, the percentage variations in consumption spending would be the same as the percentage variations in disposable income.

Wealth and consumption

Wealth can be defined as the monetary value of the assets owned by an individual or household. Aggregate wealth is the sum of these values across individuals or households. An individual or household's *net wealth* would subtract off their *liabilities*, how much they owe in the form of borrowed funds such as mortgages, car loans, credit card debt, etc.

An increase in stock and bond prices, for example, would make holders of these assets wealthier, and they would be likely to increase their consumption. A fall in the price level would increase the real value of the assets denominated in nominal terms (Canadian dollars in Canada). **Real wealth** is the nominal value of wealth deflated (divided by) by a suitable price index such as the consumper price index. When individuals are more wealthy, they are likely to increase their purchases of consumption goods.

Wealth: the monetary value of the assets owned by an individual or household.

Liabilities: how much households, individuals or firms owe in the form of borrowed funds.

Net wealth: an individual or household's net wealth is the monetary value of their assets less the monetary value of their liabilities.

Real wealth: nominal wealth deflated (divided by) by a suitable price index such as the consumer price index.

Expectations and consumption

Optimism about the future will lead consumers to expect higher future incomes and higher rates of return on their assets. This will increase their best estimates of their permanent income, and will also likely lead to an increase in the value of assets such as stock prices. Greater optimism concerning future economic growth will lead households to increase their demand for consumer goods.

6.2 The determinants of investment by firms and the aggregate investment function

The economic meaning of investment is different from its meaning in ordinary parlance, which is to buy shares, stocks, bonds and securities which already exist in stock market. But this is not real investment: it is simply a transfer of existing assets.

In macroeconomics, **investment** refers to real investment which adds to **capital equipment**. The latter refers to real assets like factories, plants, equipment, and inventories of

finished and semi-finished goods. It is any previously produced input that can be used in the production process to produce other goods. The amount of capital available in an economy is the stock of capital. Thus capital is a stock concept.

> **Investment**: the production or acquisition of real capital assets during a period of time.

> **Capital equipment**: any previously produced input that can be used in the production process to produce other goods.

Chapter 5 discussed why investment depends on the real interest rate. When a firm borrows funds for investment spending, a higher real interest rate increases the amount of real resources the firm will need to service its debt and to pay back the principal on that debt. It also reduces the discounted present value of its future profits, reducing its incentives to invest.

Clearly, this is not the only factor influencing investment demand. Before discussing the other determinants of investment, let's look at the fundamental components of aggregate investment spending as well as the distinction between gross and net investment.

The components of investment

As alluded to above, investment goods are typically categorized by their durability. Factories, warehouses, and other buildings have a long life. Productive machines and other equipment are also durable. **Business fixed investment** is the purchase of new structures and equipment by business firms for production purposes. **Inventory investment** consists of increases in stocks of unsold goods or unused input materials. This kind of investment is quite different from business fixed investment because inventory capital normally has a very short life span. **Residential investment** consists of purchases of new housing units,

whether by firms or households. New home purchases by households are counted as investment, with a monthly rental flow of housing services counted under consumption of services.

> **Business fixed investment**: the purchase of new structures and equipment by business firms for production purposes.

> **Inventory investment**: increases in stocks of unsold goods or unused input materials.

> **Residential investment**: purchases of new housing units by firms or households.

Gross investment and net investment

We already had a glimpse of this difference when discussing gross domestic product versus *net domestic product*. A firm's investment expenditures increase its capital stock to the extent that they more than replace the capital which deteriorates or is scrapped, or in other words the capital which depreciates. **Gross investment** is the real value of productive goods purchased over a period of time. **Net investment** subtracts the loss in economic value through physical wear and tear and through obsolescence.

> **Gross investment**: the real value of productive goods purchased over a period of time.

> **Net investment**: gross investment minus the loss in economic value of productive goods due to wear and tear or to obsolescence.

Net investment also measures the net change in the size of the economy's capital stock. In order for the capital stock to grow, gross investment has to exceed depreciation. If net investment is negative, the economy's capital stock is shrinking.

The capital stock and capacity utilization

An existing piece of machinery or equipment can be used more or less intensively. **Capacity utilization** indicates how intensively a firm is using its capital stock.

> **Capacity utilization**: indicates how intensively a firm is using its capital stock.

Capacity utilization involves a trade-off at the margin. If a piece of equipment is used more intensively, it can produce more output. On the other hand, it will depreciate more quickly, and this involves a cost. At the optimal rate of capacity utilization, the increased output at the margin just balances the increased cost due to depreciation.

Interest rates and investment

Chapter 5 built a simple theory of aggregate demand and aggregate supply based on the real interest rate as the main determinant of both consumption and investment. Let's delve a little deeper into this relationship before looking at other factors which influence investment spending. Let's delve a little deeper into this relationship.

Consider an investment of $10,000 to improve the insulation of a factory building and which will lead to savings of $500 per year in energy consts. For simplicity, assume the building and insulation do not depreciate, and the savings of $1,000 per year will be permanent. The return on this investment is 5 percent per year. If the firm considering this investment has $10,000 in cash on hand, it must consider the alternatives to installing the insulation. If it can purchase a consol bond (which is a bond with no maturity date) which pays $600 per year in interest (a rate of return of 6 percent), it could do so and receive enough in interest each year to pay for the additional energy costs and still have $100 left over. It would clearly not be in its interest to make the investment. If the best return on a consol bond that it could purchase was 4 percent rather than 6 percent, the firm will reduce its costs by more

than it could get in interest payments on the bond, and it will undertake the investment. In general, firms will compare the returns on a possible investment — the expected increase in sales or reduction in costs, or a combination of the two. It must also take into account the uncertainty or riskiness of the returns: the more uncertain they are, the higher they must be in terms of expected value in order to make the investment worthwhile.

As interest rates decrease, more and more firms will have potential investment projects which become profitable compared to the opportunity cost of purchasing assets with a known rate of return. This leads to the graphical relationship between the interest rate and desired investment spending given in Figure 6.1 below.

[Figure 6.1 here. XX]

Expectations and investment

A change in the capital stock changes future production capacity. Therefore, plans to change the capital stock depend crucially on expectations. A firm considers likely future sales and the likely prices at which it will be able to sell its goods. As expectations change in a way that increases the expected return from investment, the investment demand curve shifts to the right. Similarly, expectations of reduced profitability shift the investment demand curve to the left.

Other determinants of investment spending

Let's now turn to the other factors which influence investment spending, which will also allow us to introduce the concept of an aggregate investment function.

- **Risk**: The decision to invest in a new capital asset depends on whether the expected rate of return on the new investment is equal to or greater or less than the rate of

interest to be paid on the funds needed to purchase this asset. It is only when the expected rate of return is higher than the interest rate that investment will be made in acquiring new capital assets. Additionally, since the future rate of return is not certain, but is rather subject to risk, the expected return must be higher than the riskless rate of interest, the rate of return that could be earned on the funds needed to purchase the asset with no risk of loss, in order to compensate for that risk. The more risky an investment, the less likely it will be to be undertaken at a given riskless rate of interest.

- Real GDP: current real GDP is a proxy for current demand. Firms need capital to produce goods and services. An increase in the level of production boosts the demand for capital and thus lead to greater investment. Also, since fluctuations in GDP are persistent, current GDP predicts future demand to some extent. Strong GDP growth leads naturally to higher expected GDP in the future.

- Expected future GDP: investment spending by firms increases their capacity to produce goods in the future. Higher expected future GDP means stronger demand in the future. Firms will invest now in order to be able to meet this higher future demand more easily.

- Expected future real interest rates: because demand depends negatively on real interest rates, higher expected real interest rates will reduce the demand for investment. Higher expected real interest rates also increase the expected return on assets which could be held by firms instead of investment expenditure.

- Fiscal policy: corporate taxes reduce the net rate of return on investment projects. An increase in corporate tax rates or in future expected corporate tax rates will decrease the profitability of investment projects and therefore decrease investment demand. Investment tax credits or accelerated depreciation allowances reduce the costs of investing and therefore increase the demand for investment.

Risk: informally, the possibility of something bad happening. More formally, risk is related to the variability of an uncertain outcome.

Aggregate investment function

An **aggregate investment function** gives the functional relationship between total desired investment spending in an economy and the different factors which determine that spending. We can write

$$I = C\left(r, r^e, Y, Y^e, W\right).$$

Here, r^e denotes future expected real interest rates: the other variables have been defined previously.

Aggregate investment function: relates total investment spending in the economy to different factors which determine that spending: these can include current real GDP, expected growth in real GDP (which affects expected future GDP), interest rates, etc.

6.3 Induced and autonomous expenditure

We have analyzed the different factors which determine aggregate consumption spending and aggregate investment spending. One of the main determinants of both consumption and investment spending, aside from the real interest rate, is current income or current GDP.

The simple AD/AS model developed in Chapter 5 assumed that the rate of inflation is fixed in the short run (the current period), and that firms supply the quantity of goods and services demanded by households, firms, and the government. In the simple model, the central bank sets the real interest rate as a function of inflation, and GDP is equal to aggregate demand, with firms supplying the quantity of goods and services demanded at the current inflation

rate.

Induced expenditure

An important part of the expenditure in the economy is directly related to GDP and changes when GDP changes. This is defined as **induced expenditure**. It is mainly a result of household expenditure plans and expenditure on imported goods and services embodied in those plans.

> **Induced expenditure**: planned expenditure which is determined by current income and which changes when income changes.

The largest part of consumption expenditure by households is *induced expenditure*, closely linked to current income. This expenditure changes when income changes, changing in the same direction as income changes but changing by less than income changes. The **marginal propensity to consume** (*mpc*) defines this link between changes in income and the changes in consumption they induce. The *mpc* is a positive fraction.

> **Marginal propensity to consume (mpc)**: the ratio of the change in consumption expenditure *caused* by a change in income to the change of income itself.

Investment expenditure also depends to an extent on current GDP or income. The **marginal propensity to invest** (*mpi*) defines this link between changes in income and changes in investment expenditure. The *mpi* is a positive fraction, and we will assume that the sum of the *mpc* and *mpi* is less than one.

> **Marginal propensity to invest**: the ratio of the change in investment expenditure *caused* by a change in income to the change in income itself.

Autonomous expenditure

The second part of GDP expenditure is where the real action lies. It covers the important changes in expenditure that drive the business cycles in economic activity. **Autonomous expenditure**, is the planned expenditure which is not determined by current income. It is determined instead by a wide range of economic, financial, external and psychological conditions that affect household and business decisions to make expenditures on current output. These factors are summarized above in the form of the *aggregate consumption function* and the *aggregate investment function*.

> **Autonomous expenditure**: planned expenditure that is not determined by current income.

Consumption and investment have an autonomous component in addition to the induced component. We also treat government expenditure, G, as autonomous or independent of current GDP. Figure 6.2 shows the independence of autonomous expenditure, labelled A, from income. Unlike induced expenditure, autonomous expenditure does not change as a result of changes in GDP. Figure 6.2 also illustrates how induced expenditure responds to increases in GDP.

[Figure 6.2 here. XX]

The aggregate expenditure function

The **aggregate expenditure function** is the sum of *planned* induced expenditure and *planned* autonomous expenditure. The emphasis on "planned" expenditure is important. Aggregate expenditure is the expenditure households and businesses want to make based on current income and expectations of future economic conditions. Expenditure-based GDP in national accounts measures, after the fact, the expenditures that were made.

Aggregate expenditure function: a function which relates planned expenditure to its determinants, which include current income and other factors.

In a closed economy without trade with the rest of the world, we know from Chapter 4 that total expenditure is given by the sum of consumption spending, investment spending, and government spending:

$$GDP = Y = C + I + G.$$

Taking government spending as exogenous, and combining this with our aggregate consumption function and aggregate investment function, we get the following function or relationship between aggregate expenditure (AE) and its determinants:

$$AE = AE\left(r, r^e, Y, Y_d, Y^e, W, G\right).$$

In the short run, as shown in the next section, the main determinant of equilibrium output is aggregate expenditure. Also, *exogenous* changes in autonomous expenditure lead to changes in induced expenditure which have the effect of *multiplying* the original change.

6.4 Equilibrium output and spending multipliers

As we have noted, in the simple AD/AS model developed in Chapter 5, firms supply the quantity of goods and services demanded at the current inflation rate. They only modify the rate at which they change their prices with a lag: stronger-than-normal demand will lead them to increase their prices more rapidly, while weaker demand will cause them to moderate the rate at which they increase their prices. If this is the case, within the period planned expenditures become realized expenditures, which are also equal to **short-run equilibrium output**.

Short-run equilibrium output: output which is equal to planned expenditures during a given period.

Figure 6.3 below illustrates how aggregate expenditure and output are determined in the short run. The 45° line on the diagram shows values of aggregate expenditure and output where the two are equal, which must be the case in short-run equilibrium.

The planned expenditure line in Figure 6.3 has a slope of less than 45∘ since induced expenditures increase less than one-for-one with increases in current income/output. This means that the sum of the *marginal propensity to consume* plus the *marginal propensity to invest* is less than one.

When there is an unexplained or *exogenous* increase in autonomous expenditure, output increases in our simple model of Chapter 5 in order to match the increase in expenditure. This is illustrated in Figure 6.3 by the shift in autonomous expenditure from A_0 to $A_0 + \Delta A$. Note that equilibrium output must increase by more than the change in autonomous expenditure ΔA.

This is because the initial increase in autonomous expenditure leads to an equal increase in output, and this increase in output leads to a further increase in *induced expenditure*, which leads to a further increase in output, and so on. We can speak of a spending **multiplier**.

[Figure 6.3 here. XX]

Figure 6.4 below shows the impact of an increase in autonomous spending on aggregate demand for two different cases, with different marginal propensities to consume and invest.

An increase in autonomous expenditure causes the aggregate expenditure function to shift upwards. Figure 6.4 shows clearly that the final increase in short-run equilibrium is greater than the initial increase in autonomous expenditure because of the increase in induced expenditure.

How much induced expenditure results from an initial increase in autonomous expenditure depends on the marginal propensities to consume and to invest. A higher marginal propensity to consume and/or invest will give rise to an aggregate expenditure function which is steeper as a function of GDP. This leads to a greater increase in short-run equilibrium output for a given increase in autonomous expenditure. This can be seen by the difference between the two curves marked AE_1 and AE_2 in the figure.

[Figure 6.4 here. XX]

6.4.1 Spending multipliers

The **multiplier** is defined as the ratio of the change in short-run equilibrium output and income to the change in autonomous expenditure. If ΔA is the change in autonomous expenditure, we have

$$\textbf{Multiplier} = \frac{\Delta Y}{\Delta A}.$$

> **Multiplier**: the ratio of the change in short-run equilibrium output and income to the given change in autonomous expenditure that caused it.

Example Box 6.1 goes through the simple algebra of spending multipliers, and shows clearly how the size of the multiplier depends on the marginal propensities to spend on consumption and investment.

Example Box 6.1: The simple algebra of spending multipliers

Consider a simple aggregate consumption function which specifies that consumption has an autonomous component and otherwise depends on GDP:

$$C = a + bY.$$

The b parameter (with $0 < b < 1$) is the *marginal propensity to consume*, and the $a > 0$ parameter is the *autonomous* component of consumption spending, aggregate consumption spending which does not vary directly with real income.

Similarly, consider a simple aggregate investment function which says that investment spending has an autonomous component and otherwise depends on GDP:

$$I = c + dY.$$

The d parameter (with $0 < d < 1$) is the *marginal propensity to invest*, and the $c > 0$ parameter is the *autonomous* component of investment spending, aggregate investment spending which does not depend directly on real income.

Using the basic national income accounting identity of Chapter 4 (for a closed economy without commercial relations with the rest of the world), we can write

$$Y = C + I + G = a + bY + c + dY + G.$$

In the model of short-run macroeconomic equilibrium developed in Chapter 5, the rate of inflation is fixed in the short run and GDP is determined by aggregate demand AD. We can write

$$Y = AD = a + bAD + c + dAD + G,$$

which can be rewritten as

$$(1 - b - d)\, AD = a + c + G,$$

and finally we can write

$$AD = \frac{1}{(1 - b - d)} (a + c + G).$$

This equation tells us by how much aggregate demand (and, in the short run, real GDP) will change for a given change in the autonomous component of consumption spending, the autonomous component of investment spending, or government purchases of goods and services.

Since b and d are positive fractions, and since we can assume that $b + d < 1$, we must have $\frac{1}{(1-b-d)>1}$. Obviously, the higher the sum of the marginal propensity to consume b plus the marginal propensity to invest d (provided that it is still the case that $b+d < 1$), the larger is the multiplier.

Conclusions

This chapter has looked at the determinants of two main components of aggregate demand: aggregate consumption expenditure and aggregate investment expenditure. It shows how *short-run equilibrium output* depends on planned expenditure by firms and households. We defined *autonomous expenditure* as planned spending which does not depend on current income, and we showed how changes in autonomous expenditure have a multiplier effect on short-run equilibrium output.

Chapter 7 looks in more detail at government spending (the "G" in the basic national accounting identity), while Chapters 9 and 12 examine the determinants of net exports (the X-IM of the basic national accounting identity).

KEY CONCEPTS

- **Durable good**: a good that does not quickly wear out or, more specifically, one that yields utility over time rather than being completely consumed in one use. Items like bricks could be considered perfectly durable goods because they should theoretically never wear out. Highly durable goods such as refrigerators or cars usually continue to be useful for several years.
- **Nondurable good**: a good which is typically used up (consumed) shortly after it is purchased.
- **Disposable income**: the income of an individual or household after deducting direct taxes and adding transfer payments received from governments.
- **Direct tax**: a tax imposed on a person or property, such as an income tax or property tax.
- **Indirect tax**: a tax imposed on a transaction, such as a sales tax, a value-added tax, or a tariff.
- **GDP**: the national accounts measure of the sum of actual expenditure and income in the economy.
- **Disposable income**: the income of an individual or household after paying all direct taxes and minus transfer payments from governments.
- **Marginal propensity to consume**: the change in consumption expenditure caused by a change in income.
- **Permanent income**: the average income individuals or households expect to receive over the course of their lives.

- **Permanent income hypothesis**: a theory which holds that consumption expenditure depends on permanent income.
- **Marginal propensity to consume (mpc)**: the ratio of the change in consumption expenditure *caused* by a change in income to the change of income itself.
- **Marginal propensity to invest**: the ratio of the change in investment expenditure *caused* by a change in income to the change in income itself.
- **Autonomous expenditure**: planned expenditure that is not determined by current income.
- **Induced expenditure**: planned expenditures that change when income changes.
- **Short-run equilibrium output**: output which is equal to planned expenditures during a given period.
- **Multiplier**: the ratio of the change in aggregate demand (which determines output in the short run) to the change in autonomous expenditure that caused it.

Exercises for Chapter 6

Exercise 6.1

Suppose that in an economy with no government the aggregate expenditure function (as a function of GDP) is given by:

$$AE = 50 + 0.75Y.$$

(a) Draw a diagram showing the aggregate expenditure function, and indicate the level of planned expenditure when income is 150.

(b) On this same diagram, show what would happen to aggregate expenditure if income increased to 200.

(c) What are the levels of autonomous expenditure and induced expenditure at income levels of 150 and 200?

(d) On this same diagram show what would happen if autonomous expenditure increased by 20.

Exercise 6.2

Suppose the media predicts a deep and persistent economic recession. Households expect their future income and employment prospects to fall. They cut back on expenditure, reducing autonomous expenditure from 50 to 30.

(a) Re-draw the aggregate expenditure functions you have drawn in your diagrams for Exercise 6.1 to show the effects, if any, of this change in household behaviour.

(b) Suppose the negative economic forecast also reduces induced expenditure in the economy from $0.75Y$ to $0.5Y$. In a diagram show the effect would this have on the aggregate expenditure functions you have drawn.

Exercise 6.3

Construct a table showing autonomous, induced and aggregate expenditure at differ- ent income levels (Y) for an economy with autonomous expenditure of 105 and induced expenditure of $0.5Y$.

(a) Using numbers from your table draw a diagram showing the aggregate expenditure function AE. What is the intercept of this function on the vertical axis?

(b) What is the slope of the AE function, and what does the slope measure?

(c) Write the equation for the aggregate expenditure function for this economy.

Exercise 6.4

Output and income are in equilibrium when planned expenditures AE are equal to national income, Y, in other words when

$$Y = AE.$$

(a) Suppose the AE function is $AE = 175 + 0.75Y$. Draw a diagram showing the aggregate expenditure function.

(b) On your diagram draw the $45°$ line that shows all points at which national income and aggregate expenditures are equal ($Y = AE$).

(c) Using your diagram, or a numerical example, or an algebraic solution, find equilibrium output and income in this example and show it in the diagram.

Exercise 6.5

The distinction between autonomous and induced expenditure is important for the determination of equilibrium real GDP. Assume that the marginal propensity to spend on domestic output is 0.70 and autonomous aggregate expenditure is 1000.

(a) What is the equation for the aggregate expenditure function under these assumptions?

(b) Draw the aggregate expenditure function in an income-expenditure $45\circ$ line diagram.

(c) What is the equilibrium level of real GDP illustrated by your diagram?

(d) Explain why this is the equilibrium level of real GDP.

Exercise 6.6

Exercise 6.7

Chapter 7

The government sector

In this chapter we will explore the following topics.

- 7.1 Government in Canada
- 7.2 Government expenditure and taxes
- 7.3 The government's budget function
- 7.4 Fiscal policy and government budgets
- 7.5 Automatic and discretionary fiscal policy
- 7.6 The public debt and the budget balance
- 7.7 Aggregate demand and equilibrium GDP

Federal and provincial government budgets generate a lot of media coverage and public debate. In broad terms these debates involve the government's effectiveness and efficiency in providing public services and the government's fiscal management of the economy based

on:

- the size of government and the composition of government expenditures;
- the tax system and policies used to finance expenditures;
- the budget deficit or surplus; and
- the size of the public debt, absolutely and relative to national income.

Consider the response of the Canadian federal government to the Covid-19 pandemic. (See also Application Box 1.1.) The forced closings of many businesses during the pandemic acted like a strong negative supply shock.

[XX Add a couple of paragraphs with more recent examples from the Covid period.]

This chapter examines these issues and the role of government in the economy. A government sector adds important new linkages and feedback effects to the basic model of Chapter 6. Government expenditures on goods and services (G), determined by government policy, are added to other autonomous expenditures. They affect aggregate expenditure and equilibrium income through multiplier effects. Government revenue collected by a net tax rate (t) on national income reduces the income households have to spend on consumption and reduces induced consumption expenditure. The multiplier is reduced, reducing equilibrium national income and the effects of changes in autonomous expenditure on equilibrium national income.

The linkages and feedbacks work in both directions. Changes in government expenditures and taxes have effects on equilibrium national income. Government can use these effects to manage aggregate expenditure and equilibrium income. However, changes in equilibrium national income caused by changes in expenditure in other parts of the economy change incomes, government revenues and budget balances. As a result, changing economic conditions often lead to government budget outcomes that differ from initial targets and projections as in recent years.

Furthermore, over time governments must manage their budgets in ways that control the size of their debt relative to GDP. The fiscal policy governments implement through their budgets has dual objectives: manage aggregate demand and, over time, manage the size of the public debt relative to national income. Until recently, Canadian governments have been more concerned about government budget surpluses, deficits, and debt than about demand management when designing fiscal policy.

In early 2020 the Covid-19 pandemic and containment policies led to dramatic changes in government budgets and fiscal policy in Canada. Households and businesses needed extensive financial support in order to deal with the effects of business closings, sudden large increases in unemployment and ongoing costs. Plans to control budget balances and debt ratios were displaced by urgent immediate needs for financial support.

To explain the role of government in macroeconomic analysis and policy, we start with a brief look at the data on the size of the government sector in Canada.

7.1 Government in Canada

The total government sector in Canada includes the federal, provincial, and municipal governments, as well as hospitals (which in Canada are all publicly funded). Table 7.1 shows total outlays by the government sector in 2021. These totaled $1,137.9 billion. Of this total, 27.1 percent was expenditure on government employees and 19.5 percent for the goods and services that provided government services to Canadians. The remaining 53.4 percent was transfer payments to persons, business, and non-residents, and interest paid on the outstanding public debt.

Table 7.1: **Total government expense in Canada, 2020**

Total Expense $ billions	Employee Compensation percent	Goods and Services percent	Fixed Capital percent	Grants and Subsidies percent	Social Benefits percent	Other Expenses percent	Interest percent
1,137.9	27.1	19.5	7.3	7.2	27.6	5.4	6.0

Source: Department of Finance, Fiscal Reference Tables, 2022, Table 34

To provide some perspective, Table 7.2 compares the size of the government sector in Canada, relative to GDP, with the average for the G7 group of industrial countries (Canada, the United States, Japan, the United Kingdom, Germany, France, and Italy) in 2011 and 2021. These data illustrate two aspects of recent government budget activity that are of particular interest. The first is the size of the government sector in each country as measured by revenue, expenditure, budget balance and net public debt, all reported as a percent of GDP. The second is the change in government sector finances from 2011 to 2021.

Table 7.2: **The general government sector in Canada vs. the G7 countries**

	Total Revenues % GDP		Total Outlays % GDP		Budget Balance % GDP		Net Public Debt % GDP	
	2010	2017	2010	2017	2010	2017	2010	2017
Canada	38.3	41.0	41.6	46.0	-3.3	-6.0	27.5	31.6
G7 Average	34.7	36.7	42.0	45.4	-7.4	-8.7	85.1	100.0

Source: Department of Finance, Fiscal Reference Tables, 2022, Tables 51-54.

7.2 Government expenditure and taxes

A basic government budget has two components:

1. a plan for government expenditures on goods and services (denoted by G); and

2. a net tax rate on income, (denoted by t), set to generate revenue to finance expenditure.

Government expenditure is a component of autonomous expenditure, that is expenditure which does not directly depend on current GDP.

> **Government expenditure**: government spending on currently produced goods and services.

7.3 The government's budget function

7.4 Fiscal policy and government budgets

7.5 Automatic and discretionary fiscal policy

Automatic fiscal policy

Automatic stabilizers have a great advantage. They are built into the budget program by setting the net tax rate, and work automatically. There is no need to determine if the shift in autonomous expenditure is transitory or persistent. By reducing the sensitivity of the economy to expenditure shocks, automatic stabilizers are always at work reducing the size of output and employment fluctuations.

> **Automatic stabilizers**: tax and transfer programs that make aggregate demand less sensitive to change in autonomous expenditures.

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Discretionary fiscal policy

Governments use **discretionary fiscal policies** to offset *persistent* changes in autonomous expenditures. A persistent drop in investment or exports would be offset by an increase in government spending and by cutting taxes, or both as for example the Canadian government's *Economic Action Plan* in response to the recession of 2009. Another example is the planned annual deficit of $10 billion in the federal government's 2017 Budget, intended to finance major infrastructure investments and support increased aggregate demand, after the slowdown in growth in the previous years. Alternatively some provincial governments introduced austerity budgets in 2018 and 2019, cutting expenditures to try to reduce budget deficits.

> **Discretionary fiscal policy**: changes in net tax rates and government expenditure intended to offset *persistent* autonomous expenditure shocks and stabilize aggregate expenditure and output.

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7.6 The public debt and the budget balance

Budget balances and outstanding debt are closely related. A student's debt at the time of graduation is the sum of her budget balances during years of study. In any year in which her income is less than her expenses, she finances the difference by borrowing. In another year, if income is greater than expenses, she can repay some previous borrowing. In the end, the sum of borrowings minus the sum of repayments is her outstanding student debt (loan). This debt is a result of borrowing to finance investment in education.

Similarly, the outstanding **public debt** at any point in time is simply the sum of past

government budget balances. Governments borrow to finance budget deficits by selling government bonds to households and businesses. Budget surpluses reduce the government's financing requirements. Some bonds previously issued mature without being refinanced. In simple terms, the budget balance in any year changes the outstanding public debt by an equal amount but with the opposite sign. A positive balance, or *surplus*, reduces the public debt. A negative balance, or *deficit*, increases the public debt. Using PD to represent the outstanding public debt, we can express the link between the public debt and the government's budget balance as

$$\Delta PD = -BB,$$

where BB is the government's budget balance, and Δ signifies the *change* in PD from one period to the next.

> **Public debt**: the outstanding stock of government bonds issued to finance government budget deficits.

Measuring the size of the government debt is important. A government's ability to finance the interest payments on its debt and to pay down the principal depend on its capacity to raise revenue through taxation. In turn, its ability to raise revenue depends on the overall size of the economy. This is why we often measure the size of the debt **relative to the size of the economy**. The **debt-to-GDP ratio** is the most common of these measures.

> **Debt-to-GDP ratio**: the ratio of the value of public debt to the value of the gross domestic product of an economy.

To understand why the debt-to-GDP ratio is an important measure, think about the amount of debt you can afford to carry as an individual. If your personal disposable income is growing at a sufficiently fast rate, you can continue to borrow both to pay interest on your existing debt and to borrow new funds, and the ratio of your debt to your income will not grow over time.

As an example, let's say you borrow \$10,000, to be paid back at the end of the year plus interest at 3 percent, which amounts to \$300. If your annual disposable income is \$50,000, your debt at the beginning of the year amounts to 20 percent of that disposable income. At the end of the year, you take out a new loan of \$10,300, enough to pay back the principal and interest on the first loan. In the meantime your income has increased by 5 percent, to \$52,500. Your debt now amounts to only about 19.6 percent of your disposable income ($\frac{10{,}300}{52{,}500} \times 100$). You could even borrow an extra \$200 before your debt would amount to 20 percent of your disposable income. As long as your income is growing faster than the interest rate you have to pay on a loan, you can support a higher level of debt indefinitely (or until you die, in which case your estate would have to reimburse the outstanding value of the debt, including any interest payments).

What is possible for an individual is also possible for governments. In a growing economy and with sufficiently low interest rates, they can never fully pay off their outstanding debt while the ratio of their debt to GDP either does not explode or even decreases. This is known as "growing out of the debt."

The Application Box 7.1 below explores the conditions on growth rates and interest rates which make this possible.[1]

Of course an unexpected increase in interest rates or a slowdown of econommic growth can derail the decrease in the debt-to-GDP ratio. If the interest rate rises above the rate of economic growth, the only way to prevent an explosive increase in the debt-to-GDP ratio is to run sufficiently large primary surpluses.

[1] See Eichenbaum (2021) for a more detailed analysis.

Application Box 7.1: Growing out of the debt

The evolution of a government's debt level is given by the following simple equation:

$$B_{t+1} - B_t = r_t B_t + D_t,$$

where B_t is the real value of the debt at time t, r_t is the real interest rate on that debt, and D_t is the government's primary budget deficit (before its payment of interest on its debt). It says that any deficit in spending plus interest payments on the outstanding debt must be financed by more borrowin. Dividing both sides by GDP in period $t+1$ and rearanging gives

$$\begin{aligned}\frac{B_{t+1}}{Y_{t+1}} &= \frac{1}{Y_{t+1}}\left(1+r_t\right)B_t + \frac{1}{Y_{t+1}}D_t \\ &= \frac{Y_t}{Y_{t+1}}\left(1+r_t\right)B_t + \frac{Y_t}{Y_{t+1}}D_t.\end{aligned}$$

Using lower-case letters to denote ratios with respect to GDP, and using g_t to represent the growth rate of GDP, so that $g_t = \frac{Y_{t+1}}{Y_t} - 1$, we get

$$b_{t+1} = \frac{1+r_t}{1+g_t}b_t + \frac{1}{1+g_t}d_t.$$

Subtracting B_t from both sides of this equation gives us the change in the debt-to-GDP ratio:

$$\begin{aligned}b_{t+1} - b_t &= \frac{1+r_t}{1+g_t}b_t - \frac{1+g_t}{1+g_t}b_t + \frac{1}{1+g_t}d_t \\ &= \frac{r_t - g_t}{1+g_t}b_t + \frac{1}{1+g_t}d_t.\end{aligned}$$

This makes it clear that the growth in the debt-to-GDP ratio depends on the relationship between the real interest rate on the one hand, and on the other hand the government's primary budget deficit.

If GDP growth is greater than the real interest rate, the debt-to-GDP ratio will shrink even if the primary budget deficit is slightly positive. How much of a deficit can the government run without increasing the debt-to-GDP ratio? We can answer this question by setting $b_{t+1} - b_t = 0$ and solving for d_t. This gives the largest deficit compatible with not increasing the debt-to-GDP ratio. We get

$$0 = \frac{r_t - g_t}{1 + g_t} b_t + \frac{1}{1 + g_t} d_t.$$

Multiplying both sides of the equation by $(1 + g_t)$ gives

$$0 = (r_t - g_t)\, b_t + d_t,$$

so we get

$$d_t = (g_t - r_t)\, b_t.$$

This simple equation shows that the government can run a larger primary deficit the larger the difference between the growth rate of GDP and the initial debt-to-GDP ratio. Any deficit smaller than the one given by this solution will lead to a shrinking debt-to-GDP ratio over time.

7.7 Aggregate demand and equilibrium GDP

Conclusions

KEY CONCEPTS

- **Government budget balance**:
- **Primary budget balance**: the government's budget balance (expenditures minus revenues) excluding the interest payments on its outstanding debt.
- **Structural budget balance**: an estimate of what the budget balance would be if the economy were operating at potential output. Changes in the structural budget balance are indicators of changes in fiscal policy because they measure changes in expenditure and tax programs at a standardized income level.
- **Debt to GDP ratio**: the ratio of the value of outstanding government debt to gross domestic product, where the latter is usually measured over the course of a year.

Exercises for Chapter 7

Exercise 7.1

Part Three

Financial Markets and Economic Activity

8. Money, banking and money supply
9. Financial markets, interest rates, foreign exchange rates and aggregate demand
10. Central banking and monetary policy

Three chapters in this part examine the financial sector of the economy and the important role it has in the determination of output and employment. They cover money, banks and banking, financial markets, asset prices and foreign exchange rates. When integrated, these parts of the economy provide the 'monetary transmission mechanism' and a framework for the design and implementation of central bank monetary policy. Moreover, the financial sector is the key to price level and inflation rate elasticities in the aggregate demand functions derived in later chapters.

Chapter 8

Money, banking and money supply

In this chapter we will explore the following topics.

- 8.1 Money and functions of money
- 8.2 Measures of the Canadian money supply
- 8.3 Banking in Canada today
- 8.4 Money created by banks
- 8.5 The monetary base and the money supply

Today banks are still the front line of the financial system. Bank deposits are an important form in which people hold their wealth and they are also a means of payment, making them the main component of the money supply in the economy. Furthermore, banks are the major sources of credit for households and businesses, either directly through bank loans or indirectly through the credit card systems they own and third party systems they service. Banks are the foundation of the payments system.

But the financial and payments system has changed a lot in the past ten years and continues to evolve. Now *fintech* is seen as the new way for handling payments, insurance, investing and lending. *Cryptocurrencies* and crypto-assets such as Bitcoin, Ethereum and Libra, and *blockchain* networks they use for accounting and payments are major topics for discussion and analysis. Still the Bank of Canada does not see any of the crypto-assets as money right now. The banks and the banking system continue as the third parties necessary for the basic functioning of the monetary system.

This chapter examines the evolution of the financial sector and the important link it makes between aggregate expenditure and aggregate demand. *It is the key to understanding the slope and position of the AD curve.* It also creates the framework for central bank monetary policy.

8.1 Money and the functions of money

Canada's money in the seventeenth and eighteenth centuries was silver and gold coins from many countries, plus playing cards. The British pound sterling, the Spanish silver dollar, and the US dollar were the main moneys in Canada in the nineteenth century, followed by paper currencies issued by banks and then by the federal government since the late nineteenth century. The best source for the history of money in Canada is Powell (2005), available for download on the Bank of Canada's website.

It is not the commodity or token used as money that matters, but rather the social convention that it is trusted and accepted without question as a means of payment. Money makes it easier for everyone to buy and sell goods and services and economize on the use of scarce resources.

Money is defined by four important functions. It provides:

1. a means of payment as a medium of exchange;
2. a unit of account;
3. a store of value; and
4. a standard of deferred payments.

As a **means of payment** money is involved in most exchanges. We use money to pay for the goods and services — from food and clothing to transportation, to rent, to fees and taxes. People receive wages and salaries and other types of income in money. Money is not consumed in these transactions. It is used as a medium of exchange.

> **Means of payment**: a commodity, token, financial asset, or transferable electronic asset such as a bank deposit, generally accepted in payment for goods and services or the repayment of debt.

Exchange transactions without money are **barter exchanges**, a direct exchange of one good for another. These exchanges depend on a *double coincidence of wants*. Each party to the exchange has a good the other party wants and is willing to trade one good for another. This means exchange transactions are time consuming and expensive as people must find others who have what they want and want what they have. Using a money as a medium of exchange dramatically lowers the cost and increases the ease and efficiency of trade.

> **Barter exchanges**: direct exchanges of goods or services for goods or services without the use of money.

Money also serves as a **unit of account**. Prices in Canada are quoted in Canadian dollars. Similarly in other countries prices are quoted in domestic currency. In much of Europe prices are in euros, in the United States in US dollars and in Japan in yen. This reflects the convenience of using the same units for the means of payment and the unit of account.

However, there are exceptions. Historically in Canada during the time of the fur trade, books were kept in "currency" but actual currency never changed hands in the barter of trade goods for furs.

> **Unit of account**: the standard in which prices are quoted and accounts are kept.

To serve as a medium of exchange, money must also be a **store of value**. Money works as a time machine allowing people to separate the timing of their expenditures from the timing of their incomes. Money is accepted today with *confidence* that it can be used some time in the future to make payments when buying goods and services. You would not accept money today that you thought would be unacceptable when you offered it in payment at some later date. The integrity of the issuer of money and trust in the institutions that hold your money balances are essential.

> **Store of value**: an asset that carries purchasing power forward in time for future purchases.

Money is not a unique store of value. Other assets including real estate, financial assets like corporate and government bonds, fine art and antiques all serve as stores of value. These may be better ways to store value, but people still choose to hold some of their wealth as money. This choice to hold money balances is very important to the effects money balances have on financial markets and aggregate expenditure. Chapter 9 examines this question in detail.

Money provides a **standard for deferred payments**. If you take out a student loan the amounts you will repay in the future are specified in dollars. Similarly, servicing and retiring a mortgage on a property or a loan on a car calls for future payments specified in dollars. Domestic money is not essential for this function. Individuals, businesses and governments often borrow or lend in the money of other countries. In those cases the currency in which the loan transaction takes place is usually the standard for payments to settle the debt. The

essential attribute of money is its general acceptance as a means of payment. For this money must also be a store of value. This works well when money is also a unit of account and a standard of deferred payments.

> **Standard of deferred payments**: the units in which future financial obligations are measured.

The development of money

The money we use today is the product of a long and continuing evolution in the financial services industry. It is a testament to the ingenuity of people and society seeking to reduce the costs and increase the volume of trade in goods and services.

Historically, there were no banks. Money was a commodity. Gold and silver bullion are two commodities that came to be used extensively because of their relative scarcity and durability. Concerns about the purity of these metals and the inconvenience of weighing out small quantities to make payments led to coinage. The minting of gold and silver coins by heads of state offered a solution to these problems. The 'monarch' certified the purity and quantity of the metal in the coin by having his or her likeness stamped into the metal.

Unfortunately, coinage did not completely solve the concerns about the quantity and quality of gold and silver money. The integrity of the coinage process was still uncertain. The quantity of gold in a coin could be reduced by clipping its edges, or by rubbing the surfaces of the coin to wear some of the metal away. "Sweating" coins by placing them in a leather bag and shaking them was one technique used to remove some of their precious metal. The edge designs, millings, or facets that we still see on coins today were introduced to combat clipping, and wear on the heads and tails stamped into coins provided evidence of sweating. Coins that were worn or clipped were not accepted at full value in exchange for goods and services.

A second difficulty with precious metal coinage came from the sovereign who controlled the minting process. Adding a little base metal to the gold or silver being minted resulted in coins with less precious metal content than their face value certified. A little of the precious metal was withheld and could be used to mint more coin, which was, in effect, free money for the sovereign. This "debasing" of the coinage was a serious problem at times and, like clipping and sweating, reduced the acceptability of precious metal coinage as money.

The emergence of banks and paper money was a response to the problems with gold and silver commodity money. The first banks were goldsmiths who used gold in the production of jewelry and ornaments. They were accustomed to buying and selling gold bullion, and holding stocks of gold bullion. It was a natural extension of their business to offer to hold gold for safekeeping. Those who stored their gold with goldsmiths were given paper claims or receipts (IOUs), which were redeemable in gold on demand. Confidence in redemption at face value was the key to acceptability.

When people began to use gold receipts to make payments, gold receipts became a means of payment. They were **token money**, representing a fixed amount of the precious metal.

> **Token money**: redeemable claims on commodity money.

Goldsmiths became bankers when they realized that not all their customers would show up at the same time and want their gold back. Trust in the ability to redeem gold receipts made them acceptable as a medium of exchange. Gold merchants could make loans by issuing more gold receipts than they had gold in their storage vaults. They only needed gold holdings equal to a fraction of the gold receipts they had issued, as long as people used the receipts as a medium of exchange.

Banks as we know them grew out of this acceptance by society of credit (IOU) money as a medium of exchange. Banks began to accept customer deposits of token money and to issue their own bank notes (credits) as receipts. People liked the convenience and safety of

storing some of their wealth with banks. As society became more comfortable with banks and confident in the safety of banks, bank deposits, which could be transferred by cheque, became widely accepted as the medium of exchange. Bank notes and deposits were no longer redeemable in gold or commodity money, but they were redeemable in **legal tender**. Governments established central banks to control the supply of legal tender, bank notes, or cash. Bank notes now serve as both a medium of exchange and as the **reserves** banks hold to ensure the redemption of their customers' deposits on demand.

> **Legal tender**: money that by law must be accepted as a means of payment.

> **Bank reserves**: cash (legal tender) held by banks to meet possible withdrawals by depositors.

Unlike other financial institutions, such as pension funds and insurance companies, the key aspect of banks is that some of their liabilities are used as the medium of exchange; cheques and debit cards allow their deposits to be used as money to make payments. Bank deposits are credit money.

In Canada today, as in most industrial countries, we use a combination of **fiat money** and **credit money**. Fiat money, in contrast to commodity or token money, is money that the government has declared to be legal tender. Coins and paper bank notes are fiat money in Canada. If you look carefully at a $5, $10, or $20 Bank of Canada bill you will find the following statement: "This note is legal tender." By law it must be accepted as a means of payment for goods and services bought or debts repaid.

> **Fiat money**: money the government has declared as legal tender.

> **Credit money**: the debt of a private business or individual.

Our fiat money is supplemented by credit money. A bank deposit is credit money, and is redeemable in fiat money on demand, or (in the case of some savings and time deposits)

after a short waiting period. Furthermore, the bank is obliged to pay when your cheque is presented, or when you use your debit card. Bank deposits are a medium of exchange because they are generally accepted as a means of payment, even though they are not legal tender. The sum of bank deposits and fiat money in circulation outside the banks at any time is the stock of medium of exchange and the economy's **money supply**.

> **Money supply**: the total value of means of payment in the economy, namely the value of currency (notes and coin) in circulation outside the banks plus the value of bank deposits.

Payment methods, monies and financial services continue to evolve as illustrated by **fintech**, the ongoing development of **e-payments** and **e-money**.

> **Fintech**: the rapidly growing, innovative, applications of computer and internet technologies to facilitate the flow of payments and financial information.

> **E-payments**: debit cards, telephone banking, internet banking, e-transfers, wireless and mobile banking, which provide access to manage deposit accounts and make payments.

E-payments do not involve any creation of money. They facilitate the *transfer* of funds from one account to another account. One account is debited while another accounted is credited: the aggregate value of accounts does not change.

> **E-money**: monetary value electronically stored on a card, phone, or over the internet, that represents a claim on the issuer.

E-monies fall into two categories. **Centralized e-money**, for example a multi-purpose pre-paid payment card denominated a national currency, has money value based on funds received by the issuer. It is accepted as a means of payment in transactions with parties other than the issuer. Stored-value cards and gift cards for purchases at specific companies

use the Visa or MasterCard systems. They are widely accepted in payment. In Canada, transactions using these and similar cards are denominated in Canadian dollars.

> **Centralized e-money**: a payment card denominated in a national currency.

Cryptocurrencies are a form of decentralized e-money. They are financial assets but have no centralized issuer and do not have to be denominated in any national currency. *Bitcoin* and *Ethereum* are examples. Each is completely decentralized and does not represent a claim on the issuer in the way that a Canadian dollar bank deposit represents a claim on a bank. Furthermore, no bank or institution is an intermediary in a transaction between payer and payee. A cryptocurrency is decentralized over a peer-to peer computer network that directly links users, but no single user is in control of the network. It uses 'blockchain technology' which is a shared, continually reconciled data base. However, because cryptocurrencies are not redeemable in national currencies, and are not legal tender, they generally trade online and values are highly volatile in terms of national currencies. They are not a true money in that they do not serve as a '*generally acceptable*' means of payment, one of the four main functions of money.

> **Cryptocurrency**: a decentralized e-money with no centralized issuer and not necessarily denominated in any national currency.

The first decentralized cryptocurrency was Bitcoin, which was released as open-source software in 2009. As of March 2022 there were more than 9,000 other cryptocurrencies in the marketplace, of which more than 70 had a market capitalization exceeding $1 billion.

Fluctuations in the price of Bitcoin have been more volatile than the price of gold, stock market indices and exchange rates. This results from Bitcoin being held for speculative purposes. The result is that cyrptocurrencies like Bitcoin are not as useful as stores of value since their price fluctuates so much.

A new type of cryptocurrency called **stablecoins** was invented in order to address the volatility problem. A stablecoin is a cryptocurrency whose value is pegged to a reference asset. Often the reference asset is a fiat currency such as the US dollar, but it can also be a commodity or a basket of commodities (such as precious metals or industrial metals), or another cryptocurrency (making its value as volatile as that of the cryptocurrency to which it is pegged).

> **Stablecoin**: a cryptocurrency whose value is pegged to a reference asset. The reference asset could be a fiat money, exchange-traded commodities (such as precious metals or industrial metals), or another cryptocurrency.

Stablecoins can also be backed by holding reserves, also in the form of fiat money or commodities. In some cases they are unbacked, using algorithms to control the stablecoin's money supply, similar to the way central banks print and destroy currency.

These are interesting developments but in the opinion of the Bank of Canada none of the current crypto assets is money but may be useful financial portfolio assets. The need for trust in third party intermediaries like banks remains.

8.2 Measures of the Canadian money supply

As noted above, the money supply is traditionally defined as cash in circulation outside the banks, plus bank deposits. But as the banking and financial system evolved so did the types of deposits issued to the non-bank public. This has led to several different measures of the money supply.

In the early days of banking there were demand deposits on which cheques could be written and savings deposits which often required a period of notice before funds could be withdrawn. Today banks offer a much wider spectrum of deposits to customers from demand to savings

deposits that may or may not be chequable, pay interest under different terms, and some which can only be accessed online. Not all deposits serve as means of payment. For these the balance must be transferred to another account before it is available to make a payment. Which deposits should be counted in the money supply?

The structural evolution of the financial system raises further questions, such as "What is a bank?" Today, banks compete vigorously for deposits with other businesses, including trust companies and credit unions whose deposits are widely accepted as means of payment. There is no longer a reason to exclude those deposits from measures of the money supply. Different measures of the money supply illustrate the importance of different financial institutions in the industry.

The Bank of Canada and Statistics Canada publish statistics on these different measures: M0, M1, M1++, M2 and M2++. The 'pluses' indicate that the measures include institutions other than commercial banks. These include credit unions, caisses populaires, and trusts an mortgage loan companies in the case of M1++, and government-owned savings institutions and life insurance companies in the case of M2++.[1]

The higher numbers indicate broader monetary aggregates. They include assets which have less and less **liquidity**, which means it is less and less easy (in terms of cost, speed, and certainty) to convert them into cash to be used directly as a means of payment.

> **Liquidity**: the cost, speed, and certainty with which asset values can be converted into cash.

The M0 measure is the **monetary base**, which includes bank notes and coins in circulation plus deposits held by financial institutions with the Bank of Canada, which are called **settlement balances**. Bank notes and coins are legal tender in the sense defined above. Settlement balances are liquid assets from the point of view of financial institutions, and are

[1]For an international comparison on the definition of monetary aggregates, see O'Brien (2007).

important because they encourage the expansion of loans and deposits by those institutions, as Section below discusses in detail.

> **Monetary base**: the value of notes and coins in circulation plus the value of settlement balances held by financial institutions with the Bank of Canada.

> **Settlement balances**: deposits held by banks and other financial institutions with the Bank of Canada.

The broader measures of the money supply are defined as follows:[2]

- M1: currency in circulation plus personal and non-personal chequable deposits held at chartered banks

- M1++: adds chequable notice deposits at chartered banks plus chequable deposits and chequable notice deposits at credit unions, caisses populaires, and trust and mortgage loan companies.

- M2: M1 plus personal saving deposits and term deposits at banks, plus non-personal notice deposits at banks.

- M2++: adds all other deposits at credit unions, caisses populaires, and trust and mortgage companies, money market mutual funds, individual annuities at life insurance companies, personal deposits at government-owned savings institutions, other mutual funds, and Canada savings bonds.

[2]See Table 4 in O'Brien (2007).

Table 8.1: **The money supply in Canada in May 2022 (billions of $)**

Currency in circulation	116.4
Settlement balances	191.8
Monetary base (MB)	307.2
M1++	2,192.4
M2	2,372.0
M2++	4,456.4

Source: https://www.bankofcanada.ca/rates/banking-and-financial-statistics/selected-monetary-aggregates-and-their-components-formerly-e1/

Currency in circulation is only about 5 percent of M2. Deposits account for the remaining 94 percent. The importance of bank deposits as money means that understanding the operations of banks as sources of loans and deposits is the key to understanding the money supply function in the economy.

8.3 Banking in Canada today

In Canada today, and in other industrial countries, the mainstream banking system is made up of a *central bank* (the Bank of Canada) and a number of *commercial banks* and other deposit-taking institutions called *near banks*. Table 8.2 illustrates the structure of the banking industry in Canada. The industry is defined broadly to include deposit-taking institutions, not just those that operate under the federal Bank Act.

Table 8.2: **The Canadian banking system, September 2022**

Banking institution	**Number**
Central bank:	
The Bank of Canada	1
Chartered banks:	
Schedule I domestic banks	33
Schedule II foreign banks subsidiaries	13
Schedule III foreign bank branches	21
Total:	**68**

Source: Canadian Bankers' Association. https://www.cba.ca/memberbanks

Banks are **financial intermediaries**. They borrow money from the public, crediting them with a deposit. The deposit is a liability of the bank. It is money owed to depositors who are confident it will be redeemed on demand. The money raised from depositors provides the funds to support the bank loans made to businesses, households, and governments.

> **Financial intermediary**: a business that specializes in bringing borrowers and lenders together. It attracts deposits from savers by offering services and paying interest. It uses these funds to make loans to borrowers.

Banks are not the only financial intermediaries. Trust companies, credit unions, caisses populaires, insurance companies, securities dealers, mutual fund companies, and independent financial advisors all play a role in this industry. But banks hold more than 70 percent of the assets in the financial services sector, and the six largest Canadian banks account for over 90 percent of the assets of the banking industry. Trust companies, credit unions, and caisses populaires also accept deposits that are used as money, but those deposits are a small fraction of the total of deposit money. As a result, bank deposits are the focus of our discussion of money in Canada.

The **Bank of Canada** is Canada's central bank. It is the source of the bank notes used to make payments and held as cash reserves by commercial banks. Established by the government in 1935, it has the responsibility to regulate the national money supply and support the operation of financial markets. The Bank's power to meet these responsibilities comes from its monopoly on the issuance of bank notes.

> **Bank of Canada**: Canada's central bank.

The Bank of Canada also is the provider of:

- banking services for the commercial banks in the system;
- banking services for the federal government; and

- lender-of-last-resort facilities in times of liquidity crises and reserve shortfalls.

Commercial banks hold some of their reserves as deposits in the Bank of Canada, and make payments among themselves using their Bank of Canada deposits. These interbank payments arise from wire transfers, direct deposits, pre-authorized debits, bill payments, point-of-sale debits, and online payments made by bank customers. For example, cheques written by customers at one bank, say *Scotiabank*, but paid to and deposited by customers of the *Royal Bank* result in transfers of deposits between these banks. To settle these transfers, *Scotiabank* must pay the *Royal Bank*. Funds held by *Scotiabank* on deposit in the Bank of Canada are used for this purpose. They are called "settlement balances." In 2021, *Payments Canada* (www.payments.ca), which coordinates this clearing of interbank transactions, handled more than 20 billion transactions including cheques, credit card and e-transfers and point-of-sale debits totalling $135 trillion.

The government holds some deposits in the Bank of Canada. Government receipts, like income taxes paid to the Receiver General, are deposited in government accounts in the Bank of Canada. Government payments like Old Age Security, Employment Insurance benefits, bond interest, and income tax refunds are paid with government cheques or transfers drawn on its Bank of Canada account. Government funds over and above those needed to make regular payments are held on deposit in the commercial banks, and earn interest income for the government.

The key difference between a central bank and the commercial banks in the banking system is the profit motive. Central banks *do not* pursue profits. Their operations focus on the management of the cash reserves available to the public and the banks. The supply of cash reserves affects the behaviour of other banks and financial markets more generally. This is the monetary policy role of the central bank. Chapter 10 examines this in detail.

Commercial banks, on the other hand, are profit-oriented businesses. They operate, as we

will see shortly, to maximize the profit they earn for their owners. To this end, they offer banking services to the public. Using the notes and deposits issued by the Bank of Canada as reserves, they issue bank deposits to their customers—which are widely used as the medium of exchange — and they make loans to finance purchases made by businesses and households.

To illustrate the business of these banks, Table 8.3 shows the consolidated balance sheet of Canadian chartered banks in July 2022. In the table we see that the banks held small cash balances as reserves against their deposit liabilities. Their other Canadian assets were mainly loans to households and businesses, including mortgage loans, and their holdings of financial securities. Because cash and many of their financial securities have high liquidity, banks can make long-term loans and still have cash and funds available if depositors withdraw their money.

Table 8.3: **Balance sheet of Canadian chartered banks, June 2022**

Assets	**$b**	**Liabilities**	**$b**
Cash	7.5	Personal deposits	1,348.7
Bank of Canada deposits	177.6	Non-personal deposits	1,286.9
Personal loans	572.9	Government of Canada deposits	3.0
Business loans	1,321.5	Total deposits	2,638.6
Mortgages	1,638.7	Other liabilities and equity	1,609.8
Other Canadian dollar assets	578.6		
Total Canadian dollar assets	4,296.8		
Net foreign currency assets	-48.4		
Total assets	4,248.4	**Total liabilities**	4,248.4

Source: Bank of Canada, Banking and Financial Statistics,
July 2022 (month end), and authors' calculations.
Figures have been rounded to one decimal place.

However, many loans to businesses and households are quite *illiquid*. The bank cannot easily get its money back in a hurry. This is not really a cause for concern when people and businesses have confidence in the banks and make widespread use of bank deposits as money. Payments and receipts are both in bank deposit form, which are cleared quickly and efficiently through the cheque-clearing and transfer facilities. Banks need only small cash

balances to cover the net clearings and net public demand for cash. In Table 8.3, the banks are holding only $7.5 billion against deposit liabilities of $2,638.6 billion. On the other hand, banks held a large quantity of deposits with the Bank of Canada in July 2022: $177.6 billion. This can be contrasted with deposits of about $250 million before the pandemic. Section 8.5 explores the reasons for this change in more detail.

Canadian banks also carry on important international banking operations, as do banks in many other countries. We see this business recorded on the balance sheet as foreign currency assets and liabilities. The foreign currency assets are mainly loans to customers and holdings of foreign financial securities. Foreign currency deposits of customers are the main foreign currency liabilities. These foreign currency operations are similar to the banks' domestic currency operations. The banks provide loan financing to customers needing foreign currency to make payments in other countries, and they provide deposit facilities for customers using foreign currency for international transactions.

Competition and co-operation are important to the efficient operation of the banking system. Banks compete among themselves for customer deposits and customer loans. Some of the competition for deposits is based on the location, convenience, and quality of bank branches, some on the offers of service packages including personal financial advice and wealth management, and some on the interest rates offered on deposit balances. If you watch media advertising, you are probably aware that some small banks like *Simplii Financial* and *Tangerine Bank* offer you a relatively high interest rate and will make no service charges if you put some of your funds on deposit with them. Success in attracting deposits is very important to size and growth of a bank's business.

Credit-worthy customers willing to borrow funds are equally important to a bank's operations. Interest income earned on customer loans is the major source of bank revenue. As a result, banks compete in the personal and business loan markets, using both the terms of loans and the interest rates charged on loans to attract borrowers. The market for mortgage

funds is one of the most competitive areas of bank operations. Mortgage rates and terms are advertised widely in the media and in displays in bank offices and even in supermarkets.

Despite this competition for deposits and loans, the banking system depends on the co-operation among banks that makes deposits the medium of exchange. Co-operation in the cheque-clearing system and the debit card *Interac* system are two important examples of banks working jointly to provide the payments system. A cheque book or a debit card is not very useful if it can make payments only to other people or businesses that do business with the same bank you use. Joint interests in *VISA* and *MASTERCARD* are a second important part of inter-bank co-operation that makes these cards widely acceptable as a source of credit.

There are also important areas of bank co-operation on the lending side of their operations. It often happens that businesses and industries have projects that need more financing than any one bank can or wants to provide. However, several banks might agree to provide funding jointly, increasing their lending capacity and spreading the risks associated with the project among them.

These dimensions of competition and co-operation among banks, and their contribution to the efficient functioning of the money and financial sector of the economy, appear whenever questions arise about bank mergers in Canada.

Banking operations and profits

A commercial bank is a profit-oriented business. Its profits come from the difference between what it costs it to raise funds and the revenues it earns from lending. To bring deposits in, the bank offers customers a range of banking services, including safekeeping, record keeping, access to banking offices or bank machines, chequing, internet banking, e-transfers and debit card facilities, and interest income on some types of deposits. Service charges or fees cover

the costs of some of these services. The interest payments to depositors are the main net cost of funds to the bank.

To be profitable, banks have to find ways to lend, at acceptable levels of risk, the funds they have attracted from depositors. Table 8.3 shows how banks lend their money. In Canadian dollars, most is lent to households and businesses at interest rates established for different types of personal, business, and mortgage lending. Some is used to buy government securities and other financial assets, usually with a short time to maturity. These assets pay a lower rate of interest than loans, but they are more liquid and provide the banks with funds if people decide to withdraw a lot of money from their deposit accounts. Notice that the banks also hold some cash (on which no interest is earned) and deposits with the Bank of Canada, in order to cover the day-to-day **clearing balances** that come from the withdrawals, deposits, and transfers made by their customers. For this reason, banks' deposits with the Bank of Canada are called *settlement balances*.

> **Clearing balances**: cash balances used by a bank to settle the differences between its customers' payments and receipts involving other banks.

Bank profits come from the difference or spread between the interest cost of raising funds from depositors and the interest income earned on bank assets. If, for example, the banks pay, on average, 4 percent on their deposit liabilities of all types and earn, on average, 6 percent on their assets of all types, their net interest income would be 2 percent. To take an actual example, the *Scotiabank Annual Report* for 2018 reports **net interest income** of 2.26 percent of average assets in 2018. The net interest income of *Scotiabank* was higher than the previous year as a result of asset growth in residential mortgages, consumer auto and commercial lending, which increased deposit to lending interest rate spreads. The other large banks report net interest income of the same order of magnitude but there are variations among them. The key to profitability is choosing the right mix of high-quality (low-risk) loans and investments while at the same time controlling the costs of raising funds.

Net interest income: the excess of loan interest earned over deposit interest paid.

As we saw in Table 8.3 Canadian banks held only $7.5 billion in cash and $177.6 billion in deposits with the Bank of Canada against $2,634.7 billion in personal and non-personal deposit liabilities. Their reserve assets in cash and deposits with the Bank of Canada were about 7 percent of their total deposits. The skill in running a bank entails being able to judge just how much must be held in liquid assets, including cash, and how much can be lent out in less liquid forms that earn higher interest income. The profit motive pushes the bank toward riskier, higher interest paying assets and higher net interest income. **Banker's risk**, the risk that a large number of customers will simulataneously withdraw their deposits and demand cash, pushes the bank toward holding higher cash balances. But cash balances earn no interest income and reduce the bank's net interest income.

Bankers risk: the risk that a large number of customers may simultaneously demand cash for their deposits.

8.4 Money created by banks

Banks *create money* when they increase their deposit liabilities to pay for the loans they make to customers, or for the financial securities they buy. The public uses the deposit liabilities of the banks as money to make payments or to hold as a store of wealth. There are four key conditions that give banks the ability to create money.

1. The non-bank public has confidence in banks and is willing to hold and use bank deposits as money.

2. The non-bank public is willing to borrow from the banks to finance expenditure or asset purchases.

3. The banks are willing to operate with reserves assets, cash and deposits with the central bank, equal to some small fraction of their deposit liabilities.

4. The banks are willing to accept the risks involved in lending to the non-bank public.

If any of these is absent, the banks cannot create money, although they may provide safe-keeping services.

The first two conditions underlie the demand for banking services. Banks acquire cash by providing customers deposit services and bank customers use bank loans as a source for funds to pay for purchases of goods, services and financial assets like equities and bonds. If the non-bank public is unwilling to use bank services there is no banking industry.

The third condition required for the banks to create money is a bank reserve ratio that is less than one. The **reserve ratio** (rr) is the ratio of reserve assets (cash on hand plus deposits with the Bank of Canada) to deposit liabilities that banks choose to hold.

$$\text{rr} = \frac{\text{reserve assets}}{\text{deposit liabilities}} \tag{8.1}$$

Reserve ratio: the ratio of cash reserves to deposit liabilities held by banks.

If banks choose to hold reserves equal to their deposit liabilities, rr = 1 and the banks cannot create deposits. They are simple safety deposit boxes.

We can use a simplified case to show how banks can create deposits. Consider the simplified balance sheet of a bank which initially has $2,000 in reserve assets (cash plus settlement balances), $8,000 in loans, and $10,000 in deposit liabilities. Its initial situation is given by the first simplified balance sheet in Figure 8.4 below.

Table 8.4: Creation of money by a bank

Initial Balance Sheet	
$2,000 (Reserves)	$10,000 (Deposits)
$8,000 (Loans)	

Final Balance Sheet	
$200 (Reserves)	$10,200 (Deposits)
$8,200 (Loans)	

As long as the bank considers the initial $2,000 in reserves to be more than sufficient to cover its banker's risk (the fourth condition required for banks to create money), it is free to extend new loans without increasing the size of its reserve holdings. Suppose that it finds a profitable opportunity to make a $200 loan to a business or to a household. The amount of loans on its books increases by $200. The recipient of the loan receives a $200 credit to their bank account, which increases the amount of the bank's deposit liabilities.

The money supply increases by $200. The recipient of the loan, whether a household or a business, likely sought the loan in order to purchase a consumption good or an investment good. If so, they will pay for the purchase by transferring funds (either electronically or by cheque) to the seller. The bank's deposits and reserve assets will decrease by $200, but deposits and reserve assets at another bank or banks will increase by the same amount. Deposits can circulate among different financial institutions, but the aggregate amount of money in circulation increases by $200.

Financial panics

Most people know that banks operate with fractional reserve ratios and are not concerned. But if people begin to suspect that a bank has lent too much, made high risk loans or faces problems in raising funds which would make it difficult to meet depositors' claims for cash,

there would be a *run on the bank* and a **financial panic**. Recognizing the bank cannot repay all depositors immediately, you try to get your money out first while the bank can still pay. Since everyone does the same thing, they ensure that the bank is unable to pay. It holds cash equal to a small percentage of its deposit liabilities and will be unable to liquidate its loans in time to meet the demands for cash.

> **Financial panic**: a loss of confidence in banks and a rush to withdraw cash.

Banking problems in Greece in the spring and early summer of 2015 provide an example. Concerns that the Greek government might default on loan payment agreements with IMF and European Union raised the possibility that Greece might leave the euro and return to its earlier national currency: the drachma. Should that happen, all euro deposits in Greek banks would convert to drachmas at an exchange rate that would reduce their real value substantially. Fearing this possibility, depositors in Greek banks tried to withdraw their balances in cash while they were still redeemable in euros.

Greek banks, like other banks, operate on a fractional reserve basis. They could not meet this 'run on the bank' without outside support and assistance. The European Central Bank provided emergency cash to the banks but the run continued. In response, limits were placed on the amount of cash a depositor could withdraw at any one time. These measures sustained the banks until a solution to Greek debt crisis was negotiated and immediate concerns about Greek membership in the euro and the value of Greek bank deposits subsided.

However, earlier experience shows how financial crises can arise in other ways. In 2008-2009 the crisis originated in the US mortgage market and real estate sector and caused wide spread problems for banks. Many banks had become reliant on large denomination, short-term deposits as sources of funds to support their mortgage lending. Other non-bank financial institutions like insurance companies and pension funds, as well as a relatively small number of individual customers bought these deposits. As the recession and falling property values emerged, the financial community began to worry that home-owners would not be

able to pay back their mortgages.

If that happened banks would not be able to pay back depositors money, especially the large denomination short-term deposits. Once non-bank portfolio managers realized that it was difficult if not impossible to evaluate the risks of large denomination deposits, financial institutions that relied on renewing and issuing new deposits to raise funds were in difficulties. The supply of funds to replace expiring deposits dried up and banks could not repay depositors. Several large financial institutions in the United States and in other countries required government rescues or failed. The plight of famous names like *Bear Sterns*, *Countrywide Financial*, *Fannie May*, and *Freddie Mac* became headline news.

Banks in Canada were not immune to the financial difficulties created by the collapse of the large denomination deposit markets. All the major chartered banks were holding some. They were forced to accept that without a market these deposits would no longer be a source of funds. Fortunately, Canadian banks relied more heavily on strong smaller retail depositor bases as sources of funds. The banks remained financially strong and public confidence in the banks did not collapse. No Canadian bank failed or required a government bailout.

Fortunately, financial panics involving depositor runs on the bank are rare, particularly in Canada. A key reason for this, which we discuss in the next chapter, is that the central bank, the Bank of Canada, and other national central banks, will lend cash to banks in temporary difficulties. Furthermore, deposit insurance plans like the *Canadian Deposit Insurance Corporation* (CDIC) cover individual bank deposits up to $100,000 against default. Knowledge of these institutional arrangements helps prevent a self-fulfilling stampede to withdraw deposits before the bank runs out of cash.

By contrast, the financial crisis and the extended real estate and credit collapse in 2008 created large problems for US banks. Loan and financial asset defaults destroyed bank assets and bank liquidity. Even in the absence of panics and bank runs, many banks became

insolvent without sufficient liquid assets to cover their liabilities. Failed bank data illustrates the scale of the problem. The US *Federal Deposit Insurance Corporation* lists 457 US bank failures over the period January 2008 to September 2012. In the four preceding years, January 2004 to December 2007 there were just 7 US bank failures. More stable conditions similar to those before 2008 have returned. The most recent bank failure list reports 8 bank failures in 2017, 0 in 2018, and just 1 as of May 2019. [⇐ Update. XX]

8.5 The monetary base and the money supply

Table 8.1 showed that bank deposits are the major component of the money supply in Canada. This also is the case in most industrial countries. Bank deposits depend in turn on the cash balances held by banks as well as their deposits at the central bank, and on the public's willingness to hold bank deposits and borrow from the banks.

Until 1992 Canadian banks were required to hold reserves in the form of deposits with the Bank of Canada which were equal to a fraction of their deposits, the *required reserve ratio*. Since these deposits carried a zero rate of interest, banks had a very strong incentive not to hold reserve in excess of the required minimum.

In such a system, when the central bank creates additional reserves by purchasing assets from banks and paying for them by crediting banks' deposit accounts with the central bank, banks have a strong incentive to increase loans and deposits in order to reduce the amount of excess reserves to zero: they can make a positive return on loans instead of a zero rate of return on their excess reserves. There was a fairly stable and predictable **money multiplier**, the ratio of one of the broad measures of the money supply to the monetary base. This money multiplier depended on the required reserve ratio.

> **Money multiplier**: the ratio of a broad measure of the money supply (such as M2++ to the monetary base, M0.)

With the abolition of required reserves in 1992 this stable relationship no longer holds. It has varied depending on economic circumstances. Figure 8.1 below shows the evolution of the money multiplier since 1985 (using M2++ as the definition). It shows that the money multiplier has been highly variable since 1992 and plummeted during the pandemic recession.

[Figure 8.1 here. Use M2++ and the longest time series available since 1985. Use a placeholder for now.]

Figure 8.1: **The market for settlement balances**

The figure shows, using quarterly data, the evolution of the money multiplier in Canada since 1990. From Statistics Canada, Chartered bank assets and liabilities and monetary aggregates, month-end, seasonally adjusted, Bank of Canada, available here.

Even if there has been no reserve requirement since 1992, banks wish to hold settlement balances. Historically, they have banded together to form associations, or clearinghouses, a convenient place for bankers to make payments among each other over the course of the business day. To facilitate these payments, clearinghouses have often issued short-term deposits to their members. A deposit provides clearinghouse services. Keeping a small buffer stock of clearinghouse deposits can be useful to a banker in case they need to make unexpected payments to other banks.

More recently, governments and central banks have almost completely monopolized the clearinghouse function. So when a Canadian bank wants to increase its buffer of clearinghouse balances, it has no choice but to select the Bank of Canada's clearing product for that purpose. Monopolization hasn't only occurred in Canada of course, almost every government has taken over their nation's clearinghouse.

All major banks hold deposits with the Bank of Canada in order to facilitate payments with each other. When an *individual a* makes a payment using an account in Bank A to an *individual b* with an account in Bank B, the payment is *settled* in the following manner. *Individual a*'s account at *Bank A* is debited, and *individual b*'s account at *Bank B* is credited. Deposits are liabilities from a bank's point of view. A basic principle in accounting is that any change in liabilities must correspond to an equal change on the asset side of a bank's balance sheet. In this case, *Bank A*'s account with the Bank of Canada is debited and *Bank B*'s account with the Bank of Canada is credited. For this reason, banks' deposits with the Bank of Canada are called **settlement balances**.

> **Settlement balances**: deposits held by banks and other major financial institutions with the Bank of Canada.

Table 8.4 below shows the change in the balance sheets of *Bank A* and *Bank B* when *individual a* transfers $100 to *individual b*.

Table 8.5: **Balance sheet changes**

Bank A		**Bank B**	
Assets	**Liabilities**	**Assets**	**Liabilities**
-$100	-$100	+$100	+$100
(settlement balances)	(deposits)	(settlement balances)	(deposits)

Individual a with an account at *Bank A* transfers $100 to *individual b* with an account at *Bank B*.

All major banks and financial institutions hold settlement balances with the Bank of Canada. Some banks find themselves with fewer settlement balances than they require to meet their need for liquidity while other banks find themselves with a surplus of settlement balances. This has led to the development of an active **overnight market** in which banks with surplus settlement balances can lend to banks with shortages. Demand for settlement balances in this market is a decreasing function of the **overnight rate**.

Overnight market: a market in which banks and other financial institutions lend and borrow liquid assets (in the form of settlement balances).

Overnight rate: the rate of interest at which banks lend to other banks in the overnight market.

The Bank of Canada uses the overnight market as the means to conduct its monetary policy by setting a **Bank Rate** (the rate of interest at which banks can borrow funds from the Bank of Canada itself), an **Overnight Rate Target**, and a **Deposit Rate**.

Bank Rate: the interest rate, set by the Bank of Canada, at which banks and other financial institutions can borrow directly from the Bank.

Overnight rate target: the overnight rate targeted by the Bank of Canada.

Deposit Rate: the interest rate, set by the Bank of Canada, paid to banks for holding settlement balances.

Figure 8.2 illustrates how this market operates. When the overnight rate is at or above the Bank Rate, banks would prefer to borrow from the Bank of Canada than another bank, and the demand for funds in the overnight market drops to zero. When the overnight rate is at or below the Deposit Rate, banks can earn a higher rate of return by holding onto their settlement balances instead of lending them out on the overnight market, and the demand for settlement balances increases without limit.[3]

[3]This presupposes that the Deposit Rate yields a better return, once adjusted for administrative costs and risk, than other possible assets such as loans and government bonds.

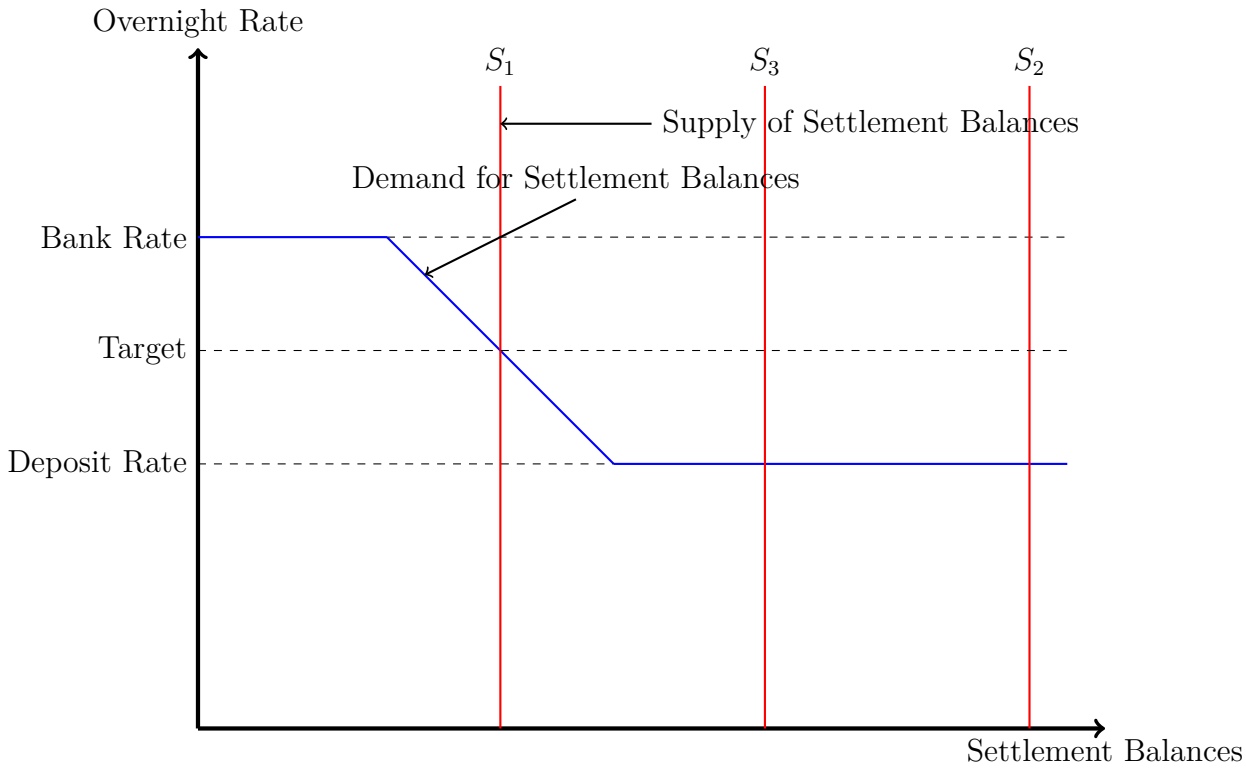


Figure 8.2: **The operation of the overnight market**

By controlling the overall supply of settlement balances, the Bank of Canada can control the equilibrium interest rate in the overnight market (the interest rate that makes supply equal demand). As long as it supplies a quantity of settlement balances that intersects the downward-sloping part of the demand curve in Figure 8.2, the equilibrium overnight rate will be between the Bank Rate and the Deposit Rate.

The Bank of Canada controls the supply of settlement balances by engaging in **open market operations**, which are sales or purchases of securities (usually government bonds, but also other types of assets). When it purchases securities from banks, it pays for them by crediting the selling banks' accounts with it, so the supply of settlement balances increases.

Traditionally, the Bank of Canada has set a target for the overnight rate which is 25 basis

point (0.25 percent) below its Bank Rate and 25 basis points above the Deposit Rate. By controlling this particular interest rate, it affects all other short-term interest rates. It controls the overnight rate by using open market operations to affect the supply of settlement balances. Expectations of the Bank of Canada's future settings of the overnight rate target also influence longer-term interest rates and rates of return.

At the beginning of the pandemic (March 2020), the Bank of Canada started buying massive amounts of federal government and other types of bonds in order to calm financial markets and to prevent a financial panic of the type discussed in Section 8.4, paying for them by crediting banks' settlement balances. Instead of a supply curve like S_1 in Figure 8.2, the supply curve shifted far to the right to a point like S_2. Settlement balance were so plentiful that it had to set the target overnight rate equal to the Deposit Rate. Both were equal to 25 basis points, which the Bank of Canada considers to be an effective lower bound for the overnight rate, from March 2020 until March 2022.

Because the supply of settlement balances was so plentiful, most banks have no need to borrow more settlement balances, and are content to keep the balances they have on deposit and earn the Deposit Rate.

Because other interest rates were very low, and because the demand for loans by households and businesses was quite weak, banks were willing to accumulate large amounts of settlement balances without expanding their loans and deposits. The money supply grew quickly during the pandemic, but not nearly as quickly as the monetary base.

The current system, in which banks and other financial institutions are paid a positive rate of return (the Deposit Rate) to hold settlement balances, and in which settlement balances are abundant, is called a **floor system**.

Floor system: a system in which the central bank creates a large amount of reserves (settlement balances) by purchasing government bonds from banks and pays interest on those reserves, so that banks are willing to hold them. The interest rate paid on those reserves is the floor of the system.

Paying interest on settlement balances effectively removes the opportunity cost of holding them, as long as the interest rate banks can earn on loans and other assets is low enough. Banks willingly hold all of the settlement balances the central bank supplies. The amount of settlement balances increased from approximately $250 million to a maximum of almost $387 billion in February 2021, an increase of over 150,000 percent.

Because the supply of settlement balances is very plentiful when the central bank operates under a floor system, almost all banks have more reserves than they need for settlement and liquidity purposes. The overnight market essentially disappears.[4] In these conditions, a lack of reserves is no longer an impediment to banks wishing to lend more. The size of the money supply is limited, not by the supply of reserves, but rather by the demand for loans for investment projects judged by banks to be profitable.

Conclusions

This chapter has looked at the definition and characteristics of money and how money is created by the central bank and the banking system, including the relationship between the monetary base and the money supply. Chapter 10 will look in more detail at the mechanics of monetary policy and the role of money in transmitting the effects of the central bank's monetary policy.

[4]Some smaller Canadian financial institutions do not hold settlement balances on deposit with the Bank of Canada, so an overnight market with a much smaller volume of transactions continued to operate.

KEY CONCEPTS

- **Money**: money has four functions: a **medium of exchange** or means of payment, a **store of value**, a **unit of account**, and a **standard of deferred payment**. The medium of exchange function distinguishes money from other assets. Money, a medium of exchange, reduces the costs of exchange and allows resources to be used for other things.
- **Barter economy**: an economy where goods are exchanged without the use of money as a medium of exchange. Trading is costly because there must be a double coincidence of wants.
- **Commodity money**:
- **Token money**: a convertible claim on commodity money. Because its monetary value greatly exceeds its production costs, token money economizes on the resource costs of transactions.
- **Legal tender**: money that by law must be accepted as a means of payment, consisting primarily of notes and coins.
- **Fiat money**: money the government has declared legal tender. The central bank controls the supply of legal tender.
- **Fintech**: application of computer and internet technologies to facilitate the flow of payments and financial information.
- **E-payments** use debit cards, telephone banking, internet banking, e-transfers, and mobile banking, which provide access to manage deposit accounts and make payments.

- **E-monies**: multi-purpose pre-paid payment cards, and stored-value cards and gift cards for purchases at specific companies.
- **Cryptocurrencies**: a form of decentralized e-money. They are financial assets but have no centralized issuer. Often they are not denominated in any national currency (with the exception of *stablecoins*). They are not money in that they do not serve as a *generally accepted* means of payment. *Bitcoin* and *Ethereum* are examples.
- **Stablecoins**: a type of cryptocurrency whose values are fixed in terms of a national fiat money.
- **The Canadian money supply**: the sum of currency in circulation outside the banks and bank deposits. Broader and broader measures of the money supply include increasingly less liquid forms of assets.
- **Liquidity**: the cost, speed, and certainty with which asset values can be converted into cash.
- **Monetary base**: comprised of notes and coins in circulation plus deposits held by banks (and other financial insitutions) with the central bank. The monetary base is directly a liability of the central bank.
- **Settlement balances**: deposits held by banks and other financial institutions with the Bank of Canada.
- **Financial intermediary**: a business that specializes in bringing borrowers and lenders together. It attracts deposits from savers by offering services and paying interest. It uses these funds to make loans to borrowers.
- **Bank of Canada**: Canada's central bank.

- **Net interest income**: the excess of loan interest earned over deposit interest paid.
- **Bankers risk**: the risk that a large number of customers may simultaneously demand cash for their deposits.
- **Financial panic**: a loss of confidence in banks and a rush to withdraw cash.
- **Money multiplier**: the ratio of a broad measure of the money supply, such as M2++, to the monetary base, M0.
- **Settlement balances**: deposits held by banks and other major financial institutions with the Bank of Canada.
- **Overnight market**: a market in which banks and other financial institutions lend and borrow liquid assets (in the form of settlement balances).
- **Overnight rate**: the rate of interest at which banks lend to other banks in the overnight market.
- **Bank Rate**: the interest rate, set by the Bank of Canada, at which banks and other financial institutions can borrow directly from the Bank.
- **Overnight rate target**: the overnight rate targeted by the Bank of Canada.
- **Deposit Rate**: the interest rate, set by the Bank of Canada, paid to banks for holding settlement balances.
- **Floor system**: a system in which the central bank creates a large amount of reserves (settlement balances) by purchasing government bonds from banks and pays interest on those reserves, so that banks are willing to hold them. The interest rate paid on those reserves is the floor of the system.

Exercises for Chapter 8

Exercise 8.1

What are the functions of money? What is money in Canada today? What is the money supply in Canada today? Are debit cards and credit cards money?

Exercise 8.2

Since both central banks and commercial banks can create money what is the key difference between a central bank, like the Bank of Canada, and the many commercial banks in the financial industry?

Exercise 8.3

Chapter 9

Financial markets, interest rates, foreign exchange rates and AD

In this chapter we will explore the following topics.

- 9.1 Portfolio choices between money and other assets
- 9.2 The demand for money balances
- 9.3 Financial market equilibrium and interest rates
- 9.4 Foreign exchange rates
- 9.5 Interest rates, exchange rates, and aggregate demand
- 9.6 The monetary transmission mechanism

Interest rates are everywhere. They provide income to lenders and impose costs on borrowers. Many types of bank and near-bank deposits pay interest income to their holders, as do

guaranteed investment certificates (GICs) and bonds issued by businesses and governments and other income paying assets. These are assets to holders and liabilities to issuers in terms of interest payments and repayments of princial.

Households, businesses and governments borrow using consumer loans, credit cards, lines of credit, mortgages, leases, bonds and other forms of debt. The interest rate attached to these borrowings is a cost of financing expenditures not covered by current income.

The interest rate links financial markets to markets for goods and services. But what is "the interest rate"? There are different interest rates attached to different forms of borrowing. There are different spectra of interest rates based on the terms of the loan and the perceived risk of default. However, it is usually the case that interest rates across a spectrum rise or fall together. Changes in "the interest rate" describe these shifts up or down across the spectrum for all assets.

This chapter addresses two key questions:

1. How is the interest rate determined?

2. How does the interest rate affect aggregate demand?

Explaining why the public decides to hold some wealth in money balances rather than other types of financial assets is the first step.

9.1 Portfolio choices between money and other assets

A **financial portfolio** is a collection of financial assets. It might include money balances, bonds, equities, mortgages, and mutual funds. The structure of a portfolio, the proportion held in each type of asset, reflects two main characteristics of the assets involved:

1. the returns paid by different financial assets; and

2. the risks arising from changes in the market prices of assets.

> **Financial portfolio**: a mixed holding of money and other financial assets such as bonds and equities, structured in order to balance expected return and risk.

Wealth holders and institutional portfolio managers for pension funds and insurance companies like their portfolios to pay high returns with low risk. To achieve this, they hold mixed portfolios of money and other financial assets.

Suppose you win $10 million in a lottery. Now that you have wealth, what are you going to do with it? You will no doubt spend some and give some away. That is a wealth effect, but what about the balance of your winnings? You have to make a portfolio choice. Will you hold your wealth as money in the bank? Will you put your money in the stock market? Will you put your money in the bond market? Will you buy bitcoin?

If you consult a financial planner, he or she will probably recommend a mixed portfolio made up of money, bonds, and equities. That recommendation will be based on your intention to increase your wealth and draw income from it while protecting it from losses in financial markets.

Money holdings are an important part of the portfolio. Money is the medium of exchange. It can be used directly to make payments for goods and services or to settle debts. Other assets, for example bonds, cannot be used as a means of payment. Furthermore, money has a fixed nominal price. It is a "safe asset." Wealth held as money does not rise or fall with the rise or fall in financial asset prices on stock and bond markets. However, money is exposed to the risk that inflation will lower its real purchasing power.

Other financial assets differ from money in three respects. First, they cannot be used as a means of payment. To use them to make a payment you would first have to sell them for

money, at their current market price, and then use the money to make the payment. Second, they offer a return in the form of an interest payment, a dividend payment, or a rise in price that provides income to the portfolio holder. Third, because the prices of financial assets like bonds or stocks fluctuate daily on financial markets, these assets carry the risk that their values may decline significantly from time to time.

Portfolio management recognizes these differences between assets by trading some return for lower risk and greater convenience in the mix of assets held. Money in the portfolio offers the convenience of the means of payment, providing low risk but zero return. Other assets offer a flow of interest and dividend income, and possible capital gains if asset prices rise, but the risk of capital loss if prices fall.

Movements in the S&P TSX, an index of the value of approximately 250 companies, in the first quarter of 2020 illustrates the risks in holding equities rather than cash. The index stood at 17,099 at the beginning of January 2020. Then, as a result of the economic impact of COVID-19, it dropped to 11,228 by late March 2020, a capital loss of about 34 percent. It then recovered to 14,967 on May 8, 2020, a capital gain of 33 percent from the low in March but still 12.5 percent below its January value. If you had held a portfolio of cash or bonds instead of equities you would have avoided all this excitement.

This portfolio choice between money balances and other assets is the basis for our discussion of the demand for money balances in the remainder of this chapter.

Bond prices, yields and interest rates

The demand for money comes from an understanding of the relationship between interest rates, bond coupons, the prices of financial assets, and yields on financial assets. To keep the examples simple assume only one type of financial asset, a bond. However, the prices and yields of other financial assets are related to interest rates in the same way as bond prices.

Several basic concepts and definitions are important. A **bond** is an asset that makes one or more *fixed money payments* to its holder each year until its maturity date. On its maturity date, it also repays its principal value. Governments and businesses issue and sell bonds on financial markets to raise funds to finance expenditures.

> **Bond**: a financial contract that makes one or more fixed money payments at specific dates in the future.

The **interest rate** is the current market rate, expressed as a percentage, paid to lenders or charged to borrowers.

> **Interest rate**: the current market rate paid to lenders or charged to borrowers.

A **bond coupon** is the *fixed money payment* made annually to the holders of the bond from the date of issue until the date of maturity. The coupon rate is a fixed percentage of the principal value of the bond at the time of issue. For example a 3 percent bond pays $3.00 annually per $100 of principal until its maturity date.

> **Bond coupon**: the annual fixed money payment paid to a bond holder.

The **price of a marketable bond** is the current price at which it can be bought or sold on the open bond market at any time between its date of issue and its maturity date.

> **Price of a marketable bond**: the current price at which the bond trades in the bond market.

The **yield on a bond** is the return to a bond holder expressed as an annual percentage rate, which is a combination of the coupon payments and any change in the market price of the bond during the period in which it is held.

Yield on a bond: the return to a bond holder expressed as an annual percentage.

Bond prices depend on current market interest rates. The **current price of a bond** is the present value of the future payments it will provide. The **present value** is found by **discounting** those future payments. Discounting is the process of converting a value received in a future time period to an equivalent value received immediately.It recognizes that money payments in the future are worth less than money payments today.

Bond price: the present value of future payments of interest and principal.

Present value: the *discounted value* of future payments.

Discounting: the process of converting a value received in a future time period to an equivalent value received immediately.

To help understand present value, ask the following question. If someone promises to give you \$1,000, would you rather have it today or a year from today? Notice that \$1,000 lent at an interest rate of 3 percent (i.e. $3/100 = 0.03$) would give you a sum at the end of the year equal to

$$\$1,000 \times (1 + \text{the interest rate}) = \$1,000 \times 1.03 = \$1,030.$$

In the same way, the amount of money you need to lend today to have \$1,000 one year from today is given by solving the following equation for M.

$$M \times 1.03 = \$1,000$$

which gives

$$M = \frac{\$1,000}{1.03} = \$970.87.$$

When the market rate of interest is 3 percent, the present value of $1,000 to be received one year from now is $970.87.

Experimenting with different interest rate assumptions in this present value calculation illustrates that the present value of $1,000 to be paid one year from today changes with the rate of interest. Higher interest rates reduce present values while lower rates increase them. For example, if the current market rate is 5 percent the present value of $1,000 to be received one year from today is

$$M = \frac{\$1,000}{1.05} = \$952.38.$$

This relationship is the key to understanding bond prices and how they fluctuate over time. A rise in market interest rates lowers the present value of fixed future payments. A fall in market rates increases present values of fixed future payments.

In general, because the future payments offered by bonds are fixed in dollar terms, the prices of marketable bonds vary inversely to market rates of interest. Rising interest rates mean falling bond prices, and falling interest rates mean rising bond prices. There are many types of bonds that differ by coupon, maturity date, frequency of future payments, and in other ways. However, the relationship between prices, yields, and interest rates remains the same. Because bond prices are the present value of future payments, prices and interest rates move in opposite directions.

Furthermore, the size of the change in the price of a bond as a result of a change in the interest rate depends on the bond's term to maturity. The prices of longer-term bonds are more volatile than those of shorter-term bonds. This an important consideration for bond portfolio managers concerned with trade-offs between risk and return.

Asset markets like the bond market are very active. Large volumes of bonds are bought and sold every business day. Example Box 9.1 below gives a more detailed example of the relationship between market interest rates, bond prices and yields to maturity. You

can see the recent movements in yields on Canadian government bonds issued with different terms to maturity and coupon yields at: https://www.rbcdirectinvesting.com/pricing/gic-bond-rates.html

Example Box 9.1: Bond prices and interest rates

Consider the price of the 4.25 percent bond with a maturity date of June 1, 2023 and a principal of $100 to be reimbursed at maturity. Let's assume that the 3 year market rate of interest on the date you buy the bond, say June 1, 2020 is 4.25 percent. The price of the bond is the present value of the future payments: $4.25 on June 1, 2021, $4.25 on June 1, 2022, and $104.25 on June 1, 2023. Payments to be received two years in the future are discounted twice, and three years in the future three times, to give

$$\text{PV} = \frac{\$4.25}{1.0425} + \frac{\$4.25}{1.0425^2} + \frac{\$104.25}{1.0425^3} = \$4.076 + \$3.911 + \$92.013 = \$100.00.$$

A bond bought for $100 and held to maturity would yield 4.25 percent, the current market rate of interest assumed in this example. The bond is trading at par because the market price equals the face value.

As an alternative assume that the 3 year market rate of interest on June 1, 2020 is 1.75 percent. The price of the bond is then the present value of the future payments: $4.25 on June 1, 2021, $4.25 on June 1, 2022, and $104.25 on June 1, 2023. Payments to be received two years in the future are discounted twice, and three years in the future three times, to give

$$\text{PV} = \frac{\$4.25}{1.0175} + \frac{\$4.25}{1.0175^2} + \frac{\$104.25}{1.0175^3} = \$4.076 + \$3.911 + \$92.013 = \$107.26.$$

The price of this 4.25 percent bond on June 1, 2020 would be $107.26 per $100 of face value (principal). The assumption that the market rate of interest is 1.75 percent, which is clearly lower than the 4.25 percent coupon on the bond, means the bond trades at a premium. The premium price means that buying the bond and holding it to its maturity date will give an annualized return of 1.75 percent on your money. That is the then current assumed 3 year rate.

Taking account of the changes in bond prices as market interest rates change, the **yield on the bond** — the present value of its coupon payment plus the **capital loss** as its price falls to par at maturity — gives a rate of return equal to the market interest rate of 1.75 percent.

9.2 The demand for money balances

Canadians held M2 money balances of $1,716 billion in May 2019. Three variables that may explain the size of these holdings are: the interest rate, the price level, and real income. Together they provide the basis for a theory of the demand for money.

Why hold money?

It is important to distinguish between money and income when discussing the demand for money. You might have a high income but no money, or no income and lots of money. That is because income is a flow of funds over a period of time. If you spend your income as it is received you will not accumulate a *stock of money*. Alternatively, you might have a stock of money or a money balance but no income. Then you can choose to either hold or spend your money. If you have no income you can finance a flow of expenditures by spending your

money balance.

Chapter 8 discussed money as a means of payment and a store of value. Those two functions motivate the demand to hold at least some wealth in money balances. There are alternative stores of value. Bonds, equities, precious metals, real estate, and art are a few examples. The quantity of money people choose to hold is part of the *portfolio decision* they make about their wealth. They choose money instead of some other asset.

To develop an analysis of the demand for money balances it is useful to simplify the portfolio decisions by assuming there are only two assets:

1. *money*, which has a constant money price, pays no interest income but does serve as the means of payment; and

2. *bonds*, representing all interest-earnings assets, have money prices that change if market interest rates change, but are not means of payment.

The financial wealth people build up by saving some of their income calls for a decision. People could hold this wealth as money, which pays no interest, but is a safe asset because its price is constant. Or they could hold this wealth in bonds, which pay interest income but are risky because bond prices move up and down as market interest rates move down and up. If the expected return to holding bonds is positive (due to the interest rate together with any change in price) why would people hold any money balances?

The demand for money comes in three parts, namely:

1. the transactions demand;

2. the precautionary demand; and

3. the asset or speculative demand.

The transactions demand

As the name suggests, the transactions demand for money is based on money being the means of payment. People and businesses hold some money to pay for their purchases of goods, services and assets. This demand reflects the lack of coordination of receipts and payments. Income is paid bi-weekly or monthly but purchases are made more frequently and in smaller amounts. Pocket money and bank balances that can be transferred by debit card are readily available to make these purchases between paydays. If all income receipts were used on paydays to buy bonds to earn interest income it would be costly and inconvenient to sell bond holdings bit by bit as payments were made. The costs of frequent switching between money, bonds and money would more than offset any interest income earned from very-short-term bond holdings.

The precautionary demand

Uncertainty about the timing of receipts and payments creates a precautionary demand for money balances. There are two sides to this uncertainty. On one side there may be some unexpected changes in the timing or size of income receipts. Regular payments can still be made if enough money is available, over and above that need for usual expenses and payments. Alternatively, unexpected or emergency expenses in terms of appliance, computer or car breakdowns or unexpected opportunities for bargains or travel can by covered by precautionary money holdings. Money balances cover the unexpected gaps between income receipts and payment requirements without the costs and inconvenience of selling bonds on short notice.

The asset or speculative demand

The asset or speculative demand for money comes from financial portfolio decisions rather than the lack of coordination and uncertainty behind the two preceding demands. Businesses and professional portfolio managers use money balances to take advantage of expected changes in interest rates. Essentially they speculate by switching between bonds and money based on their own forecasts of future interest rates.

Recall that bond prices and interest rates vary inversely. If while holding money balances you predict a fall in interest rates, you buy bonds. If your prediction is right and interest rates do fall, the prices of your bonds rise. Now you can sell and harvest the capital gain you earned by speculating in the bond market. Alternatively, if you correctly predict a rise in interest rates and act before it happens you can avoid a capital loss on your bond holdings by selling and holding money before the interest rate rises.

Even if portfolio managers are not interested in speculating on interest rate changes there is an asset demand for money. A mixed portfolio of money and bonds is less risky than one that holds only bonds. The money component has a stable market price while the bond component provides interest income along with the risk of a variable price. Changing the shares of money and bonds in the portfolio allows the manager a trade-off between return and risk. However, as interest rates rise, the opportunity cost of holding a share of the portfolio in money rises. Furthermore, the estimated risk from the bond share of the portfolio may fall if interest rates are expected to fall in the near future. As a result, rising interest rates reduce the asset demand for money balances.

The demand for money function

The demand for money balances can be summarized by a simple equation. Let the size of the real money balances people wish to hold for transactions and precautionary reasons (L_t) be a fraction k of GDP. With nominal GDP defined as real GDP (Y) times the GDP deflator (P), nominal GDP = PY. Using this notation, the demand for nominal money balances for transactions and precautionary reasons is kPY, and the demand for real balances is kY, where k is a positive fraction. When real income changes, bringing with it changes in spending, the change in the demand for real money balances changes is determined by k. This makes a link between part of the demand for money balances (L_t) and income, namely $L_t = kY$.

What is the value of k in Canada? In the second quarter of 2019, Canadians held money balances as measured by M2 of about $1,716 billion. Nominal GDP in that quarter was $2,250 billion measured at an annual rate. If we divide M2 holdings by GDP, we get $k = \frac{\$1,716}{\$2,250} = 0.76$, or about 76 percent of annual income. This value of k suggests that a rise in GDP of $100 will increase the demand for money balances by $76, measured in either nominal or real terms.

Changes in nominal interest rates also change the size of the money balances people wish to hold, based on the asset motive. A rise in interest rates increases the opportunity cost of holding money balances rather than bonds. It may also create the expectation that interest rates in the future will fall back to previous levels. As a result, people will want to use some of their money balances to buy bonds, changing the mix of money and bonds in their wealth holdings. A fall in interest rates has the opposite effect.

The way people adjust their portfolios in response to changes in interest rates results in a negative relationship between the asset demand for money balances and the nominal interest rate. Then, using $-h$ to measure the change in money balances in response to a change in

interest rates, this can be written as $-h = \frac{\Delta L}{\Delta i}$. If individual and institutional portfolio mangers' decisions are very sensitive to the current interest rates, h will be a large negative number. A small rise in interest rates will cause a large shift from money to bonds. Alternatively, if portfolio decisions are not at all sensitive to interest rate changes, h would be zero.

Putting these components of the demand for real money balances together gives the demand for money function, which is a demand to hold real money balances L:

$$\text{Money demand} = \text{precautionary and transactions demand based on income}\,(kY)$$

$$+\ \text{asset demand based on interest rates}\,(-hi)\,,$$

which can be written as

$$L = kY - hi.$$

Figure 9.1 shows the relationship between the demand for real money balances and the interest rate, drawn for a given level of real GDP, Y_0. The demand for money function would have an intercept of kY_0 on the horizontal axis. At higher interest rates the opportunity cost of holding money balances is higher because the expected return from holding bonds is positive. The negative slope of the demand function shows how people change their demand for money when interest rates change. The slope of the demand curve for money is $-1/h$. The effect of a change in the interest rate is shown by a movement along the L function. A change in real income would require us to draw a new demand for money function, to the right of L_0 if Y increased, or to the left if Y decreased.

[Figure 9.1 about here. XX]

This straight line demand for money function is a useful simplification. However, it would be more realistic to draw the function with a decreasing slope as interest rates decline. That

would capture two important ideas.

1. First, as interest rates fall, and fall relative to the costs of buying and selling bonds, opportunity costs decline faster than interest rates.

2. Second, consider the speculative demand for money. As interest rates fall, the riskiness of bonds increases. A subsequent rise in interest rates has a larger negative effect on bond prices. Expectations of future increases in interest rates may strengthen as interest rates decline. As a result, portfolio managers may shift funds increasingly from bonds to money as interests fall. If their expectations are confirmed by events they avoid the capital losses caused by falling bond prices.

9.3 Financial market equilibrium and interest rates

The money supply and the demand for money in the financial market determine nominal interest rates. From Chapter 8, a nominal money supply depends primarily on the monetary base and the money multiplier, namely

$$M = \frac{1}{rr} \times MB.$$

The demand for money is a demand for real money balances as determined by real income and interest rates:

$$L = kY - hi.$$

Here, k and h are positive parameters which influence the sensitivity of money demand to changes in real income and the nominal interest rate i.

The **real money supply** is simply the nominal money supply M divided by the price level P, (M/P), which measures its purchasing power in terms of goods and services.

Real money supply: the nominal money supply M divided by the price level P.

The central bank, as the source of the monetary base MB, can control the nominal money supply, *as long as the banks' cash reserve ratio rr and the public's holdings of cash are constant*. Alternatively, the central bank can target the short term interest rate i and vary the size of the monetary base in order to hit that target.

The next chapter explains how the central bank manages the monetary base and targets the short term interest rate. If the price level is fixed, the central bank also controls the real money supply. Changes in nominal money tend to lead eventually to changes in prices. However, the central bank can still control the real money supply in the short run — it can change M faster than prices P respond — but in the long run other forces determine real money (M/P). For the moment, assume the price level as fixed.

The demand for money as a demand for real money balances is summarized above. The quantity of real money demanded rises when real income rises, but falls when nominal interest rates rise.

Money market equilibrium

Figure 9.2 combines the demand curve for real money balances from Figure 9.1 with the money supply function in Figure 8.2 to give a money market diagram. The demand curve is drawn for a given level of real income, Y_0, and the supply curve for a given monetary base MB_0. With a given price level, the central bank controls the supply of nominal and real money. The supply curve is vertical at (M_0/P_0). Equilibrium in the money market is at E. At the interest rate i_0, the real money balances people wish to hold just equal the money supplied by the central bank and the banking system.

[Figure 9.2 about here. XX]

Alternatively, the central bank can decide to target the short term interest rate i_0, which means it must vary the monetary base as demand for M_0 fluctuates in order to hit that target. Chapter 10 discusses the demand for M_0 in more detail and how the central bank achieves a target for the short term interest rate.

9.4 Foreign exchange rates

The interest rates determined in the money market have important effects on the **foreign exchange rate**. With free international trade in financial assets, portfolio managers, having chosen to hold some part of their portfolios in bonds, have an additional choice. They can hold some bonds issued by domestic borrowers and some issued by foreign borrowers. They might, for example, hold some bonds issued by the Government of Canada, some issued by the United States Treasury and some issued by other governments. Similarly, residents of other countries can choose to include bonds issued by the Government of Canada in their holdings. These choices are made on the basis of the yields on bonds established by conditions in different national money and bond markets.

> **Foreign exchange rate**: the domestic currency price of a unit of foreign currency.

To achieve the highest return on the bond portion of their portfolios, managers buy bonds that offer the highest rate of return for a given level of risk. If interest rates are constant in other financial markets, a rise in Canadian interest rates and bond yields makes Canadian bonds more attractive to both domestic and foreign bondholders. The demand for Canadian bonds increases. A fall in Canadian interest rates has the opposite effect.

Bonds are issued and priced in national currency. Most Government of Canada bonds are denominated in Canadian dollars. US Treasury bonds are denominated in US dollars, and bonds issued by European governments are denominated in euros. If Canadians want to

purchase bonds on foreign bond markets they need foreign currency to make payment. Similarly, if residents of other countries want to purchase Canadian bonds they need Canadian dollars to make payment. These foreign exchange requirements for trading in financial assets are the same as those for trading in goods and services. The foreign exchange market is the market in which currencies of different countries are bought and sold and foreign exchange rates are determined.

Foreign exchange markets and rates are examined in detail in Chapter 12. For now it will be enough to consider the effects of changes in domestic interest rates on the foreign exchange rate.

Consider an increase in the domestic money supply in Canada. Money and bond market adjustments to this increased money supply lower the Canadian interest rate. At these lower interest rates domestic bond yields are lower relative to foreign bond yields than they were before. This provides the incentive for domestic portfolio managers to switch their purchases from domestic bonds to foreign (US) bonds. To pay for foreign bonds they need foreign currency. The demand for US dollars increases.

Simultaneously, bond holders in the US shift their purchases from the now relatively low-yield Canadian bonds to US bonds. Lower sales of Canadian securities in the US market reduce the supply of US dollars. This drop in the supply of US dollars combined with the increase in demand raises the Canadian dollar price of US dollars. This is a **depreciation of the Canadian currency**. If the initial exchange rate was \$1.20Cdn = \$1.00US, the exchange rate would be somewhat higher, say \$1.25Cdn = \$1.00US.

> **Depreciation of the national currency**: a decline in the value of the currency relative to other national currencies, which results in a rise in the domestic price of foreign currencies.

In this example a fall in domestic interest rates, other things constant, causes depreciation

in the domestic currency relative to foreign currencies. This interest rate-exchange rate linkage is symmetrical. Rises in domestic interest rates cause **appreciation of the national currency**.

> **Appreciation of the national currency**: an increase in the value of the currency relative to other national currencies, which results in a fall in the domestic price of foreign currencies.

A *decrease* in the money supply or a change in the demand for money with a fixed money supply would affect the foreign exchange rate through the same linkages. Changes in domestic financial markets and foreign exchange markets happen simultaneously. With current communications and information technology these markets adjust very rapidly and continuously. The changes in interest rates and foreign exchange rates that result from changes in domestic money market conditions have important effects on aggregate expenditure and aggregate demand.

9.5 Interest rates, exchange rates, and aggregate demand

Interest rates and exchange rates link the changes in money and financial markets to the expenditure decisions that determine aggregate demand.

The impact of financial markets, interest rates, and exchange rates on aggregate expenditure, aggregate demand, and real output, is described by the **transmission mechanism**. It has three important channels, namely:

1. the effect of interest rate changes on consumption expenditure;
2. the effect of interest rate changes on investment expenditure; and

3. the effect of interest rate changes on foreign exchange rates and net exports.

> **Transmission mechanism**: the link from money, interest rates, and exchange rates through financial markets to output and employment and prices.

Interest rates and expenditure

The basic consumption function in Chapter 6 was illustrated by a straight line relating aggregate consumption to disposable income. The positive slope of that line, the marginal propensity to consume, showed the change in consumption expenditure that would result from a change in disposable income. The vertical intercept of the consumption function showed *autonomous consumption* expenditure, the consumption expenditure not determined by disposable income. Changes in income moved households *along* the consumption function. Changes in autonomous consumption expenditure changed the vertical intercept, *shifting* the consumption function *up or down*.

Changes in interest rates affect autonomous consumption expenditure in two ways:

1. through a **wealth effect** from changes in the prices of financial assets; and
2. through a **cost of credit** effect.

> **Wealth effect**: the change in expenditure caused by a change in real wealth.

> **Cost of credit**: the cost of financing expenditures by borrowing at market interest rates.

The market prices of bonds are the present values of expected future interest and principal payments. Current market interest rates are the key factor in this relationship. Similarly, interest rates and the expected stream of profits and dividend payments determine the present

values and prices of company shares. Lower discount rates give higher present values and higher interest rates reduce present values. As a result, falling interest rates raise financial asset prices and rising interest rates reduce financial asset prices.

This means that changes in interest rates, by changing prices of financial assets, change the wealth held in household portfolios. A fall in market interest rates raises household financial wealth which increases household consumption expenditure. Autonomous consumption expenditure increases as a result of this **wealth effect**. A rise in interest rates would reduce autonomous consumption expenditure.

Changes in interest rates, for example a fall in rates, also has important effects on house prices by lowering the **cost of credit**, increasing the present values of rental incomes, and increasing the market prices of residential real estate. Households often use the increased market values and equity in their housing to set up home equity lines of credit with relatively low borrowing rates. This borrowing is used to finance other expenditures. Autonomous consumption expenditures change as interest rate changes change the cost and extent of this financing.

Thus, two forces — wealth effects and the availability and cost of credit — explain the effects of money on planned consumption expenditure. This is one part of the transmission mechanism through which money and interest rates affect expenditure. Operating through wealth effects and the supply and cost of credit, changes in money supply and interest rates shift the consumption function. We can recognize the effects of both income and interest rates on consumption by using an equation, namely that consumption expenditure depends on both national income and interest rates.

$$C = C\left(Y, i\right).$$

The marginal propensity to consume out of national income is a positive fraction, $0 <$

$(\Delta C/\Delta Y) < 1$, and the relationship between consumption and interest rates is negative, $\Delta C/\Delta i < 0$.

When consumption expenditure is plotted relative to national income as in the 45° line diagrams of Chapters 6 and 7, a change in the interest rate *shifts the consumption function* but does not change its slope.

Interest rates and investment expenditure

In Chapters 4 and 6 we defined investment expenditure as the purchase of currently produced fixed capital, which includes plants, machinery and equipment; and inventories of raw materials, components, and finished goods. Spending on new residential and non-residential construction is also included in investment. Assume investment is independent of current income and therefore an autonomous component of aggregate expenditure. However, the interest rates determined in money and financial markets affect investment expenditure.

The data in Chapters 4 and 6 showed investment at about 20 percent of GDP in 2019 but with the level of investment spending changing from year to year within a range of ± 11 percent. Although the total change in inventories is quite small, this component of total investment is volatile and contributes to the fluctuations in the total level of investment. Interest rate changes are responsible for some part of the volatility in investment spending.

Government capital expenditures on buildings, roads, bridges, and machinery and equipment are a part of government expenditure G. We treat government capital expenditure as part of fiscal policy and include it in G, not in I.

Businesses spend on fixed capital, plant and equipment to expand their output capacity if they expect growth in demand for their output, or if they see opportunities to reduce costs by adopting new technology and production techniques. Wireless companies like *Bell Canada*,

Rogers and *Telus* spend continuously on new equipment to accommodate subscriber growth and new products and applications that require more and faster data and voice transmission. Auto makers add to or reduce assembly capacity and develop new product and production technologies to remain competitive and to meet needs for increased fuel efficiency. Solar, wind energy and biofuel companies build new solar farms, wind farms and ethanol plants to provide new sources of electricity and fuels.

The firm's decision to invest is based on its expectation of future markets and profits that will justify the estimated cost of new plant, equipment and technologies. Financial markets provide some important guidance.

The current market values of existing firms are the *present values of their expected profits*. A firm thinking about entering an industry or expanding its current capacity can compare the cost of building a new plant and buying equipment with the market value of capital already in the industry. The investment looks profitable if the cost to enter the industry or build and install new capacity is less than the value the market places on existing businesses. Alternatively, if the value the market places on existing business is less than the capital cost of new business there is no incentive to invest in more plant and equipment. However, there might be an opportunity to enter the industry, or expand by taking over an existing business.

The present value of expected profits depends on the interest rate. Changes in interest rates change both the values the market puts on existing businesses and productive capacity and the costs of financing new investment. A rise in interest rates lowers the market value of existing firms and increases the costs of financing new investment. A fall in interest rates increases current market values and lowers financing costs. As a result, investment expenditures are inversely related to interest rates, if all other conditions are constant.

Inventory management is another important part of investment expenditure. Some firms hold inventories of basic inputs to production like raw materials and may also hold components

and finished product. Other firms organize their production and coordinate with suppliers to minimize inventories to achieve "just in time" delivery of inputs. Financial services firms often hold inventories of bonds and other assets to help customers adjust their portfolios.

Inventories can accommodate differences in the timing of production and sales for the benefit of both producers and consumers. If demand for output rises sharply, plant capacity cannot be changed overnight. If demand exceeds current output, sellers would rather not disappoint potential customers. Car dealers hold inventories in part to help smooth the flow of production, and in part to be able to offer immediate delivery. Retail stores carry inventories so customers can buy what they want when they want it. As demand fluctuates, it can be more efficient to allow inventories of finished goods to fluctuate than to try to adjust production to volatile market conditions.

But inventories involve costs. To the producer, unsold goods represent costs of labour, materials, and energy paid but not yet recovered from the sale of the product. These costs have to be financed, either by borrowing or tying up internal funds. Retailers have similar carrying costs for their inventories. Thus, interest rates determine the important finance costs of holding inventories. If we assume prices are constant and interest rates rise, producers and retailers will want smaller inventories. Alternatively, if prices are rising, the difference between the nominal interest rate and the rate of inflation is the real cost of carrying inventories.

The **investment function** is based on these explanations of expenditure on fixed capital and inventories. The negative effect of interest rates in the investment function, $(\Delta I/\Delta i) < 0$, shows that higher interest rates cause lower levels of planned investment expenditure. But how sensitive are investment plans to financing costs? If these financing costs were not a large factor in the investment decision, $(\Delta I/\Delta i)$ would be small. A rise in the interest rate from i0 to i1 would still lower planned investment, but by only a small amount. Alternatively, a larger value for $(\Delta I/\Delta i)$ would mean that investment plans are sensitive to interest rates.

Investment function: the level of planned investment expenditure as a function of the interest rate.

Investment expenditure therefore depends on the interest rates:

$$I = I\left(i\right).$$

A rise in the interest rate lowers investment expenditure: $(\Delta I/\Delta i) < 0$.

When plotted in a diagram with interest rate (i) on the vertical axis and investment (I) on the horizontal axis, the slope of the investment function, $I = I(i)$, is $-\left(\Delta i/\Delta I\right)$. The position of the investment function reflects the effect of all factors, other than interest rates, that affect investment decisions. The price of new capital equipment, optimism or pessimism about future markets and market growth, the introduction of new technologies embodied in newly available equipment, and many other factors underlie investment decisions. Changes in any of these conditions would *shift* the I function and change planned investment at every interest rate. The sharp drop in oil company expenditures on new equipment and production capacity in response to the collapse in oil prices is a clear example of a shift in the investment function. Increased business confidence and expectations of stronger and larger markets shift the I curve to the right. Pessimism shifts it to the left.

COVID-19 business shutdowns, for example, and the sharp drop in crude oil prices will dramatically reduce business spending on new buildings, equipment and resource development.

The volatility of investment that causes business cycle fluctuations in output and national income comes from volatility in business profit expectations, rather than from interest rates. Changes in investment, a result of changes in interest rates or as a result of other factors, shift aggregate expenditure and work through the multiplier to change AD, output, and employment. The reaction of investment expenditure to changes in interest rates provides the important link in the monetary transmission mechanism but does not explain the volatility

of investment expenditure we saw in Chapter 6.

Exchange rates and net exports

The changes in foreign exchange rates caused by changes in interest rates affect the competitiveness and profitability of imports and exports relative to domestically produced goods and services. A rise in interest rates leads to an appreciation of the domestic currency. Import prices fall relative to the prices of domestic goods and services. Exports become less competitive and less profitable. Imports rise and exports fall, lowering the net export component of aggregate expenditure and demand. Alternatively, a fall in interest rates leads to a depreciation of the domestic currency. Prices of imported goods and services rise relative to the prices of domestic goods and services. Exports are more competitive and more profitable. Net exports increase.

In Chapter 6 we assumed exports were autonomous, independent of national income but dependent on foreign incomes, foreign prices relative to domestic prices, and the exchange rate, which we held constant. Imports were a function of national income, based on a marginal propensity to import, with an autonomous component to capture relative price and exchange rate conditions. Exchange rates were assumed to be constant.

Dropping the assumption that the exchange rate is constant makes the important third link between interest rates and aggregate expenditure through net exports. Exchange rate effects reinforce the negative relationship between interest rates and expenditures in the consumption and investment functions. If interest rates rise, other things constant, the domestic currency appreciates and the exchange rate er falls. Exports fall, and imports rise, reducing net exports and aggregate expenditure. A net export function that describes this relationship would be:

$$NX = NX\left(er\left(i\right), Y, \ldots\right).$$

Here, the $er\,(i)$) captures the effect of interest rates on exchange rates, and exchange rates on net exports. The variable Y captures the effect of changes in Y through the marginal propensity to import. From the foreign exchange market we know that a rise in interest rates leads to an appreciation of the domestic currency that lowers the exchange rate, $(\Delta er/\Delta i) < 0$. Also, a fall in the exchange rate lowers net exports, $(\Delta NX/\Delta er) > 0$.

The appreciation of the Canadian dollar that reduced the Canadian to US dollar exchange rate from \$1.57Cdn for \$1.00US in 2002 to \$1.014Cdn for \$1.00US in March 2008, and to \$0.9814Cdn for \$1.00US in November 2012 illustrates the point. Although due more to the rise in commodity and energy prices than to interest rate differentials, the lower exchange rate increased imports and reduced the viability of manufacturing based on exports to the US market, or competition with imports. To the extent that interest rate changes affect exchange rates, they also change net exports and aggregate expenditure.

The depreciation of the Canadian dollar following the collapse of energy and commodity prices in late 2014, and the subsequent lowering of interest rates by the Bank of Canada raised the exchange rate to \$1.31Cdn for \$1.00US in early August 2015. Although only partly a result of lower Canadian interest rates, this lower dollar made exports more competitive and profitable and imports more expensive. Over time, net exports increased, increasing aggregate demand.

Figure 9.5 summarizes the relationship between interest rates and expenditures, assuming all things other than interest rates and exchange rates are constant. The downward sloping line $A\,(i)$ illustrates the inverse relationship between the consumption, investment, and net export components of autonomous expenditure and the interest rate. Starting with interest rate i_0, the level expenditure related to interest rates is $A\,(i_0)$, given by point D on the expenditure function. A fall in interest rates from i_0 to i_1 increases expenditure to $A\,(i_1)$, moving along the expenditure function to point E. Lower interest rates increase consumption and investment expenditure directly through wealth and cost and availability of finance

effects. Lower interest rates also increase net exports through the effects of lower interest rates on the foreign exchange rate. A rise in interest rates would have the opposite effect.

[Figure 9.3 about here. XX]

The changes in interest rates and exchange rates are the key linkages between the monetary and financial sector and aggregate demand.

9.6 The monetary transmission mechanism

We can now summarize and illustrate the relationships that transmit changes in money, financial markets, and interest rates to aggregate demand, output, and employment. There are four linkages in the transmission mechanism.

1. Tha Bank of Canada changes the short-term nominal interest rate, which moves the short-term real interest rate in the same direction, and affects longer-term interest rates.

2. Changes in interest rates change consumption expenditure through the wealth effect, the cost and availability of credit, and the change in the relative price of current consumption in terms of future consumption.

3. Changes in interest rates also cause changes in planned investment expenditure through the cost and availability of credit to finance the purchase of capital equipment and to carry inventories, and changes in the discounted value of future expected profits.

4. Changes in interest rates also cause changes in exchange rates, which change the price competitiveness and profitability of trade goods and services.

5. Changes in consumption, investment and net exports affect aggregate demand, and the initial change in aggregate demand leads to further changes via a multiplier effect.

Working through these linkages, the effects of changes in money and interest rates on aggregate expenditure, aggregate demand and equilibrium real GDP is illustrated as follows:

$$\Delta M \rightarrow \Delta i \rightarrow \left(\begin{array}{c} \Delta C + \Delta I \\ \Delta er \rightarrow \Delta NX \end{array} \right) \rightarrow \Delta AE \times \text{multiplier} \rightarrow AD \rightarrow Y.$$

Figure 9.6 shows the transmission mechanism using four interrelated diagrams: a) the money market; b) interest rates and planned expenditure; c) aggregate expenditure and equilibrium output; and d) aggregate demand and supply, output, and prices. We continue to assume a constant rate of inflation, as the diagrams show. Changes in the money and financial sector affect aggregate demand and output, to add another dimension to our understanding of the sources of AD and fluctuations in AD.

[Figure 9.4 about here. XX]

To see the linkages in the transmission mechanism start in Panel a) with an equilibrium interest rate i_0 determined by the initial money supply (M_0/P) and demand for money $L(Y_0)$. This interest rate i_0 induces autonomous expenditure $A(i_0)$ in Panel b). That autonomous expenditure is the vertical intercept $A(i_0)$ of the aggregate expenditure function $AE(i_0)$ in Panel c), and through the multiplier the equilibrium GDP, Y_0. In Panel d) the corresponding aggregate demand curve AD_0 crosses the horizontal AS curve at the equilibrium real GDP Y_0.

A decrease in the interest rate i to i_1 in Panel a), which increases money demand to (M_1/P) in the money market. This causes an increase in autonomous expenditure to $A(i_1)$ in Panel b) and an upward shift in the AE function on Panel c). Increased autonomous expenditure and the multiplier increase equilibrium real GDP and shift the AD curve to the right by the increase in A times the multiplier. The new equilibrium is Y_1 at the inflation rate P_0.

[The rest of this section on the steepness of the money demand function is not necessary

given the emphasis on the interest rate as the monetary policy instrument. XX]

Business cycles, output gaps, and policy issues

The effect of money and financial markets on expenditure, output, and employment raises two issues for macroeconomic policy. First, fluctuations in money supply and financial conditions are an important source of business cycle fluctuations in output and employment. These effects are particularly strong and important when the small changes in money supply have big impacts on interest rates and expenditure. A steep $L(i)$ function and a flat expenditure/interest rate function would create these conditions. Stabilization policy would then need to control and stabilize the money supply, a policy approach advocated by Monetarists, who see money supply disturbances as the major source of business cycles. If you can fix money supply at M_0 in Figure 9.6, and the demand for money $L(Y, i)$ and the interest rate/expenditure function are stable, you remove monetary disturbances as a source of business cycles.

This Monetarist approach to money and the financial sector concentrates on the "automatic" stabilization effects of money supply control. With the money supply fixed, any tendency for the economy to experience a recessionary or inflationary gap changes the demand for money, and interest rates change in an offsetting direction. A fall in real output that creates a recessionary gap reduces the demand for money $L(Y, i)$ and, with a fixed money supply, interest rates fall to induce additional expenditure. An inflationary gap would produce an automatic rise in interest rates. The monetary sector automatically resists fluctuations in expenditure and output.

The second policy issue is the alternative to this approach. Discretionary monetary policy would attempt to manage money supply or interest rates or financial conditions more broadly. The objective would be to counter persistent autonomous expenditure and financial

disturbances that create output gaps. The intent is to manage aggregate demand in an active way. In other words, if business cycles were caused by shifts and fluctuations in the interest rate/expenditure function in Panel b) of Figure 9.6, monetary policy would react by changing interest rates and money supply and move the economy along the new expenditure function to stabilize autonomous expenditure and aggregate demand. Keynesian and New-Keynesian economists advocate this active approach to policy in the money and financial sector, based on a different and broader view of the sources of business cycles in the economy.

Recent experience extends beyond these two policy concerns. A collapse in the financial sector on the supply side was a major cause of the recession of 2009. Banks and other financial institutions suffered losses on mortgages and other assets followed as energy and commodity prices dropped and expectations of business profits followed. Uncertainty on the part of many lenders about the quality of assets and the risks of lending reduced the availability of credit. Uncertainty on the part of households and businesses reduced their confidence in financial institutions. Although central banks worked to keep interest rates low and bank reserves strong, shifts in the availability of credit and the willingness to borrow shifted the $A(i)$ curve in Figure 9.6 sharply to the left, expenditure fell, and AD shifted left, opening a strong recessionary gap that has been persistent in many industrial countries.

The dramatic shifts in government policies to contain the COVID-19 pandemic changed the scope and scale of monetary and fiscal policies. Mandated business shutdowns caused unprecedented increases in unemployment and losses of business revenues. New monetary policies were developed quickly to fund the dramatic shift in government program expenditures and budget deficits designed to offset support households and businesses. There was a shift, at least during the crisis, from the earlier pattern of monetary policy aimed at an inflation target and fiscal policy constrained by debt ratio targets.

Conclusions

This chapter makes the link between money, interest rates, aggregate demand, and output in the model of the economy. It also shows that monetary policy, working through the monetary transmission mechanism, provides a second policy channel, in addition to fiscal policy, which government might use to stabilize business cycle fluctuations. Chapter 10 studies in detail the monetary policy operations of central banks, including the Bank of Canada.

Application Box 9.1: A basic guide to financial assets

Three broad classes of financial assets are bought and sold in financial markets. These are *bills*, *bonds*, and *equities*.

Bills are short-term financial assets that make no interest payment to the holder but do make specified cash payment on their maturity date. They trade at a discount. A government treasury bill or T-Bill is an example. Every second week the government sells T-Bills that promise to pay the buyer $100 for each $100 of face value on the date that is about three months in the future. The interest earned is the difference between the price paid and the face amount received at the maturity date.

Bonds are longer-term financial assets that pay a fixed money income payment each year and repay their face value on a fixed maturity date. Bonds are marketable, and trade on the bond market between their issue dates and maturity dates at prices determined by supply and demand. As with T-Bills, the return to the holder of a bond depends on the price paid for the bond. In this case, the calculation is more complex however, because it involves a fixed annual money payment and a fixed value at maturity.

Equities are shares in the ownership of the business. They give the holder the right to

a share in the profits of the business, either in the form of dividend payments or in terms of the increase in the size of the business if profits are used for business expansion. The shares or stocks in publicly traded businesses can be bought and sold on stock markets like the Toronto Stock Exchange. The financial pages of major newspapers give you daily reports on stocks prices and stock markets. Shareholders' returns from their stock holdings depend on the combination of dividend income they receive and the changes in the market price of the shares they hold. Equity prices are the expected value of the future profits of business. Because expectations of future business performance are volatile, equity prices are volatile and therefore risky. Equities do however offer the prospect of higher long-term returns.

Application Box 9.2: Nominal and real interest rates

Both nominal and real interest rates play important roles in the economy. The **nominal** (or money) **interest rate** is the annual percentage of the principal of a loan that the borrower pays to the lender. It is determined by supply and demand conditions in money markets. The **real interest rate** is the nominal interest rate adjusted for annual changes in the price level (real interest rate = nominal interest rate minus the inflation rate). When the inflation rate is zero, nominal and real interest rates are equal.

Nominal interest rates and financial asset prices are linked. The present value calculation of asset prices uses the nominal rate for discounting. Nominal interest rates and asset prices vary inversely.

Nominal interest rates also affect nominal cash flows of both households and businesses. A rise in nominal rates on lines of credit or mortgages increases the current cash cost of

that borrowing. A fall in nominal rates on lines of credit or mortgages releases current cash commitments.

Real interest rates determine the *real* cost of borrowing and the real return to lending.

A family borrows $200,000 for one year at a nominal interest rate of 5 percent to buy a house. At the end of the year they would owe the lender $200,000 plus $10,000 ($200,000 $\times$ 0.05) interest. Their nominal interest cost is $10,000. If the price level has been constant over the year, their nominal interest cost and their real interest cost are equal at 5 percent.

Suppose however that the all prices are rising by 3 percent a year. The house bought today for $200,000 will sell for $206,000 one year from now. Borrowing at 5 percent to buy the house cost $10,000 but the rise in the price of the house by $6,000 offsets part of that cost. The real interest cost is $\$10{,}000 - \$6{,}000 = \$4{,}000$. The real interest rate is 2 percent based on the nominal interest rate of 5 percent minus the change in the price level of 3 percent.

With inflation rates greater than zero, lenders' real interest earnings are less than nominal interest earnings. In the preceding example, the mortgage lender's real return was just 2 percent (5 percent $-$ 3 percent inflation) because the $210,000 received at the end of the year had its purchasing power reduced to approximately $204,000 by the 3 percent rise in the price level.

Nominal and real interest rates affect expenditure decisions by their effects on asset prices, cash flows, and the real costs and returns involved in borrowing and lending.

KEY CONCEPTS

- **Financial portfolio**: a mixed holding of money and other financial assets such as bonds and equities, structured in order to balance expected return and risk.
- **Bond**: a financial contract that makes one or more fixed money payments at specific dates in the future.
- **Interest rate**: the current market rate paid to lenders or charged to borrowers.
- **Bond coupon**: the annual fixed money payment paid to a bond holder.
- **Price of a marketable bond**: the current price at which the bond trades in the bond market.
- **Yield on a bond**: the return to a bond holder expressed as an annual
- **Bond price**: the present value of future payments of interest and principal.
- **Present value**: the price of a financial asset like a bond that promises to make future payments.
- **Discounting**: the process of converting a value received in a future time period to an equivalent value received immediately.
- **Inverse relationship between bond prices and interest rates**: this arises because current interest rates are used to discount future payments and determine this present value.
- **Demand for money**: a demand for real money balances measured in terms of purchasing power over goods and services. It arises from the portfolio decisions people make about the form in which to hold their wealth.

- **Real money supply**: the nominal money supply divided by the price level.
- **Foreign exchange rate**: the domestic currency price of a unit of foreign currency.
- **Depreciation of the national currency**: a decline in the value of the currency relative to other national currencies, which results in a rise in the domestic price of foreign currencies.
- **Appreciation of the national currency**: an increase in the value of the currency relative to other national currencies, which results in a fall in the domestic price of foreign currencies.
- **Monetary transmission mechanism**: the link between interest rates and changes in aggregate expenditure, aggregate demand, and output.
- **Wealth effect**: the change in expenditure caused by a change in real wealth.
- **Investment function**: the level of planned investment expenditure as a function of the interest rate.

Exercises for Chapter 9

Exercise 9.1

If the current market interest rate is 3 percent and a bond promises a coupon of \$3 each year in perpetuity (forever), what is the current market price of the bond? Suppose you were holding such a bond and current market interest rates fell from 3 percent to 2.5 percent. Would you be pleased or disappointed by the return on your bond holding? Why?

Exercise 9.2

Suppose you are holding a bond that will pay \$5 each year for the next two years from today and mature two years from today.

(a) If current two-year market interest rates are 5 percent, what is the market price of your bond?

(b) If market interest rates rise tomorrow to 6 percent, what happens to the market price of your bond?

(c) What is the "market risk" in holding bonds?

Exercise 9.3

Draw a diagram to illustrate the relationship between the demand for real money balances (L), GDP (Y) and the interest rate (i), with the relationship given by $L = kY - hi$, when real GDP has a given value Y_0.

(a) Explain your choice of the intersection of your demand for money function with the

horizontal axis, and your choice of the slope of the function.

(b) Using your diagram, illustrate and explain the quantity of real money balances demanded for a specific interest rate, say i_0. Pay particular attention to the underlying motives for holding these money balances. (c) Suppose interest rates declined from your initial assumption of i_0 to a new lower rate i_1. Illustrate and explain the effect of the change in interest rates on the demand for money balances. (d) Holding interest rates constant at either i_0 or i_1, suppose real GDP were to increase. Illustrate and explain the effect of the increase in real GDP on the demand function and the quantity of real money balances people hold.

Exercise 9.4

Today it costs \$1.25Cdn to buy \$1US. Suppose tomorrow US interest rates rise. What would happen to the foreign exchange rate between Canadian and US dollars? Explain why. w

Exercise 9.5

(a) Draw a diagram to illustrate equilibrium in the money market.

(b) Starting from your initial equilibrium, suppose real national income (Y) increased. Illustrate and explain how the money market would adjust to this change in economic conditions.

(c) How does the interest rate in the new equilibrium compare with the interest rate in the initial equilibrium?

Exercise 9.6

Construct a set of diagrams that shows the monetary transmission mechanism linking interest rates to aggregate demand and output. Using these diagrams, show and explain the following.

(a) How a reduction in the money supply would affect aggregate demand and output.

(b) Alternatively, how an increase in the precautionary demand for money balances caused by terrorist activity, or severe weather events, or an increase in uncertainty in general would affect aggregate demand and output. Assume the money supply is held constant.

(c) Alternatively, how would an increase in autonomous investment expenditure and exports affect aggregate demand, output, and interest rates?

Chapter 10

Central banking and monetary policy

In this chapter we will explore the following topics.

- 10.1 Central banking and the Bank of Canada
- 10.2 Central banking operating techniques
- 10.3 Monetary policy targets and instruments
- 10.4 Monetary policy rules
- 10.5 Monetary policy indicators

The Bank of Canada underestimated the persistence of supply chain problems coming out of the pandemic.

These are recent examples of monetary policy decisions by the Bank of Canada to defend its inflation rate target and support the economy's growth rate. This chapter examines the role of the central bank. The central bank is responsible for monetary policy. Its monopoly

control of the supply of cash, or monetary base, gives it a powerful influence in financial markets. Sometimes the central bank controls the monetary base to control the supply of money. Other times it controls short-term interest rates. In either case, central bank actions are designed to affect inflation, output, and employment. They work through the transmission mechanism that links monetary policy to aggregate demand, as we discussed in the last chapter.

10.1 Central banking and the Bank of Canada

Most countries have a **central bank**. Some of these central banks, like the Bank of England, were private firms originally in business for profit, but began to operate in part to promote stability in financial market conditions. The focus of their business shifted to take on an informal role in what is now called monetary policy. As governments also became interested in monetary policy, central banking institutions were established in countries where none previously existed. The Federal Reserve System, the United States central bank, was created under federal law in 1913. It is a system of 12 regional banks, each owned by the commercial banks that are its members. Canada's central bank, the Bank of Canada, was set up and started operations in 1935 as a privately owned institution, but was nationalized in 1938. In the United Kingdom, the previously private owned Bank of England was nationalized in 1947. The 19 member states of the eurozone[1] share a common currency (the euro) and a central bank (the European Central Bank), which conducts a common monetary policy for its members.

> **Central bank**: an institution which conducts monetary policy using its control of the monetary base and interest rates.

In every case, the important distinction between a private bank and a central bank is the

[1] Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia, and Spain

purpose that drives the institution's operations. Private banks are profit-oriented businesses providing financial services to businesses and households. Central banks conduct their operations to influence the behaviour of other banks and intermediaries in the financial system. Profits are not the motive behind central banks' operations, although they do make profits. They also serve as banker to the government and to the banks. But their primary role and responsibility is to conduct **monetary policy**: To control inflation and support economic growth through their control of the monetary base and interest rates, and perhaps the foreign exchange rate.

> **Monetary policy**: central bank action to control inflation and support economic growth through control of the money supply, interest rates, and exchange rates in order to change aggregate demand and economic performance.

The Bank of Canada is Canada's central bank. A visit to its website bankofcanada.ca provides detailed information on its structure, operations and monetary policy objectives. The information the bank provides on monetary policy is of particular relevance for this chapter. See bankofcanada.ca/core-functions/monetary-policy/.

The Bank of Canada is led by the Governing Council, the policy-making body of the Bank. The Governing Council is made up of the Governor, the Senior Deputy Governor and four Deputy Governors. The current governor is Tiff Macklem. Currently, the Council's main tool for conducting monetary policy is the target for the overnight rate (also known as the key policy rate). Governing Council manages the Bank's balance sheet to implement monetary policy. It can expand the Bank's asset holdings and pay for that expansion by creating new Bank of Canada liabilities, which are additions to the monetary base. Alternatively, the Bank can sell some of the Bank's assets, destroying an equal amount of liabilities and monetary base. No reserve requirements (as seen in Chapter 8 and explained in detail in Section 10.2) limit these operations. Governing Council works to set interest rates and the monetary base which are appropriate for the economy.

There is a further interesting difference between the commercial and central bank balance sheets. Private banks concentrate on their deposit base and loan operations. These are the main entries in their balance sheets and the source of their banking profits, as discussed in Chapter 8. The Bank of Canada, by contrast, does very little direct lending, and any it does is of very short duration. Indeed lending to banks and other financial institutions, advances to members of the Canadian Payments Association, which would be central bank loans, were $XX million at the end of August 2022.

Having the power to conduct monetary policy is one thing; how you use it is another. The Bank of Canada's responsibilities are set out in the Bank of Canada Act, the act of Parliament that established the Bank in 1934. According to the Act, the Bank is to conduct its policy in ways that support the economy by reducing fluctuations in output, prices, and employment while protecting the external value of the currency. In terms of our study of the economy, we can describe these goals of monetary policy as the pursuit of potential output and low, stable inflation rates.

Exactly how the Bank is to achieve those objectives has been, and continues to be, a topic for discussion and debate. Over the years, our understanding of what monetary policy can and cannot do has evolved, as have the Bank's interpretation of its mandate and the techniques it uses to conduct monetary policy. The Canadian economist Robert Mundell was a major contributor to this work. His explanations of the transmission mechanism and the strength of monetary policy under different foreign exchange rate systems were recognized by his 1999 Nobel Prize in Economics.

The goals of Canada's monetary policy are established by an agreement between the Bank of Canada and the Government of Canada. Currently, the Bank works to maintain inflation within a target range of 1 percent to 3 percent, but that has not always been its explicit policy objective. Gordon Thiessen (2001), a recent Governor of the Bank of Canada, provides an interesting overview of the evolution of monetary policy in Canada from the 1930s to the

end of the 1990s.

10.2 Central banking operating techniques

The money supply — currency in circulation plus the deposits of the commercial or chartered banks — is partly a liability of the central bank (currency) and partly a liability of the commercial banks (deposits). In Chapter 8 we discussed the monetary base supplied by the central bank. You will recall that the money multiplier gives the size of the money supply to the size of the monetary base. The money multiplier is larger when:

1. the reserve ratio (rr) banks hold is smaller; and

2. the amount of currency the non-bank public wishes to hold is small and constant.

If these two ratios are constant, the central bank can change the size of the money supply by changing the size of the monetary base.

In general, central banks have three main techniques for the control of the monetary base and the money supply. These are:

1. establishing reserve requirements;

2. using open-market operations; and

3. adjusting central bank lending rates.

Not all central banks use all three techniques, but we will examine each of them. Later we will see that the Bank of Canada has some additional operating techniques it uses to influence interest rates in the short run.

n the financial crisis and deep recession of 2008-2009, central banks developed additional techniques to support the banking system, the availability of credit, and the money supply. The "Quantitative Easing" techniques used in the US and more recently in Europe are examples of these techniques, as is the Bank of Canada's policy response to the Covid-19 crisis.

Reserve requirements

In some cases, commercial banks operate under a legal **required reserve ratio**. They are required by law to hold cash reserves and central bank deposits not less than some specified percentage of their deposit liabilities.

> **Required reserve ratio**: a legal minimum ratio of cash reserves to deposits.

Banks can hold more than the required reserves but not less. If their reserves fall below the required amount, they must borrow cash, from the central bank, to restore their required reserve ratio. Since a loan from the central bank carries an interest rate, usually higher than the market interest rate, borrowing imposes a cost on the bank and lowers profitability. Banks usually hold slightly larger reserves than required to avoid the costs of falling short.

A required reserve ratio is essentially a regulation used to give the central bank control of the money supply. The reserve ratio is a key determinant of the money multiplier. If a central bank has the power to change the commercial banks' required reserve ratio, it can use it to change the money supply. For a given monetary base, a rise in the required reserve ratio reduces the size of the money multiplier and the money supply. A reduction in the reserve ratio has the opposite effect.

However, changing required reserve ratios are blunt techniques for monetary control. They simultaneously affect the reserve positions of all banks in a system and require large adjust-

ments in financial markets. As a result, changes in reserve ratios are not widely used as techniques for money supply control.

Required reserve ratios are different in different national banking systems. In the United States, for example, the Federal Reserve is authorized to impose reserve requirements of 8 percent to 14 percent on chequing deposits, and up to 9 percent on non-personal time deposits. As of February 2002, the ratios were set at 10 percent for chequing deposits and 0 percent for time deposits. The European Central Bank also imposes reserve requirements. In 2012, both India and China reduced deposit reserve ratios on several occasions to encourage monetary expansion in the face of declining GDP growth rates.

Until 1994, banks in Canada were subject to legal minimum reserve requirements. These have now been phased out, as have reserve requirements in many other countries. In Canada, until the beginning of the pandemic, banks held reserves made up of very small settlement balances in the Bank of Canada, in addition to their cash holdings. The banks decide the size of their reserve ratios based on their own assessments of their reserve needs, rather than a legal requirement. We will see later that reserve holdings, and the Bank of Canada's management of the available cash reserves, are important to the implementation of monetary policy in Canada.

he absence of legal reserve requirements in Canada means that reserve ratios in the banking system change from time to time. They may change as the banks change their outlook on financial conditions and their evaluation of banker's risk. These changes are linked to the profit motive of the banks rather than the control interests of the central bank. Whether they come from central bank action or commercial bank asset management, changes in the banks' reserve ratio change the money multiplier and the money supply.

Open market operations

Open market operations are central bank purchases or sales of government securities in the open financial market. They are the main technique used by central banks to manage the *size of the monetary base*. Whereas reserve requirements affect the money supply through control of the money multiplier, open market operations work directly on the monetary base. Since the money supply is the monetary base multiplied by the money multiplier, open market operations alter the money supply.

> **Open market operations**: central bank purchases or sales of government securities in the open financial market.

Central banks use open market operations to provide the monetary base needed to support the demand for money and the increase in the demand for money as the economy grows. If monetary policy is conducted by setting interest rates, as discussed later in the chapter, open market operations are passive. They provide the monetary base needed to meet the demand for money at the interest rate set by the central bank. An open market purchase makes a permanent addition to the central bank's assets and monetary base.

There are times when monetary policy is conducted through control of the money supply. If the money multiplier is constant, a central bank can control the size of the money supply by controlling the monetary base using open market operations. Open market purchases increase the monetary base and increased bank lending increases the money supply. Open market sales have the opposite effect.

In times of financial and economic crisis, as in 2008 and 2009 and since the beginning of the pandemic, open market operations are used along with interest rate setting. High uncertainty in financial markets and falling demand in goods-and-services markets increased the demand for liquid cash balances. If interest rates are reduced close to zero without increasing lending and spending and asset demand, the central bank may undertake "quantitative easing,"

using open market purchase to increase the monetary base and offset a shortage of liquidity in the economy. This topic comes up again after we look at monetary policy in more normal times.

[Scrub the section on the effects of the monetary base on the money supply. XX]

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The overnight market

The Bank Rate and the Deposit Rate

The overnight rate target

At the beginning of the pandemic, the Bank of Canada rapidly decreased its overnight rate target to 0.25 percent. It considers that to be the effective lower bound for

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10.3 Monetary policy targets and instruments

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Bank of Canada operating techniques

In Canada, the overnight rate is now the Bank of Canada's key policy instrument. This is the interest rate that large financial institutions receive or pay on loans from one day until the next. The Bank implements monetary policy by setting a target for the overnight rate

at the midpoint of an operating band that is plus or minus one-quarter of one percentage point, or 25 basis points, from the target rate.

Traditionally, the Bank of Canada has operated a corridor system when implementing monetary policy. In a corridor system, the Bank sets its overnight rate target at the midpoint of a band of 50 basis points (a basis point is 1/100th of a percent). At the bottom end of the band is the Deposit Rate, which is the rate the Bank pays financial institutions who leave settlement balances on deposit at the Bank of Canada. At the top end is the Bank Rate, which is the rate the Bank charges financial institutions to borrow from it. Under the corridor system, monetary policy decisions simply shift the band up or down a specific amount, typically 25 basis points.[2]

There is a clear link in this system between the overnight rate and the level of settlement balances as shown in Figure 10.1. When the overnight rate is equal to the Bank Rate, the demand curve for funds becomes horizontal: banks can borrow funds overnight from the Bank of Canada at the same rate they can borrow from other banks, so they have no incentive to use the overnight market. When the overnight rate is equal to the Deposit Rate, the demand is also horizontal: banks have an equal incentive to borrow and lend funds in the overnight market as they do leave them on deposit with the Bank of Canada. In between the Bank Rate and the Deposit Rate, there is a downward-sloping demand curve for settlement balances. By varying the total supply of settlement balances via asset purchases and sales, the Bank of Canada can keep the overnight rate in the overnight market close to its target. This is illustrated by the supply curve labelled S_1 in the figure. As the supply of settlement balances increases (decreases), the overnight rate in the market decreases (increases) as it is easier (harder) for banks that are short of balances to borrow from other banks that are in a credit position.

[2]For a detailed analysis of corridor and floor systems of monetary policy control, see Ambler, Koeppl and Kronick (2022).

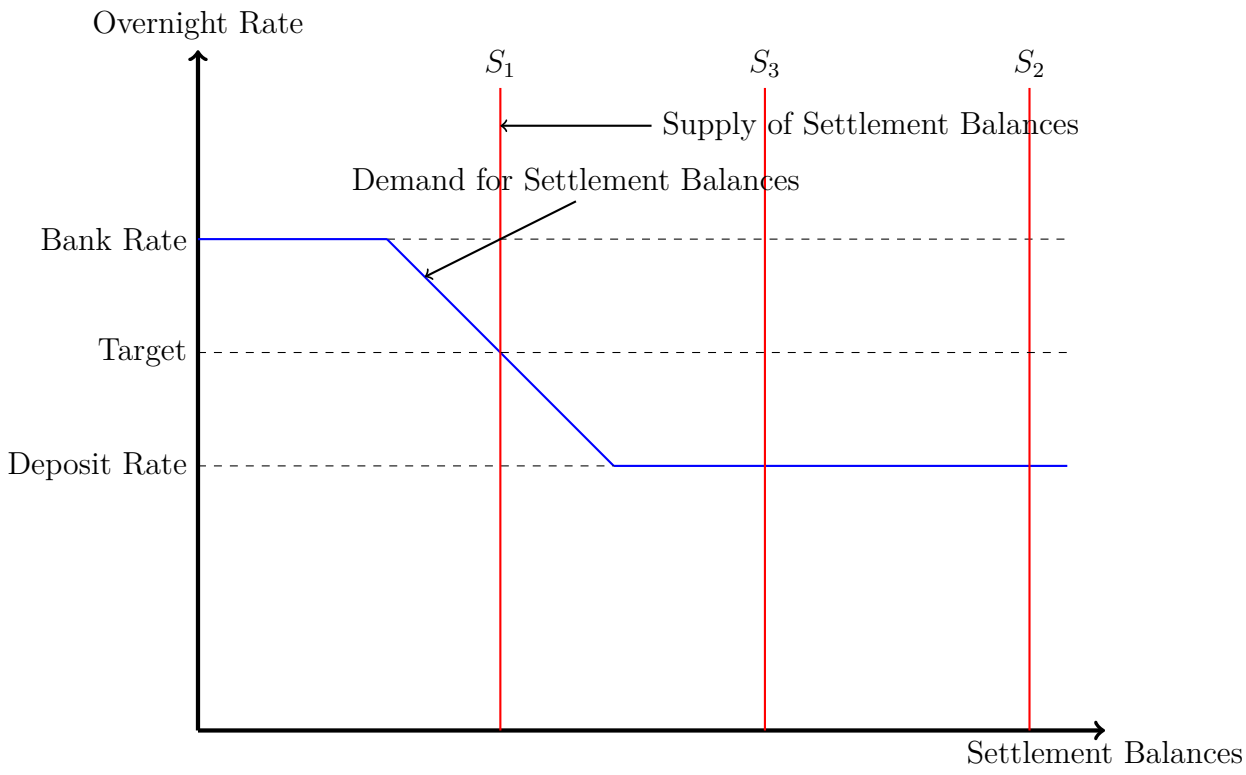


Figure 10.1: **Corridor System**

As settlement balances continue to increase, the overnight rate will drop towards the Deposit Rate at the bottom of the operating band. Eventually these increases become such that it is impossible to sustain an overnight rate above the Deposit Rate.

This is precisely what happened during the pandemic when the Bank of Canada bought Government of Canada bonds from financial institutions in secondary markets. In essence, an overnight rate target above the Deposit Rate became untenable, forcing the central bank to set the two equal to each other. This system of monetary policy is called a floor system.24 Figure 1 illustrates this outcome: with a supply of settlement balances equal to S_2, the equilibrium outcome is far to the right of the zone where there is a downward-sloping demand curve for settlement balances.

But note that demand can change too, and what we argued in the medium-run section is there will be upward pressure on demand for settlement balances. The exact size of this increase in demand is unclear, but with the current size of the balance sheet, and the hold-to-maturity QT strategy, we believe supply will still be in the elastic zone, moving from a position like S_2 to a position like S_3

Benefits of a floor system

The immediate benefit of a floor system — and, indeed, more of a consequence — is that it gives the Bank of Canada an additional policy tool in the form of QE/QT.26 The Bank can still use its traditional interest rate instrument by moving the floor (which moves the overnight rate and the Deposit Rate simultaneously) up and down. However, the Bank has an additional lever (its balance sheet) that comes into play if the Deposit Rate reaches the lower bound on interest rates. It can increase or decrease the size of the balance sheet without necessarily moving the overnight rate.

Another benefit of the floor system is the varying demand for settlement balances across time under the modernized payments system. Such varying demand makes it hard for the Bank to set the supply of settlement balances under the corridor system that ensures the overnight rate is at target. Under the floor system, the Bank of Canada could simply supply large enough settlement balances to avoid excessive day-to-day management.

Costs of a floor system

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10.4 Monetary policy rules

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10.5 Monetary policy indicators

Conclusions

This chapter completes the development and explanation of the basic expenditure and monetary structure of the economy under the assumption that the general price level is constant. Chapter 11 elaborates on the AD/AS model introduced in Chapter 5 which explains short-run fluctuations, output, and inflation. That model is built on modern monetary policy that sets interest rates to achieve inflation control. It is used to illustrate and evaluate recent Canadian fiscal and monetary policies.

KEY CONCEPTS

- **Central banks** operate to influence the behaviour of other banks and intermediaries in the financial system.
- A central bank conducts **monetary policy** through its control of the monetary base and interest rates. It is also banker to the government and to the commercial banks.
- **The Bank of Canada** is Canada's central bank. It is the source of the monetary base. It sets short-term interest rates, acts as banker to the commercial banks and the federal government, and is the lender of last resort to the banks. Monetary policy in Canada is the responsibility of the Bank of Canada. The Bank uses its control of the monetary base and interest rates to promote economic stability at potential output and a low stable inflation rate.
- **Monetary policy** in Canada is the responsibility of the Bank of Canada. The Bank uses its control of the monetary base and interest rates to promote economic stability at potential output and a low stable inflation rate.
- Central banks have three main operating techniques: **reserve requirements imposed on commercial banks**, **open-market operations**, and **bank rate setting**. These techniques are used to manage the monetary base, the money multiplier, and interest rates.
- Central banks can implement monetary policy through the monetary base and money supply control or through interest rate control, but cannot do both simultaneously. In practice, the Bank cannot control money supply exactly. Thus, for most central banks, a short-term interest rate is the instrument of monetary policy.

- The Bank of Canada uses the **overnight interest rate** as its policy instrument, and an inflation rate of 1 percent to 3 percent as its policy target.

- The Bank of Canada uses **SPRAs** and **SRAs** to intervene in the market for overnight funds and to reinforce its setting of the overnight interest rate.

- A **monetary policy rule** such as a rule for setting the interest rate provides a useful description of the way the central bank sets and adjusts its interest rate policy instrument.

- The **neutral rate of interest** is the interest rate that, in the central bank's judgment, is consistent with actual real GDP equal to potential real GDP and inflation at target.

- Changes in the central bank's policy instrument change nominal and real interest rates and change aggregate demand through the **transmission mechanism**, which includes wealth effects, cost of financing effects, and exchange rate effects on the components of aggregate expenditure.

- **Quantitative easing** is the use of central bank purchases of securities with the aim of increasing the monetary base to meet unusually high demands for liquid cash balances in times of financial and economic crisis.

- **Credit easing** is the increase in specific kinds of central bank asset holdings (for example, commercial paper) designed to provide liquidity and support lending in specific markets facing shortages of funds.

- The central bank uses **forward guidance** by communicating its intentions concerning future changes in its interest rate setting.

- Real and nominal interest rates, exchange rates and rates of growth of money aggregates relative to national income can be used as **monetary policy indicators**, which .

Exercises for Chapter 10

Exercise 10.1

Explain carefully why a central bank does not operate to make a profit but a commercial bank does. What is the central bank's operating objective? What unique power does a central bank have that allows it to pursue its operating objective?

Part Four

Real GDP, Business Cycles, Policy and Growth

11. Inflation, real GDP, monetary policy and fiscal policy
12. Exchange rates, monetary policy and fiscal policy
13. Economic growth

This Part integrates the material of the preceding chapters. Chapter 11 fleshes out the aggregate demand and aggregate supply model to explain the convergence of inflation to its target rate and of real GDP to its full employment level. Chapter 12 introduces international aspects of macroeconomics and the importance of foreign exchange rates to the design and effectiveness of monetary and fiscal policy, using the model from Chapter 11. Chapter 13 introduces theories of economic growth and the importance of technology and productivity growth for standards of living.

Chapter 11

Inflation, real GDP, monetary policy and fiscal policy

In this chapter we will explore the following topics.

- 11.1 Adjustment to output gaps
- 11.2 Monetary and fiscal policy
- 11.3 Optimal monetary policy
- 11.4 Convergence to the inflation target
- 11.5 Working with the AS/AD model
- 11.6 Recession, disinflation and deflation
- 11.7 Policy at the zero lower bound

Chapter 4 identified the inflation rate, GDP, and the unemployment rate as key indicators of economic performance. This chapter looks in more detail at the basic macroeconomic model of Chapter 5 for the study of causes of change in the first two of these indicators. It is a simplified version of the models currently used by central banks and policy analysts to evaluate current economic performance and policy, forecast future performance and prescribe policy action. Chapter 13 will cover economic growth and growth rates.

Normally, in the absence of random shocks, underlying short-run conditions on the supply side of the economy are the same in this chapter as in earlier chapters. The labour force and technology are fixed by assumption, fixing potential output at a given level, which we have written as Y_P. We look at the adjustment process of inflation and output when inflation rates are stable in the short run and adjust slowly to output gaps. We also look at the adjustment process when the interest rate set by the central bank cannot be reduced any further because it has reached its lower bound: this was where the Bank of Canada (and other major central banks) found itself during the financial crisis and Great Recession of 2008-2009 and during the Covid-19 pandemic.

On the demand side, monetary policy is aimed at inflation control using the short-term interest rate as the instrument, as explained in Chapter 10. It reflects the Bank of Canada's current monetary policy framework (as explained in Bank of Canada 2021b). In normal conditions this allows fiscal policy to focus on managing the government's budget balance as it affects output, employment and the public debt ratio.

The model provides explanations of business cycle fluctuations in output, employment and inflation rates. It provides a basis for evaluating recent changes in economic conditions and monetary and fiscal policy actions. It can also be used to illustrate the changes in equilibrium real GDP and the inflation rate caused by policies to control the spread of the Covid-19 pandemic.

11.1 Adjustment to output gaps

Figure 11.1 reproduces Figure 5.9 for an economy which initially has an equilibrium real GDP greater than potential output (that is to say with an inflationary gap). The aggregate supply curve AS_0 will gradually shift up over time as illustrated by the arrows, as firms increase their prices by more than the rate of inflation. The final equilibrium the economy will reach is with real GDP equal to potential at Y_P and inflation given by π^*, the long-run equilibrium inflation rate. As the inflationary gap diminishes, firms increase their prices less quickly. At the new long-term equilibrium they are once again satisfied with increasing their prices at the rate of inflation, so inflation no longer increases.

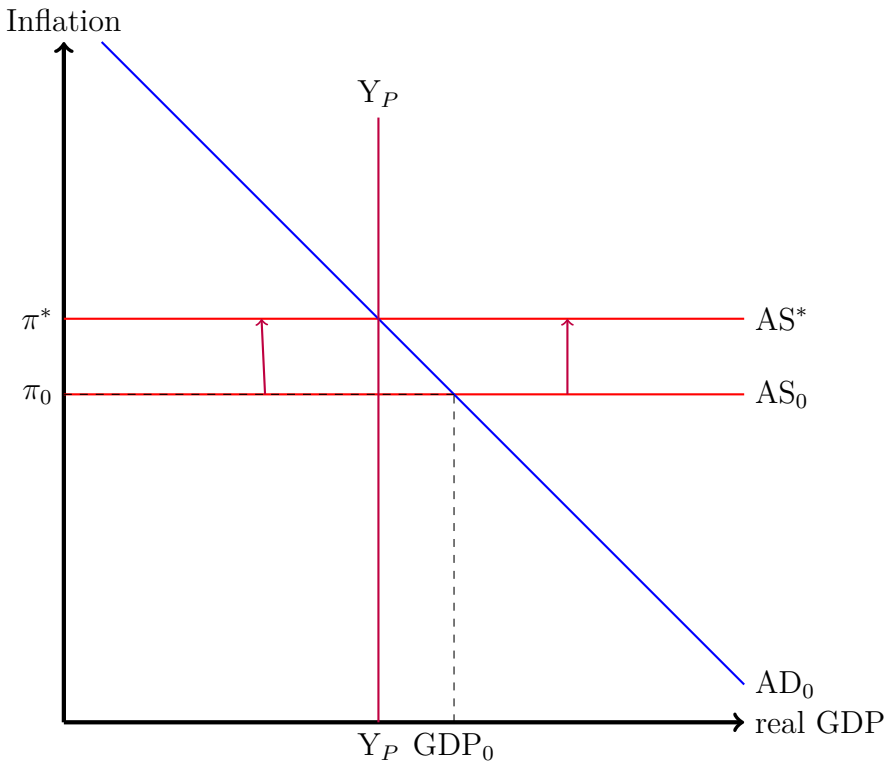


Figure 11.1: Adjustment to an inflationary gap

Inflation adjustment with an inflationary gap. In the initial equilibrium, with output equal to GDP_0 and inflation equal to π_0, there is an inflationary gap. Inflation gradually increases so that, in the long run, inflation equals π^* and the inflationary gap is eliminated.

Figure 11.2 illustrates an initial situation with a recessionary gap, i.e. with real GDP less than potential output. The aggregate supply curve AS_0 will gradually shift down over time as illustrated by the arrows, as firms increase their prices by less than the rate of inflation. The final equilibrium the economy will reach is with real GDP equal to potential at Y_{P_1} and inflation given by π^*.

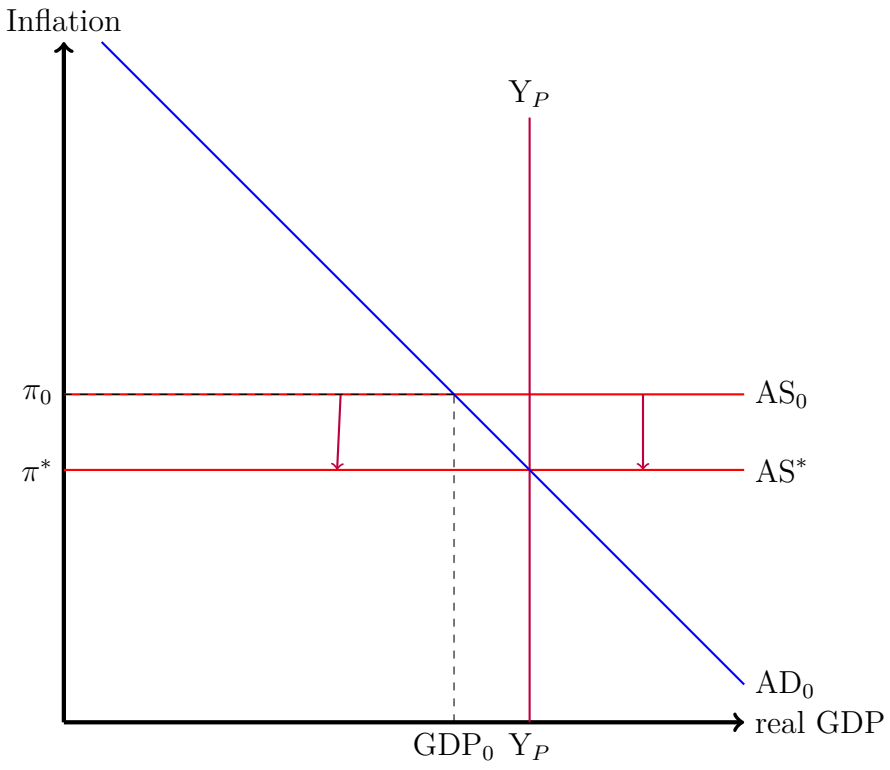


Figure 11.2: Adjustment to a recessionary gap

Inflation adjustment with a recessionary gap. In the initial equilibrium, with output equal to GDP_0 and inflation equal to π_0, there is an recessionary gap. Inflation gradually decreases so that, in the long run, inflation equals π^* and the recessionary gap is eliminated.

11.2 Monetary and fiscal policy

Monetary policy

In practical terms central banks set their policy interest rates based on their inflation rate control target and their assessment of current and future economic conditions. This approach is described by a policy rule for setting the overnight interest rate.

We first introduced such a rule in Chapter 5. The rule was encapsulated by Figure 5.3, which showed a central bank which raised the **real** interest rate as inflation increased. We will continue here to suppose that the central bank is sufficiently well informed concerning inflation expectations in order to be able to set the real interest rate.

We will assume a rule like the one introduced in Chapter 5, but where the central bank's real interest rate r responds to the output gap as well as to inflation.

$$r = r^* + \alpha\left(\pi - \pi^*\right) + \beta\left(\mathrm{Y} - \mathrm{Y}_P\right). \tag{11.1}$$

In this equation, α and β are positive constants which determine the strength with which the central bank reacts to, respectively, inflation and output gaps. When inflation is equal to its long-run value π^* and real GDP is equal to potential, the real interest rate is equal to its long-run equilibrium value r^*. Here, π^* has the interpretation of the central bank's inflation target.. When output is equal to potential output ($\mathrm{Y} = \mathrm{Y}_P$) and inflation is equal to its target ($\pi = \pi^*$), the central bank sets the real interest rate equal to its long-run equilibrium value ($r = r^*$). The difference between actual output Y and potential output Y_p is commonly referred to as the **output gap**.

> **Output gap**: the difference between the actual level of real output (real GDP) and potential output.

Adding a term for the output gap means the central bank looks at both the inflation rate and the state of the economy in making its interest rate setting decisions. In terms of the AS/AD model, the output gap is a predictor of the way the inflation rate will move if current conditions persist. In times of recession, for example, the output gap term in the policy rule calls for a cut in interest rates even if the inflation rate is still π^*. This way the central bank preempts the fall in inflation that a recession would cause.

This makes the central bank's monetary policy forward-looking.

The rule described by (11.1) is known as a **Taylor rule** after Professor John Taylor of Stanford University. He showed that his rule is a very good description of how central banks actually set their policy interest rate (see Taylor 1993), and also yields good economic outcomes (in terms of keeping inflation, employment, and GDP stable) in the types of forecasting and policy analysis models used by central banks.

> **Taylor rule**: a monetary policy rule, first discussed in Taylor (1003), which stipulates that the central bank sets the real interest rate as a function of the deviation of inflation from its target and of the deviation of real output from potential output.

Application Box 11.1 below shows how the Taylor rule given in equation (11.1) can be used, along with the negative relationship between aggregate demand and the real interest rate, to derive an algebraic representation of the AD curve.

Application Box 11.1: An algebraic version of the simple AS/AD model

We can express the simple AS/AD model developed in Chapter 5 in simple algebraic terms. The equations convey exactly the same information as the curves but in a different

form.

The downward-sloping relationship between aggregate demand and the real interest rate (represented by Figure 5.2) can be written as

$$\mathrm{Y} = \mathrm{Y}_P - \rho\left(r - r^*\right). \tag{11.2}$$

The positive constant ρ indicates how sensitive aggregate demand is to changes in the real interest rate.

The inflation adjustment equation can be written as follows:

$$\pi_{t+1} = \pi + \varphi\left(\mathrm{Y} - \mathrm{Y}_P\right). \tag{11.3}$$

The positive constant φ indicates how sensitive the change in the inflation rate is to the difference between equilibrium real GDP and potential output. On the left hand side of the equality, π_{t+1} gives the height of the (horizontal) AS curve in the following period.

The central bank's policy function given by equation 11.1 can be used to isolate $(r - r^*)$, and then to substitute this expression into equation (11.2) to get

$$\left(\mathrm{Y} - \mathrm{Y}_P\right) = -\rho\left(\alpha\left(\pi - \pi^*\right) + \beta\left(\mathrm{Y} - \mathrm{Y}_P\right)\right).$$

We can then solve for the output gap $(\mathrm{Y} - \mathrm{Y}_P)$ as follows:

$$\left(\mathrm{Y} - \mathrm{Y}_P\right) + \rho\beta\left(\mathrm{Y} - \mathrm{Y}_P\right) = -\rho\alpha\left(\pi - \pi^*\right),$$

which gives

$$\left(1 + \rho\beta\right)\left(\mathrm{Y} - \mathrm{Y}_P\right) = -\rho\alpha\left(\pi - \pi^*\right),$$

which gives

$$\mathrm{Y} = \mathrm{Y}_P - \frac{\rho\alpha}{1+\rho\beta}\left(\pi - \pi^*\right). \tag{11.4}$$

This is just an algebraic representation of the downward-sloping AD curve in Figure 5.1. The slope of the curve is given by $-\frac{\rho\alpha}{1+\rho\beta}$. The only (slight) difference compared to the version in Chapter 5 is that we assumed there that the real interest rate set by the central bank depended only on inflation, so that $\beta = 0$.

Equation (11.4) shows that when inflation is equal to the inflation target π^* ($\pi = \pi^*$), GDP must be equal to potential output ($Y = Y_p$). This means that the AD curve passes through the point (Y_P, π^*), which is the long-run equilibrium of the economy.

When Y is greater than Y_P, the AS curve shifts up and inflation increases. When Y is less than Y_P, the AS curve shifts down and inflation decreases.

11.3 Optimal monetary policy

Let's assume that, instead of following the Taylor rule, the central bank can observe shifts in the AD and AS curve and can respond optimally to these shifts. What would it do?

Let's imagine an initial situation where the output gap is zero and inflation is at its target, and there is a temporary shift to the right of the AD curve due to an increase in autonomous expenditure. If the central bank is immediately aware of the change, it will immediately raise the real interest rate, causing the AD curve to shift back to its initial position, with no output gap and inflation still at target. Because monetary policy operates by affecting aggregate demand through the real interest rate, it can offset shocks to aggregate demand if they are observable with no delay, the central bank acts immediately, and changes in the real interest rate have an immediate impact on aggregate demand. This is illustrated in

Figure 11.3 below. The AD curve shifts to the right because of the increase in autonomous expenditure, and immediately shifts back to its original position.

[Figure 11.3 here]

Now imagine that an aggregate supply shock hits the economy. One example could be a major increase in oil and commodity prices which increases costs and pushes inflation up temporarily. This is illustrated by Figure 11.4 below. The short-run equilibrium of the economy is now at a point where inflation is above its long-run equilibrium level (above the inflation target) and the output gap is negative. If the central bank is immediately aware of the change, what can it do? If it decreases the real interest rate the AD curve shifts to the right: this would diminish the size of the output gap, but it would make inflation worse. If it increases the real interest rate and the AD curve shifts to the left, inflation would decrease towards the target rate, but the output gap would worsen.

[Figure 11.4 here]

The implication is that the central bank, because changing the real interest rate affects aggregate demand, it can offset shocks which shift the AD curve and stabilize both output and inflation. In response to shocks which shift the AS curve, the central bank faces a dilemma or a trade-off: it can stabilize output at the cost of making inflation worse, or it can stabilize inflation at the cost of worsening the output gap.

11.4 Convergence to the inflation target

If the central bank follows a Taylor rule, it cannot stabilize output and inflation perfectly, even in response to demand shocks. The parameters of the Taylor rule (α and β in equation (11.1) above influence the slope of the AD curve as shown in equation (11.4) in Application Box 11.1.

A larger value of α means that the central bank responds more strongly to deviations of the inflation rate from target, and the AD curve is steeper all other things being equal. With a steeper AD curve, a given shift in the AS curve as firms adjust their rate of price increases will have a greater effect on inflation and a smaller effect on the output gap. In other words, a larger value of α means that inflation adjusts relatively more quickly as the economy adjusts towards its long-run equilibrium

By contrast, a larger value of β means that the central bank responds more strongly to the output gap. Equation (11.4) shows that this means a shallower AD curve, which means that when the AS curve shifts in response to firms adjusting their rate of price increases, the effect on the output gap will be relatively greater. The output gap will adjust relatively more quickly as the economy adjusts towards its long-run equilibrium.

11.5 Working with the AS/AD model

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11.6 Monetary policy at the lower bound

What would happen if your bank offered you a deposit rate of -5 percent? A sum of $1,000 deposited at the beginning of the year would decline in value to $950 by the end of the year. Rather than making the deposit, you could instead hold $1,000 in the form of cash and still have $1,000 at the end of the year. You would not likely make the deposit. For this reason, prevailing interest rates cannot be substantially below zero.

This suggests that nominal interest rates could be *slightly* negative: you might be willing to accept a *small* negative return to avoid the costs of keeping your currency holdings safe

(such as buying a safe or renting a safety deposit box). Having a bank account also makes it easier to access your funds than if they are locked up in a safe or a safety deposit box. However, there is a lower bound on the nominal interest rate.

In fact, the Bank of Canada considers the effective lower bound on its overnight rate target to be equal to 0.25 percent. The Bank lowered its overnight rate target to this level during the Great Recession (from May 2009 until June 2010) and during the recession which resulted from the response to the Covid-19 pandemic (from March 2020 until March 2022).

In order to analyze the impact of the existence of a lower bound on nominal interest rates, we will assume for simplicity that it is exactly equal to zero. Our key assumption is as follows: *the nominal interest rate cannot be negative.*

The zero lower bound on the nominal interest rate affects the behaviour of the real interest rate. Recall that the Taylor rule (11.1) stipulates that the central bank sets the real interest rate as a function of the deviation of inflation from the target level and the output gap. By definition, the real interest rate is the difference between the nominal interest rate and expected inflation. This can be written as follows:

$$r = i - \pi^e,$$

where π^e is expected inflation. In situations where the nominal interest rate is at its zero lower bound, the real interest rate is just the inverse of expected inflation:

$$r = -\pi^e.$$

If the central bank is able to set the real interest rate according to the Taylor rule, it will do so. If achieving the desired real interest rate would require a negative nominal interest rate, it will set the nominal interest rate to zero, and the real interest rate will be equal to $-\pi^e$.

This means that we need to analyze the properties of the aggregate demand curve AD when the nominal interest rate is constrained to be at or above zero. In order to do this, we need to discuss the behaviour of expected inflation.

The behaviour of expected inflation

We will assume that *actual* inflation has an important impact on expected inflation. We have assumed that actual inflation is fixed at a point in time, and that it rises, falls, or holds steady over time depending on whether output is above, below, or equal to its natural rate (depending on the output gap). So, at any point in time the current inflation rate is a major determinant of inflation in the near future. We will assume that expected inflation is an increasing function of actual inflation:

$$\pi^e = \pi^e(\pi).$$

The MP curve

The Taylor rule (equation 11.1) stipulates that the central bank reacting to changes in real output as well as inflation. This can be represented graphically by Figure 11.5 below. We call the curve describing the relationship between real output and the real interest rate the **MP curve**. The graph shows the relationship between real GDP and the real interest rate set by the central bank. This is different from the relationship illustrated in Figure 5.3, which stressed the relationship between *inflation* and the real interest rate set by the central bank. The Taylor rule states that the real interest rate set by the central bank *also* depends on the inflation rate. This means that the MP curve is an example of *ceteris paribus*, that is to say it assumes a given inflation rate. Changes in the inflation rate will cause *shifts* in the MP curve. We analyze these shifts in detail below.

MP curve: describes the functional relationship between real output (GDP) and the real interest rate set by the central bank, holding the inflation rate constant.

[Figure 11.5 here. Base on Figure I-2 in Romer (2018)]

The MP curve with a lower bound on the nominal interest rate

How does taking the zero lower bound into account affect the shape of the MP curve? By definition, the real interest rate is equal to the nominal interest rate minus expected inflation: $r = i - \pi^e$. The central bank actually sets a nominal interest rate. Since it knows the value of expected inflation, it can therefore set the real interest rate.

What happens if inflation and/or real output are so low that the Taylor rule dictates a nominal interest rate below zero? The central bank is constrained by not being able to set a negative nominal interest rate. We will assume that if the central bank's desired real interest rate is below the lowest possible level, it will make the real rate as low as it can. In other words, if the Taylor rule calls for a negative nominal interest rate, it will set the nominal rate to zero.

With a nominal interest rate of zero, the real interest rate must be equal to the negative of expected inflation, i.e. $(0 - \pi^e(\pi))$. This is illustrated by Figure 11.6 below.

[Figure 11.6 here. Base on Figure IV-2 in Romer (2018)]

Most of the time, real output will be sufficiently high so that the central bank will want to set a positive nominal interest rate, and therefore will be on the upward-sloping portion of the LM curve. The MP curve is drawn for a given rate of inflatioon, and therefore for a given value of expected inflation. When real output is as low as or lower than the level at which the central bank would like to reduce its policy interest rate below zero, the LM curve becomes horizontal, with a real interest rate equal to $(0 - \pi^e(\pi))$.

The AD curve with a lower bound on the nominal interest rate

As shown in Chapter 5, the AD curve (illustrated by Figure 5.1) gives the relation between the real interest rate and planned expenditures by households and firms. It comes from considering the IS curve (illustrated by Figure 5.2) and the MP curve for different inflation rates.

The zero lower bound affects how the real interest rate is determined, but it does not affect the demand for goods at a given real interest rate. This means that it does not affect the IS curve, which retains its usual downward-sloping form.

However, the inflation rate does affect the MP curve. Changes in the inflation rate will shift both the upward-sloping part of the MP curve and its horizontal portion. This is illustrated by Figure 11.7 below.

[Figure 11.7 here. Base on Figure IV-3 in Romer (2018). No need to reproduce the lower portion of the graph]

The figure illustrates the effect of a drop in the inflation rate from π_0 to $\pi_1 < \pi_0$. First, consider the upward-sloping portion of the MP curve. The real interest rate stipulated by the Taylor rule depends negatively on the rate of inflation. Therefore, this portion of the MP curve must shift down. Now consider the horizontal portion of the MP curve. With the nominal interest rate stuck at zero, a lower rate of inflation implies a lower expected inflation rate and therefore a higher real interest rate. The horizontal part of the MP curve shifts up. The kink in the MP curve (the point at which the real interest rate stipulated by the Taylor rule is exactly equal to zero) shifts up and to the right.

Implications for the AD curve

If the inflation rate is high enough, the IS curve and the MP curve will intersect along the upward-sloping portion of the MP curve. This is illustrated in Figure 11.8 below, with an MP curve compatible with an inflation rate of π_0, labelled $MP(\pi_0)$. As noted in the previous subsection, as the inflation rate falls the upward-sloping portion of the MP curve shifts down along the downward-sloping IS curve. Planned expenditures increase as inflation decreases, so the AD curve is downward-sloping, like in the basic model of Chapter 5. Then, when the inflation rate falls to π_1 in Figure 11.6, the IS and the MP curve, labelled $MP(\pi_1)$ will meet at the *kink* in the MP curve. As the inflation rate falls below π_1 in the figure, the IS curve intersects the MP curve on the flat part of the MP curve. At lower and lower rates of inflation, the flat part of the MP curve shifts up and intersects the IS curve at higher and higher points, which imply lower and lower levels of planned expenditure. One possible intersection point, when $\pi_2 < \pi_1$, for the MP curve labelled $MP(\pi_2)$, which gives planned expenditure $Y_2 < Y_1$.

This means that, for inflation rates less than π_1 in Figure 11.6, the AD curve becomes *upward-sloping*. This is illustrated in Figure 11.8 below.

[Figure 11.8 here. Base in Figure IV-6 in Romer (2018). Reproduce the points from the previous figure with π_0, π_1 and π_2]

Aggregate supply

The zero lower bound affects how the central bank conducts monetary policy. Therefore it affects the aggregate demand side of the economy. However, it does not affect aggregate supply. The behavior of inflation and of the AS or IA curve is the same as before. Inflation is given at a point in time. It rises if output is above its natural rate, falls if output is below

its natural rate, and stays constant if it is equal to its natural rate.

Inflation adjustment at the lower bound

Consider a large negative shock to AD. How does the AD curve shift in response to such a shock? This is illustrated in Figure 11.9 below.

[Figure 11.9 here. Base on Figure IV-8 in Romer (2018). Show the inflation target and the natural level of output, here and in all figures that follow.]

The top part of the figure shows a large shift in the IS curve (from IS_0 to IS_1), large enough so that it intersects the MP curve along its flat portion. The zero lower bound on the central bank's nominal interest rate becomes binding in response to the shift.

The lower part of the figure shows what is happening with the AD curve. Since output is lower at any given inflation rate, the AD curve must shift to the left. Because output is lower for any given inflation rate, this reduces the central bank's nominal interest rate for any given rate of inflation as stipulated by the Taylor rule. This means that the upward-sloping portion of the MP curve shifts upwards, so the kink in the AD curve (the point at which it changes from downward-sloping to upward-sloping) shifts up and to the left. At the new intersection point between the AD curve and IA curve, the AD curve (AD_1) is upward-sloping, so we know that the zero lower bound is binding.

We have analyzed the immediate impact of a negative demand shock which pushes the central bank's nominal interest rate to its zero lower bound. How does the economy evolve over time after this shock? We turn to this subject in the next subsection.

The behaviour of the economy over time

Figure 11.10 shows what happens to the economy after the initial shock. The dynamics can be analyzed using an AD/AS diagram.

[Figure 11.10 here. Base on Figure IV-9 in Romer (2018)]

Because of the leftward shift in the AD curve, output is below its natural level. Therefore, inflation begins to fall. In the following period it falls from π_1 to π_2. Because we are on the upward-sloping portion of the AD curve, output must fall. This moves the short-run equilibrium output of the economy **further away** from its natural level. The real interest rate is no longer determined by what the central bank would like it to be. Instead, it is determined by the combination of expected inflation and the zero lower bound on the nominal interest rate. With the real interest rate equal to $0^{\smile}\pi^e$, and since π^e falls when inflation falls, a fall in the inflation rate raises the real interest rate and causes inflation to fall even further.

This process continues. The following period, inflation falls from π_2 to π_3, causing an additional droop in equilibrium output. The process continues from there. This means that the zero lower bound, when it is binding on the central bank, eliminates a key force which helps to stabilize the economy. Under normal circumstances, output below its natural level leads inflation to fall, prompting the central bank to reduce the real interest rate, thereby boosting aggregate demand and pushing output back towards its natural level.

What we have shown is that, in response to a shock which shifts the IS curve (and therefore the AD curve) to the left sufficiently to make the zero lower bound on the central bank's interest rate binding, the inflation adjustment process does not move the economy back towards its long-run equilibrium with output equal to its natural level and inflation at target. Such shocks are typically not permanent, even if they can be persistent.

What happens if the IS curve shifts back to the right? This is illustrated by Figure 11.11 below. We assume the shift happens when inflation is π_3 and is strong enough to shift the IS curve to a point where it intersect with the upward-sloping portion of the MP curve. The zero lower bound is no longer binding. As illustrated, short-term equlibrium output is still below its natural level. The central bank's nominal interest rate lifts off the zero lower bound, but the real interest rate is below its long-run level. Over time, inflation and output increase towards their long-run equilibrium levels, as does the real interest rate.

[Figure 11.11 here. Base in Figure IV-10 in Romer (2018)]

In our analysis, we have assumed a shift in the IS curve which is permanent or at least very persistent. What if the shock is only temporary, and the IS curve shifts back to its original position after one period? XX

The bottom line is that when the economy is in recession (output is below natural output), inflation must be falling. If the central bank's interest rate is at its lower bound, this means that the *real interest rate* must be *increasing*. This means that aggregate demand, all other things being equal, must be *falling*. This means that the economy is caught in a downward spiral, with both inflation and output decreasing over time.

The adjustment process which normally leads the economy to return to a long-run equilibrium, with inflation equal to target and real output equal to its natural level, is no longer operative.

Explaining the Great Recession

This example captures a central feature of what happened to many of the major world economies starting in 2008. A series of events led to a large fall in investment and consumption demand. In the case of Canada, there was also a large drop in the demand for Canadian

exports.[1] – so large that central banks cut interest rates virtually to zero. Unfortunately, those interest rate cuts were not enough to return output to normal. Without that stabilizing factor, output remained below its normal level for several years.

Explaining the economic effects of the Covid-19 pandemic

11.7 Policy at the zero lower bound

> **Disinflation**: a persistent fall in the inflation rate.

> **Deflation**: a persistent fall in the general price level.

Conclusions

This chapter examined the dynamic adjustment process of the economy towards its long-run equilibrium with GDP equal to its natural level and inflation equal to the central bank's inflation target. It looked at the optimal response of monetary policy to shocks to aggregate demand and aggregate supply if the central bank can observe those shocks with no delay.

[1] See Ambler and Kronick (2018), Chapter 5

KEY CONCEPTS

- **Taylor rule**: a monetary policy rule which stipulates that the central bank sets the real interest rate as a function of the deviation of inflation from its target and of the deviation of real output from potential output.
- **Equilibrium inflation rate**: the inflation control target set by the central bank.
- **Disinflation**: a persistent fall in the inflation rate.
- **Deflation**: a persistent fall in the general price level.

Exercises for Chapter 11

Chapter 12

Exchange rates, monetary policy and fiscal policy

In this chapter we will explore the following topics.

- 12.1 The balance of payments
- 12.2 The foreign exchange market
- 12.3 Flexible exchange rates and fixed exchange rates
- 12.4 Monetary and fiscal policy under flexible exchange rates
- 12.5 Monetary and fiscal policy under fixed exchange rates

In 1999 the Canadian economist Robert Mundell won the Nobel Prize in Economics for his work on the importance of exchange rate policy for the effectiveness of monetary and fiscal policies as tools to manage aggregate demand. Mundell showed for a small open economy like Canada, with a high degree of international capital mobility, that:

- with *flexible* exchange rates monetary policy is a powerful demand management tool, but fiscal policy is weak; and
- with *fixed* exchange rates monetary policy is ineffective as a demand management tool, but fiscal policy is strong.

The Bank of Canada's monetary policy framework, using interest rates, flexible exchange rates and an inflation rate target reflects these strong theoretical arguments. Furthermore, the difficulties European countries using the euro have experienced trying to cut budget deficits and stimulate income growth show the constraint a fixed exchange rate imposes on fiscal adjustments.

This chapter explains the foreign exchange market, flexible and fixed exchange rates and the reasons why different exchange rate policies affect the design and effectiveness of monetary and fiscal policy.

12.1 The balance of payments

The **balance of payments accounts** provide the background to supply and demand in the foreign exchange market. They record transactions between residents of one country and the rest of the world that involve payments in different national currencies. The balance of payments accounts provide the background to supply and demand in the foreign exchange market. They record transactions between residents of one country and the rest of the world that involve payments in different national currencies. For the Canadian balance of payments, entries in the accounts are converted to and entered in Canadian dollars. Transactions that give rise to an inflow of funds from other countries to Canada are entered as credits. Transactions that give rise to an outflow of funds from Canada to other countries are entered as payments.

Balance of payments accounts: a record of trade and financial transactions between residents of one country and the rest of the world.

Table 12.1 shows the actual Canadian balance of payments accounts in 2021. Entries in the "Exports" column represent supplies of foreign currency coming to the Canadian foreign exchange market, converted to Canadian dollars. Entries in the "Imports" column represent the demand for foreign currency in the Canadian foreign exchange market, converted to Canadian dollars. Row 5 in the table shows that after adjustment for statistical error and changes in official reserves, the foreign exchange market is in equilibrium — supply equals demand.

Table 12.1: **The Canadian Balance of Payments, 2021 (billions of Cdn $)**

		Receipts (Exports)	**Payments** (Imports)	**Balance**
1.	**Current account**			
	Goods	636.4	631.7	4.7
	Services	139.4	145.2	-5.8
	Investment Income	149.1	144.1	5.0
	Transfers, etc.	15.1	20.5	-5.4
	Balance			**-1.5**
2.	**Financial account**			
	Investment	**Foreign investment in Canada**	**Foreign investment by Canada**	
	Direct investment	81.3	120.6	-39.4
	Portfolio investment	218.0	165.5	52.5
	Other invesment	123.3	109.0	14.3
	Balance			**27.4**
3.	**Statistical discrepancy**			**-0.6**
4.	**Official reserves**			**25.3**
5.	**Balance of payments** $[(1)+(2)+(3)-(4)]$			**0.0**

Source: Statistics Canada Tables 36-10-0014-01 and 36-10-0471-01

The **current account** of the balance of payments records international flows of goods, services, investment income and transfer payments. The merchandise trade is exports and

imports of goods; things like cars and car parts, steel, wheat, and electronic equipment. Non-merchandise trade measures exports and imports of services like travel, banking and financial services, transportation, and tourism. The total of merchandise and non-merchandise trade is the **trade balance** defined as *net exports* in our earlier study of planned expenditure and aggregate demand.

> **Current account**: a record of trade in goods, services, investment income and transfer payments.

> **Trade balance**: net exports, the value of exports minus the value of imports.

The trade balance is not the same thing as the current account of the balance of payments. There are also flows of investment income in the form of interest payments, dividends and reinvested earnings, and transfer payments between countries as a result of government programs like foreign aid as well as private receipts and payments.

But exports and imports of goods and services are the largest components of the current account. Trade in goods and services is based, in part on differences across countries in tastes, in the types of goods and services available, in economic structure, in national income levels and differences in the prices of domestic goods and services relative to foreign goods and services.

Three factors determine the prices of foreign goods and services relative to prices of domestic goods, namely:

1. the domestic price level (P_{Cdn}) for Canada;
2. the foreign currency price of imports (in the case of American goods, P_{US}); and
3. The **nominal exchange rate** (er), the domestic currency price of foreign currency.

International price competitiveness is measured by the **real exchange rate**, which combines these three factors. For example, the real exchange rate between Canada and the United States would be:

$$\text{Real exchange rate} = \frac{er \times P_{US}}{P_{Cdn}},$$

where the nominal exchange rate er is the Canadian dollar price of the US dollar and P_{US} and P_{Cdn} are general price levels as measured, for example, by GDP deflators or consumer price indexes. The real exchange rate measures the relative price of United States goods and services in Canadian dollars relative to Canadian goods and services in Canadian dollars.

> **Nominal exchange rate**: the domestic currency price of a unit of foreign currency.

> **Real exchange rate**: the relative price of goods and services from different countries measured in a common currency.

The real exchange rate makes an important link in the transmission mechanism between the foreign exchange rate and the impact of domestic price levels and inflation rates on net exports, aggregate expenditure and aggregate demand.

Consider the following example.

- The nominal exchange rate is $er = \frac{\$1.25\text{Cdn}}{\$1\text{US}}$.
- The GDP deflator for Canada is 121.3, on the base year 2002.
- The GDP deflator for the US is 110.4, on the base year 2002.

Then, the real exchange rate, which gives the price of US goods in Canadian dollars relative to the price of Canadian goods in Canadian dollars, is given by

$$\text{Real exchange rate} = \frac{er \times P_{US}}{P_{Cdn}} = \frac{1.25\ddot{O}110.4}{121.3} = 1.138.$$

In this example, US goods and services are about 14 percent more expensive than Canadian goods and services, on average, when both are priced in Canadian dollars. At the same time, Canadian goods and services are less expensive than domestic goods in the US when both are priced in US dollars. These price differentials as are important to the flows of exports and imports of goods and services between countries.

The **capital account** of the balance of payments makes a link between interest rates and the supply and demand for foreign exchange and the exchange rate.

> **Capital account**: the record of capital transfers and the purchases and sales of real and financial assets.

The financial account records the flows of funds for international purchases and sales of real and financial assets. Table 12.1 shows a net capital inflow of $27.4 billion in 2021. The payments by foreigners buying Canadian assets exceeded the payments made by Canadians buying foreign physical and financial assets. A financial account surplus was the result.

Receipts and payments in the financial account reflect sales and purchases of foreign assets. These flows have become increasingly important. Computers and electronic communications make it as easy for a Canadian resident to buy and sell stocks and bonds in the financial markets of New York or London as in Toronto. Moreover, controls on international capital flows have gradually been dismantled with globalization and financial integration.

The world's financial markets now have two crucial features. First, financial account restrictions on capital flows between advanced countries have been abolished. Funds can move freely from one country to another in search of the highest expected *rate of return.* Second, trillions of dollars are internationally footloose, capable of being switched between countries and currencies when assets with similar degrees of risk are expected to offer different rates of return in different countries and currencies.

This is the age of **perfect capital mobility** when small differences in expected returns

trigger very large flows of funds from country to country. Indeed, the stock of international funds is now so huge that capital flows could swamp the typical current account flows from exports and imports.

> **Perfect capital mobility**: when very small differences in expected returns cause very large international flows of funds.

In international asset markets, capital gains or losses arise not merely from changes in the domestic price of an asset, but also from interest rate differentials and changes in exchange rates while temporarily holding foreign assets. Table 12.2 provides an example.

Table 12.2: **Returns from lending $1,000 for a year**

	$1,000 lent in	**Interest rate (%)**	**Exchange rate ($Cdn/$US)**		**Final asset value**	
			Initial	**Final**	**$Cdn**	**$US**
1.	Canada	4.0			1,040.00	
2.	United States	5.0	1.03	1.009	1,028.50	1,019.41

table footnote

Suppose you can invest $1,000Cdn for a year. Canadian one-year interest rates are 4 percent. In the United States one-year rates are 5 percent. The higher United States rates look attractive. If you keep your funds in Canadian dollars, Row 1 shows that you will have $1,040 at the end of the year. Can you do better by buying a United States asset?

Row 2 shows what happens if you convert $1,000Cdn into US dollars at an initial exchange rate of $1.03Cdn/$1US. You would have $970.87US to invest at the United States interest rate of 5 percent. You would get $1,019.41US. You would be ahead if the exchange rate remained constant: $1,019.41US is $1,050Cdn, a return of 5 percent, as you would expect.

Suppose, however, the exchange rate changes while your funds are out of the country. Let's say the Canadian dollar appreciates by 2 percent during the year, lowering the exchange rate to $1.009Cdn/$1US When converted back to Canadian dollars your $1,019.41US now buys

just $1,028.50Cdn. You get 1 percent more interest income from holding the United States asset instead of the Canadian asset, but you suffer a capital loss of 2 percent by temporarily holding US dollars, whose value relative to Canadian dollars fell by 2 percent in that year.

In this example, you end up with about $1,028.50Cdn if you lend in US dollars. The Canadian dollar appreciated by more than 1 percent, the difference between Canadian and United States interest rates. As a result, the capital loss from the exchange rate while holding US dollars outweighed the gain on interest. This was the experience of many portfolios in 2008 as the Canadian dollar appreciated strongly and the exchange rate fell. The total return on lending in US dollars was lower than the return in Canadian dollars.

Conversely, if the Canadian dollar depreciated against the US dollar while you were holding your United States asset, your total return would be higher than the 1 percent interest rate differential. You would get a gain on the exchange rate when you converted back to Canadian dollars. This was the experience of portfolios holding assets denominated in US dollars as the Canadian dollar depreciated over the period from May 2008 to March 2009, raising the nominal exchange rate from $er = 0.9994$ to $er = 1.2645$. The exchange rate movement provided a 26.5% annual return, in terms of Canadian dollars, to portfolios holding US dollar assets.

The following equation summarizes this result. The total return on temporarily lending in a foreign currency is the interest paid on assets in that currency plus any capital gain (or minus any capital loss) arising from the depreciation (appreciation) of the domestic currency during the period.

$$\text{Return on foreign asset} = (\text{Interest rate on foreign asset}) \pm (\%\ \text{increase/decrease in } er)$$

$$= i_f + \%\Delta er.$$

As a result, the net capital flow in the balance of payments depends positively on the differential between domestic and foreign nominal interest rates $(i - i_f)$. A rise in domestic rates relative to foreign rates would attract a flow of funds into the domestic financial market. A fall in domestic rates would push the flow toward foreign financial markets, assuming in both cases that the exchange rate is not expected to change in an offsetting direction.

Alternatively, assuming the interest rate differential is constant, the net capital flow depends negatively on the expected rate of depreciation of the domestic currency suggested by $\left(\frac{er^e}{er} - 1\right)$. An expectation that the domestic currency will depreciate (a rise in er^e) will increase the returns from holding foreign assets and lead to a net capital outflow. An expected appreciation would reduce expected returns on foreign assets with the opposite effect. These capital flows are important parts of the supply and demand for foreign exchange on the foreign exchange market.

The **change in official international reserves** in Table 12.1 records the increase or decrease in the Government of Canada's holdings of foreign currency balances. A government's holdings of foreign currencies are in its official international reserves account. These balances are like investments in foreign countries because they are the government's holdings of foreign assets. An increase in the official reserves is like a payment item in the financial account of the balance of payments. Because Canada maintains a flexible exchange rate, annual changes in international reserves are small. When it comes to discussing different exchange rate policies, countries that adopt fixed exchange rates often experience large changes in their foreign currency reserves in defense of the exchange rate they have set.

> **Change in official international reserves**: the change in the Government of Canada's foreign currency balances.

The **balance of payments** is the sum of the balances in current and financial accounts minus the change in the official international reserves account. In Table 12.1, this balance is shown as the sum of accounts $(1 + 2 + 3 - 4)$ namely $(-1.5 + 27.4 - 0.6 - 25.3) \approx 0$. If

all items in the accounts were measured correctly, the balance would be zero. To recognize this, a statistical discrepancy adjustment is made, as shown in the table, to account for any errors in the measurement of other items.

> **Balance of payments**: the sum of the balances in current accounts and capital accounts, minus the change in the holdings of official reserves.

The record of the change in official reserves is always of equal magnitude to the sum of the balances on the current and capital accounts, if there is no statistical discrepancy in the measurements. As a result, *the balance of payments always balances*, but the state of the individual accounts underlying that overall balance need not be in balance. Indeed, changes in the foreign exchange rate in the foreign exchange market reconcile the different account balances to produce overall balance.

Net Domestic Savings, International Capital Flows and Policy Issues

The Balance of Payments must always balance, as the example in Table 12.1 shows. Current account surpluses or deficits must be offset by capital account deficits or surpluses. The national accounts make a link between incomes and expenditures and the current account in the balance of payments that illustrates why and how *net domestic savings* and *net international capital flows* are related. That relationship often raises policy questions and debates about the causes of, and remedies for, current account deficits and government budget deficits.

To see this, recall from the national accounts in Chapter 4 that GDP, the sum of actual expenditures, is given by the following identity.

$$GDP = C + I + G + X - IM.$$

Recall that GDP gives the value of final goods and services produced in a country. Some of this value added is owned by foreigners and is transferred abroad. Some citizens of the country own property or work abroad and transfer income to the country.

This leads to a distinction between GDP and **gross national product** or **GNP**, which gives the value of final output owned by the citizens of a country as opposed to the value of final output produced within the borders of a country.

> **Gross national product (GNP)**: the value of final output owned by citizens of a country.

The difference between GNP and GDP is the value of net transfers (investment income and transfers received from citizens living abroad minus investment income and transfers sent abroad by foreigners living in the country). If NT denotes net transfers we have the following definition of gross national product:

$$GNP = C + I + G + X - IM + NT.$$

Note as well that $(X - IM + NT)$ corresponds to the *current account* of the balance of payments.

The GNP received by households can be used for three possible purposes: consumption, the payment of taxes, and saving, which can be written as follows:

$$GNP = C + T + S.$$

This is just another way of saying that disposable income $(GNP - T)$ can be used for either consumption or saving. Equating these two different ways of decomposing GNP gives the following equation.

$$C + T + S = C + I + G + X - IM + NT.$$

Subtracting $(C + I + G)$ from both sides of the equation leads to the following equality.

$$(S - I) + (T - G) = (X - IM + NT).$$

The two terms on the left hand side of this equation have the interpretation of **net national saving**. The first term in parenteses gives net *private* saving, equal to household saving minus private investment spending. The second term give net *public* spending, government's (all levels of government) tax receipts less what it spends.

> **Net national saving**: the sum of net private saving (household saving minus private investment) and net public saving (the total tax receipts of all levels of government less its spending on goods and services).

We know that the balance of payments has to balance. Since the current account is equivalent to net national savings, this tells us that negative net national savings must be financed from one of two sources: positive net capital flows from abroad, or by a decrease in the official reserve holdings by the central bank.

The equation says that changes in the current account balance can result from:

1. a change in household savings;
2. a change in private investment;
3. a change in the government's budget balance;
4. a change in net exports; and/or
5. a change in the value of net international investment income or transfers.

Of course these changes are not independent from one another, and changes are constrained to satisfy the equality.

The important policy questions are whether the underlying cause of the change in the current account balance would positively affect national economic conditions and activity. However, regardless of the causes of changes in the current account balance, international capital flows in the financial account balance will change to maintain overall balance in the balance of payments.

12.2 The foreign exchange market

The foreign exchange market is the market in which the currencies of different countries are bought and sold and the prices of currencies, the foreign exchange rates, are established. Consider the market for US dollars as the foreign currency. The sources of supply and demand for foreign exchange are shown by the balance of payments in Table 12.1. Exports of goods, services, and financial assets generate a supply of foreign currencies that are sold in the foreign exchange market for Canadian dollars. Imports of goods, services, and securities must be paid for in foreign currencies. The demand for foreign exchange is derived from this demand for imports. Without intervention by governments, demand and supply determine the exchange rate, as, for example, $er_0 = 1.05$ in Figure 12.1.

Different economic and financial conditions would change supply and demand for foreign exchange and result in a different exchange rate. In May of 2019, for example, the Canadian dollar price of the US dollar was $1.33. By contrast when energy and commodity prices were high in 2010 the price of a US dollar was $1.0299 Canadian dollars.

[Figure 12.1 here. XX]

The exchange rate $er_0 = \$1.05$ is what it costs in Canadian dollars to buy each US dollar you want for your winter reading week break in Florida. Alternatively, if you as an exporter of lumber to the US market receive $1,000US for every 1000 board feet of 2x4 lumber you

sell to US builders, your Canadian dollar revenue to cover your Canadian costs is $1,050.

If the price of goods in US markets is constant, a lower exchange rate er_1, say $er_1 = 1.01$, *other things constant*, by lowering the price and raising the quantity of Canadian imports, must raise the demand for US dollars. In Figure 12.1, the demand curve for US dollars D_0 *slopes downwards*. More US dollars are demanded to buy more imports at a lower Cdn$/US$ exchange rate.

The US dollars supplied on the foreign exchange market are the receipts from the export of goods, services, and securities to US residents. From the discussion of the current and financial accounts of the balance of payments, exports of goods and services depend on foreign income, the relative prices of domestic and foreign goods and services, and the exchange rate. Net exports of securities depend on the difference between domestic and foreign interest rates, for given expectations of the future exchange rate.

In Figure 12.1, the supply curve shows the quantities of US dollars that would come to the market at different exchange rates, er, all other things constant. It slopes upward because a higher Cdn$/US$ exchange rate lowers the prices of Canadian goods and services to US buyers. As a result, United States residents buy more Canadian exports and total export receipts rise. The quantity of US dollars coming onto the foreign exchange market increases as we move up the supply curve. The supply curve has a positive slope.

At the equilibrium exchange rate er_0, the quantities of US dollars supplied and demanded are equal. In terms of the balance of payments, the balance is zero. Receipts equal payments.

In practice, as seen in Table 12.1, the balance of payments is recorded in domestic currency. However, the equality of receipts and payments still holds. Both are easily converted to Canadian dollars by multiplying the US dollar amounts by the exchange rate. In terms of Figure 12.1, multiplying U_0 on the horizontal axis by the exchange rate er_0 on the vertical axis gives the area of the rectangle bounded by the dotted lines and the vertical and horizontal

axes, the Canadian dollar value of total receipts or total payments recorded in the balance of payments.

What would change the equilibrium in Figure 12.1? A change in any of the factors held constant in order to draw the supply and demand curves will shift one or the other or both curves. We see this in both the net export and capital flow functions. A rise in United States income would increase US imports from Canada and shift the supply of foreign exchange to the right. As discussed above and in Chapter 9, a change in interest rates in Canada or the United States would change the trade in financial assets and affect both the supply curve and the demand curve. In short, a change in any market condition other than the exchange rate er will change supply and demand conditions in the market. The exchange rate will then change to a new equilibrium. Figure 12.2 and 12.3 provide examples.

The effect of a recession in the US economy on the exchange rate

The demand and supply curves in the foreign exchange market of Figure 12.2 are drawn on the assumption that tastes, incomes, prices of goods and services, interest rates, and expectations of future exchange rates are constant. The flows of payments and receipts under these conditions result in the equilibrium exchange rate er_0. This would be a Canadian dollar price for the US dollar of, for example, $1.35. From the United States perspective, a Canadian dollar costs a United States resident about $0.74US.

[Figure 12.2 here. XX]

Now suppose, as occurred in early 2008 and 2009, a recession in the United States lowers United States real income. United States imports fall, based on the US marginal propensity to import. United States imports are Canadian exports, and the US dollar receipts of Canadian exporters are reduced. The recession and difficult household financial conditions reduce US residential construction and Canadian lumber exports decline. Recession also reduces

travel by US residents, and the Canadian tourism industry suffers a decline in bookings and receipts. If expenditures on new cars in the United States are reduced, Canadian auto industry sales to the United States market are reduced. In the balance of payments, the balance on trade in goods and services falls, and in the foreign exchange market *the supply of US dollars on the market is reduced*.

The supply curve in Figure 12.2 shifts leftward to S_1. At the initial exchange rate er0 , the demand for US dollars exceeds the supply, putting upward pressure on the exchange rate. In terms of the balance of payments, the excess demand for US dollars represents a balance of payments deficit. In the example shown here, the Canadian dollar depreciates and the exchange rate rises to restore equilibrium in the foreign exchange market and the balance of payments. A higher price for the US dollar reduces Canadian imports and increases the Canadian dollar receipts of Canadian exporters. The effects of the US recession on the Canadian balance of payments are offset by the exchange rate change.

The rise in the exchange rate in this case is a **depreciation** of the Canadian dollar and a corresponding **appreciation** of the US dollar.

> **Currency depreciation**: a fall in external value of the domestic currency that raises domestic currency price of foreign currency.

> **Currency appreciation**: a rise in external value of the domestic currency that lowers the domestic currency price of foreign currency.

Before the recession of 2009, Canadian experience was the opposite of this example. High GDP growth rates in the US and Asia created very strong international demand for Canadian commodities and crude oil at high international prices. Strong oil and commodity exports increased the supply of foreign currencies on the Canadian foreign exchange market. The Canadian dollar appreciated strongly, with the exchange rate falling from $1.57Cdn/$1US in 2002 to an average of $0.9994 Cdn/$1US in May of 2008, a fall of about 60 percent over the

six year period. Exchange rate changes led to a restructuring of both exports and imports to maintain equilibrium in the balance of payments as Canada's international trade changed dramatically.

The effect of a fall in foreign interest rates on the foreign exchange rate

n the previous example a change in foreign income and the supply of foreign exchange disrupted the equilibrium in the foreign exchange market and changed the exchange rate. As an alternative to that example, consider the effects of a cut in foreign interest rates.

In Figure 12.3 the foreign exchange market is in equilibrium, initially at an exchange rate er_0. A fall in foreign interest rates, other things constant, disrupts this equilibrium. Now lower foreign rates make domestic (Canadian) bonds more attractive to foreign portfolios than they were previously. The demand for domestic bonds rises. The supply of US dollars coming on the market to pay for these bond exports increases, shifting S0 to S1 in the diagram. At the same time, the attractiveness of foreign bonds for domestic portfolios is reduced, reducing the demand for US dollars to pay for them. The demand curve shifts from D_0 to D_1. The equilibrium exchange rate falls to er_1.

[Figure 12.3 here. XX]

In balance of payments terms the net capital inflow, the balance on financial account, is increased. The change in the exchange rate causes an offsetting change in the current account that restores equilibrium in the foreign exchange market and the balance of payments. A lower nominal exchange rate lowers the real exchange rate. Imports are now cheaper and exports, priced internationally in US dollars, are less profitable. Export receipts are reduced. As we saw in Chapter 9, changes in the exchange rate are one channel by which changes in financial conditions impact AD and equilibrium GDP.

Figures 12.2 and 12.3 provide two examples of adjustments in the foreign exchange rate. The underlying assumption is that *exchange rates are flexible* and allow the market to adjust freely and quickly to changing circumstances.

However, there are alternative exchange rate arrangements. To understand how the foreign exchange rate operates in different countries, we need to consider the different *exchange rate policies* governments can adopt. These result in different foreign exchange rate regimes, different ways that the balance of payments adjusts to change, and different roles for monetary and fiscal policies.

12.3 Flexible exchange rates and fixed exchange rates

To grasp the basics of **exchange rate regimes**, we focus on two extreme forms that have been adopted to handle international transactions in the world economy: **flexible exchange rates** and **fixed exchange rates**.

Floating or flexible exchange rates

In a **floating or flexible exchange rate regime**, the exchange rate is allowed to find its equilibrium level on the foreign exchange market *without central bank intervention*.

> **Flexible exchange rate**: Supply and demand in the foreign exchange market determine the equilibrium exchange rate without central bank intervention.

Figures 12.2 and 12.3 showed the exchange rates that would result if rates adjusted flexibly and freely in response to changes in demand and supply. The central bank *did not intervene* to fix or adjust the rate. The rise in the demand for US dollars would result in a rise in the exchange rate to clear the foreign exchange market and maintain the balance of payments.

Alternatively, the fall in demand would result in a fall in the exchange rate. The Bank of Canada would not intervene in either case. The holdings of official foreign exchange reserves and the domestic money supply would not be affected by foreign exchange market adjustments.

The alternative is a *fixed exchange rate* as explained below. In this regime, the central bank sets an official exchange rate and intervenes in the foreign exchange market to offset the effects of fluctuations in supply and demand and maintain a constant exchange rate. In Canada in the 1960s the exchange rate was fixed by policy at \$1US = \$1.075Cdn (\$1Cdn ≈ \$0.925US) and the Bank of Canada intervened in the foreign exchange market to maintain that rate.

How do countries choose between fixed and floating exchange rates? Obviously, there is not one answer for all countries or we would not see different exchange rate regimes today. With flexible rates, the foreign exchange market sets the exchange rate, and monetary policy is available to pursue other targets. On the other hand, fixed exchange rates require central bank intervention. *Monetary policy is aimed at the exchange rate.*

The importance a country attaches to an *independent monetary policy* is one very important factor in the choice of an exchange rate regime. Another is the size and volatility of the international trade sector of the economy. A flexible exchange rate provides some *automatic adjustment and stabilization* in times of change in net exports or net capital flows.

Fixed exchange rates

In a **fixed exchange rate** regime, the government intervenes actively through the central bank to maintain convertibility of their currency into other currencies at a fixed exchange rate. A currency is **convertible** if the central bank will buy or sell as much of the foreign currency as people wish to trade at a fixed exchange rate.

Fixed exchange rate: an exchange rate set by government policy that does not change as a result of changes in market conditions.

Convertible currency: a national currency that can be freely exchanged for a different national currency at the prevailing exchange rate.

In Figure 12.4, suppose the exchange rate is fixed at er^* . There would be a free market equilibrium at A if the supply curve for US dollars is S_1 and the demand curve for US dollars is D_1. The central bank does not need to buy or sell US dollars. The market is in equilibrium and clears by itself at the fixed rate.

[Figure 12.4 here. XX]

Suppose demand for US dollars shifts from D_1 to D_2. Canadians want to spend more time in Florida to escape the long, cold Canadian winter. They need more US dollars to finance their expenditures in the United States. The free market equilibrium would be at B, and the exchange rate would rise if the Bank of Canada took no action.

However, with the exchange rate fixed by policy at er^* there is an excess demand for US dollars equal to AC. To peg[1] the exchange rate, the Bank of Canada sells US dollars from the **official exchange reserves** in the amount AC. The supply of US dollars on the market is then the "market" supply represented by S_1 plus the amount AC supplied by the Bank of Canada. The payment the Bank receives in Canadian dollars is the amount ($er^* \times$AC), which *reduces the monetary base* by that amount, just like an open market sale of government bonds. The lower monetary base pushes domestic interest rates up and attracts a larger net capital inflow. Higher interest rates also reduce domestic expenditure and the demand for imports and for foreign exchange. *The exchange rate target drives the Bank's monetary policy*, which in turn changes both international capital flows and domestic income and

[1]Typically, a country will "peg" its currency, either to a major currency such as the US dollar or to a basket of currencies.

expenditure.

> **Official exchange reserves**: government foreign currency holdings managed by the central bank.

What if the demand for US dollars falls to D3 ? The market equilibrium would be at F. At the exchange rate at er^* there is an excess supply of US dollars EA. The Bank of Canada would have to *buy* EA US dollars, reducing the supply of US dollars on the market to meet the "unofficial" demand. The Bank of Canada's purchase would be added to foreign exchange reserves. The Bank would pay for these US dollars by *creating more monetary base*, as in the case of an open market purchase of government securities. In either case, maintaining a fixed exchange rate requires **central bank intervention** in the foreign currency market. The central bank's monetary policy is expansionary because it is committed to the exchange rate target.

> **Central bank intervention**: purchases or sales of foreign currency intended to manage the exchange rate.

When the demand schedule is D_2, foreign exchange reserves are running down. When the demand schedule is D_3, foreign exchange reserves are increasing. If the demand for US dollars fluctuates between D_2 and D_3, the Bank of Canada can sustain and stabilize the exchange rate in the long run.

However, if the demand for US dollars is (on average) D_2, the foreign exchange reserves are steadily declining to support the exchange rate er^*, and the monetary base is falling as well. In this case, the Canadian dollar is overvalued at er^*; in other words, er^* is too low a price for the US dollar. A higher er is required for long-run equilibrium in the foreign exchange market and the balance of payments. As reserves start to run out, the government may try to borrow foreign exchange reserves from other countries and the International Monetary

Fund (IMF), an international body that exists primarily to lend to countries in short-term difficulties.

At best, this is only a temporary solution. Unless the demand for US dollars decreases, or the supply increases in the longer term, it is necessary to **devalue** the Canadian dollar. If a fixed exchange rate is to be maintained, the official rate must be reset at a higher domestic currency price for foreign currency.

> **Devaluation (revaluation)**: a reduction (increase) in the international value of the domestic currency.

For many years frequent media and political discussions of the persistent rise in China's foreign exchange holdings provide a good example of the defense of an undervalued currency. With the yuan at its current fixed rate relative to US dollars and other currencies, China has a large current account surplus that is not offset by a financial account deficit. Balance of payments equilibrium requires ongoing intervention by the Chinese central bank to buy foreign exchange and add to official reserve holdings. Buying foreign exchange adds to the monetary base and money supply, raising concerns about inflation. The Bank has responded in part with a small revaluation of the yuan and in part with an increase in the reserve requirements for Chinese banks. Neither of these adjustments has been sufficient to change the situation fundamentally and growth in official foreign exchange reserves continues.

In Europe the euro currency system effectively fixes exchange rates among member countries. Individual member countries do not have national monetary policies. Monetary policy is set by the European Central Bank. In the years following the financial crisis of 2008 and the Great Recession this has been a source of controversy because economic and fiscal conditions have differed significantly among countries. Countries trying to adjust fiscal deficits and national public debt crises have been forced into fiscal austerity without offsetting monetary policy support. In many cases the results have been deep and prolonged recessions without solving their debt problems. Greece is the poster child.

Of course, it is not necessary to adopt the extreme regimes of pure or clean floating on the one hand and perfectly fixed exchange rates on the other hand. *Dirty or managed floating* is used to offset large and rapid shifts in supply or demand schedules in the short run. The intent is to smooth the adjustment as the exchange rate is gradually allowed to find its equilibrium level in response to longer-term changes.

12.4 Monetary and fiscal policy under flexible exchange rates

In a closed economy with slow wage and price adjustments, monetary and fiscal policies are both important tools for aggregate demand management in the short run. Things are different in open economies with high international capital mobility. *With flexible exchange rates monetary policy is powerful* for changing AD. It works through both interest rate and exchange rate linkages in the transmission mechanism, not just the interest rate linkages of the closed economy. By contrast, *the effects of fiscal policy on aggregate demand are reduced.* In the absence of supporting monetary policy, fiscal expansions crowd out private sector expenditures through both interest rate and exchange rate linkages, leaving AD unchanged.

Fixed exchange rates have the opposite implications for policy effectiveness as an AD management tool. *The effects of fiscal policy are enhanced by induced changes in monetary conditions required to maintain the fixed exchange rate. But monetary policy alone, committed to fixing the exchange rate, is almost powerless to change AD.* As a result, the first important step in the design of macroeconomic policy in the open economy is the choice of an exchange rate regime.

Monetary policy

With flexible exchange rates, monetary policy causes changes in both interest rates and exchange rates. Net international capital flows link exchange rates and changes in domestic interest rates when exchange rates are flexible. Given the exchange rate expected in the long run, higher interest rates in the short to medium run cause a capital inflow, an increased supply of foreign exchange on the foreign exchange market, which lowers the exchange rate, er. Conversely, lower domestic interest rates relative to international rates cause a rise in the exchange rate, er.

The "transmission mechanism" introduced in Chapter 9 shows how changes in monetary policy, with flexible exchange rates change aggregate demand and equilibrium income.

$$\Delta i \Rightarrow \left(\begin{array}{c} \Delta C + \Delta I \\ \Delta er \Rightarrow \Delta NX \end{array} \right) \Rightarrow \Delta AE \times \text{multiplier} \Rightarrow \Delta AD \Rightarrow \Delta Y.$$

As a result, in an open economy with flexible exchange rates, monetary policy affects aggregate demand not just through the effects of interest rates on consumption and investment. With linkages through both domestic and international components of expenditure, monetary policy is more powerful under flexible exchange rates than in a closed economy.

Canada and a number of other countries conduct monetary policy in terms of a target for the domestic inflation rate. A flexible exchange rate policy is essential for the monetary policy independence and power required to pursue that target. That is why the Bank of Canada defines Canada's flexible exchange rate as a key component of Canada's monetary policy framework. The other key component is the Bank's inflation control target.

12.4.1 Fiscal policy

With flexible exchange rates, but without monetary policy accommodation or support, the effect of interest rate changes on exchange rates and competitiveness undermines the power of fiscal policy to manage aggregate demand.

Suppose the government undertakes a *fiscal expansion*, raising government expenditures or lowering taxes or some combination of the two: Aggregate demand increases. When monetary policy targets an inflation rate using either an interest rate rule or a money supply rule, the expansion in AD caused by fiscal policy changes the economic fundamentals on which the central bank's policy had been set and induces the bank to *raise interest rates*. The higher interest rates cause a net capital inflow and an increased supply of foreign exchange on the foreign exchange market, and the nominal exchange rate falls. A fall in the nominal foreign exchange rate *lowers the real exchange rate*. International price competitiveness (as measured by the real exchange rate) is reduced and net exports fall, offsetting the expansionary effects of the change in fiscal policy. *With flexible exchange rates monetary policy targeted to the inflation rate dominates fiscal policy* as a tool for AD management. The sequence of crowding out can be summarized as follows.

$$\uparrow G \Rightarrow \uparrow AE \Rightarrow \frac{\uparrow Y}{Y_p} \Rightarrow \uparrow \pi \Rightarrow \uparrow i_{onr} \Rightarrow \downarrow er \Rightarrow \downarrow NX \Rightarrow \downarrow AE \Rightarrow \frac{\downarrow Y}{Y_p}.$$

As discussed previously, Canadian experience provides an example. In the 2005-2007 period,the federal government provided fiscal stimulus through tax cuts and expenditure increases. The primary structural budget balance fell from an average 3.4 percent of potential GDP for 2002 to 2004 to 2.6 percent for 2005 to 2007. At the same time the Bank of Canada's estimates showed the economy operating with a small but persistent inflationary gap. The inflation rate was in the upper level of the Bank's target range. The Bank responded to strong current and expected demand (coming from both the government and private sec-

tor) by raising its overnight rate in steps, from 2.5 percent in late-2005 to 4.5 percent by mid-2007, to defend its inflation target. The inflationary gap and inflation were contained as higher interest rates and lower exchange rates limited the growth of aggregate demand, including that coming from fiscal stimulus.

However, if control or reduction of the debt ratio is the prime target of fiscal policy, the flexible exchange rate is helpful. If the government raises tax rates or cuts expenditures to raise its structural budget balance and reduce the debt ratio, lower settings for the central bank's interest rate and a rising exchange rate provide some offsetting "crowding in" through both domestic expenditure and net exports. The limited aggregate demand effects of fiscal policy under flexible exchange rates facilitate control of the government's budget balance and debt ratio.

This analysis of the policy implications of flexible rate regimes leads to a clear recommendation for policy co-ordination. Flexible exchange rates provide the framework for effective monetary policy focused on a medium term inflation target. The exchange rate regime enhances the power of monetary policy to moderate business cycle fluctuations and the output gaps they create. Stabilizing the economy at or close to potential output avoids the cumulative inflationary or recessionary pressures that would push inflation rates away from the monetary policy target. Monetary policy is then the aggregate demand management tool.

Fiscal policy is not an effective AD management tool when exchange rates are flexible. Its impacts on aggregate demand are limited by crowding out and dominated by monetary policy. However, this does enhance the power of fiscal policy to pursue deficit control and debt ratio control. The effects of fiscal restraint aimed at improved public finances are moderated by a monetary policy focused on an inflation target in a flexible exchange rate regime.

The Canadian experience with economic policy and performance provides an excellent ex-

ample of this sort of coordinated policy. Starting in 1995 the federal government introduced a policy of strong fiscal adjustment through restraint aimed at reducing the public debt-to-GDP ratio. The structural primary budget balance was increased through expenditure cuts and tax increases. At the same time, monetary policy was aimed at maintaining inflation within the 1-3 percent target band, which required monetary stimulus. The nominal and real overnight interest rates were reduced. Economic growth was constrained by the fiscal austerity but still sufficient to eliminate the recessionary gap by the end of the decade. The support of domestic monetary policy, a significant depreciation of the Canadian dollar, strong growth in the US economy and strong export growth were keys to this successful fiscal adjustment. The coordination of fiscal restraint and monetary stimulus moved the economy to potential output with stable inflation and a falling ratio of public debt to GDP.

Policy responses to the recession of 2009 provide a further example, both domestic and international. Monetary policy was the first line response, with central banks in most industrial countries lowering their interest rate to or close to the **zero lower bound**. Some countries, like the US, then went further to provide quantitative and credit easing through general and selective open market operations. Fiscal stimulus added to these highly accommodative monetary conditions. Central bank commitments, like those in both the US and Canada, to maintain policy rates at their minimum for periods as long as a year or more eliminated concerns about fiscal crowding out.

> **Zero lower bound**: the effective lower bound on the central bank's policy interest rate, which is at or close to zero.

Coordinating the focus of both monetary policy and fiscal policy was designed to stimulate aggregate demand and restore growth in real GDP. In a time of deep recession, high indebtedness, and high uncertainty even very low interest rates won't induce households and business to take on more debt to build more houses or factories. There is already an excess supply of productive capacity and housing. Monetary conditions can support an expansion

in expenditure but cannot trigger it.

Fiscal policy, by contrast, can add directly to expenditure and aggregate demand, especially expenditure on infrastructure, education, research, and similar public investments. Tax cuts are likely to have smaller expenditure effects if only because the recipients have marginal propensities to spend that are less than one. Nonetheless, there is an important debate about whether expenditure increases or tax cuts should be used for fiscal stimulus, and which will have the larger and more desirable effect.

With this policy coordination there is no cause for concern about crowding out. Central banks were not concerned about the effects of increased aggregate demand on inflation rates and their inflation targets. Quite the opposite, like the Bank of Canada they hoped to raise inflation to their target. Fiscal expansion will not induce higher interest rates or lower exchange rates.

12.5 Monetary and fiscal policy under fixed exchange rates

Monetary policy

If a country adopts a fixed exchange rate policy, *the exchange rate is the target of monetary policy*. Monetary policy cannot pursue an inflation target or an output target at the same time as it pursues an exchange rate target. Nor can it set either interest rates or money supply growth rates independently.

With a fixed exchange rate, interest rates must be set as needed to maintain the exchange rate when capital mobility is high. Indeed, the higher international capital mobility is, the less is the scope for independent monetary policy. This is what we mean when we say fixed

exchange rates eliminate monetary policy sovereignty. The central bank cannot follow an independent monetary policy.

Fiscal policy with fixed exchange rates

A fixed exchange rate and perfect capital mobility undermine the scope for monetary policy, but maintain the effectiveness of fiscal policy.

In a closed economy, in the short run, fiscal expansion raises output. Under a monetary policy rule with the interest rate as the policy instrument, *as long as output is less than potential output*, the central bank supports the increase in output by maintaining interest rates and increasing the money supply as output expands. However, at outputs equal to or greater than potential output, central banks raise interest rates to crowd out the effect of fiscal expansion.

In an open economy with fixed exchange rates, monetary policy adjusts passively to keep the interest rate fixed in order to defend the exchange rate. Interest rates do not change to support fiscal policy or moderate the effect of fiscal policy. Hence, any fall in domestic demand can be offset by a fiscal expansion to help restore potential output. If the change in domestic demand is the only reason that the current account balance departed from equilibrium, this fiscal expansion will also restore the current account balance.

Fiscal policy is an important stabilization policy under fixed exchange rates. It helps to compensate for the fact that monetary policy can no longer be used. Automatic fiscal stabilizers play this role. Discretionary changes in government spending or taxes are useful only if fiscal policy can react quickly to temporary shocks. In some political systems, such as in Canada, this is feasible. In others, such as in the United States, where Congress and the President may be from different parties and budget decisions are more protracted, rapid changes in fiscal policy are more difficult.

In times of prolonged recession, discretionary fiscal policy can contribute importantly to a return to potential output, *provided it is not constrained by high public debt ratios.* With interest rates tied to the exchange rate, financing a fiscal expansion does not push rates up to crowd out private sector expenditure; nor does the recovery of the economy result in rising rates. Indeed, fiscal policy is the only effective domestic demand management tool available.

Unfortunately, high public debt ratios and concerns about the default risk of sovereign debt cause problems for fiscal policy. This was the situation recently in Europe. Fiscal expansion is impossible if financial markets are unwilling to buy more sovereign debt from economies in recession that already have high debt ratios. On the other hand, fiscal austerity to control deficits and debt ratios makes recessions worse and may even raise already high debt ratios as GDP and government net revenue fall. The euro fixes exchange rates within Europe and precludes stimulus from currency depreciation. Neither domestic fiscal nor monetary policy offers a solution.

Things are further complicated because many European countries have similar economic and financial difficulties. Canadian success with fiscal austerity and adjustment in the 1990s came from a very different economic environment. Monetary policy and exchange rate depreciation provided stimulus. Strong economic growth in major trade partners provided further stimulus through export growth. These conditions are clearly not met in Europe and coordinated fiscal austerity to address sovereign debt issues has been described as an "economic suicide pact."

Conclusions

This chapter extended the discussion of short-run macroeconomic performance and policy by covering in more detail the importance of international trade, capital flows, and exchange rates for the design, coordination and effectiveness of monetary and fiscal policies. The

next chapter introduces the theory of economic growth that explains the long-run growth in potential output based on growth in the labour force, growth in the capital stock and changes in productivity based on advances in technology.

KEY CONCEPTS

- **Balance of payments**: a record of the transactions between residents of one country and the rest of the world.
- **Trade balance**: the difference between the value of the exports of goods and services and the imports of goods and services.
- **Current account**: the trade balance, plus net international transfer payments and income earned on holdings of foreign assets.
- **Trade balance**: net exports, the value of exports minus the value of imports.
- **Nominal exchange rate**: the domestic currency price of a unit of foreign currency.
- **Real exchange rate**: the relative price of goods and services from different countries measured in a common currency.
- **Capital account**: the record of capital transfers and the purchases and sales of real and financial assets.
- **Perfect capital mobility**: when very small differences in expected returns cause very large international flows of funds.
- **Change in official international reserves**: the change in the Government of Canada's foreign currency balances.
- **Balance of payments**: the sum of the balances in current accounts and capital accounts, minus the change in the holdings of official reserves.
- **Gross national product (GNP)**: the value of final output owned by citizens of a country.

- **Net national saving**: the sum of net private saving (household saving minus private investment) and net public saving (the total tax receipts of all levels of government less its spending on goods and services).
- **Currency depreciation**: a fall in external value of the domestic currency that raises domestic currency price of foreign currency.
- **Currency appreciation**: a rise in external value of the domestic currency that lowers the domestic currency price of foreign currency.
- **Flexible exchange rate**: Supply and demand in the foreign exchange market determine the equilibrium exchange rate without central bank intervention.
- **Fixed exchange rate**: an exchange rate set by government policy that does not change as a result of changes in market conditions.
- **Convertible currency**: a national currency that can be freely exchanged for a different national currency at the prevailing exchange rate.
- **Official exchange reserves**: government foreign currency holdings managed by the central bank.
- **Central bank intervention**: purchases or sales of foreign currency intended to manage the exchange rate.
- **Devaluation (revaluation)**: a reduction (increase) in the international value of the domestic currency.
- **Zero lower bound**: the effective lower bound on the central bank's policy interest rate, which is at or close to zero.

Exercises for Chapter 12

Exercise 12.1

Consider a country with a fixed exchange rate that has a current account surplus of $20 billion, but a financial account deficit of $18 billion.

(a) Is its balance of payments in deficit or surplus? Why?

(b) What change in official exchange reserves would you see? Why?

(c) Is the central bank buying or selling foreign currency?

(d) What effect does the central bank's foreign currency purchase or sale have on the monetary base? Explain why.

Exercise 12.2

Assume the initial exchange rate is $1.20Cdn for $1.00US After 10 years, the United States price level has risen from 100 to 200, and the Canadian price level has risen from 100 to 175. What was the inflation rate in each country? What nominal exchange rate would preserve the initial real exchange rate? Which country's currency depreciated?

Exercise 12.3

Suppose portfolio managers shift $100 million in assets under their control out of Canadian government securities and into United States government securities. What change would this portfolio shift make in the Canadian balance of payments?

Exercise 12.4

What is the expected rate of appreciation of the US dollar if interest rate parity prevails and Canadian nominal interest rates are 1 percent higher than United States interest rates?

Exercise 12.5

Suppose natural gas and crude oil prices were to drop sharply and expectations were they would remain low. Use a foreign exchange market diagram to show the effect on the Canadian/US dollar exchange rate?

Exercise 12.6

Using a diagram to illustrate the following:

(a) the demand for foreign exchange and the demand curve for foreign exchange;

(b) the supply of foreign exchange and the supply curve for foreign exchange; and

(c) the equilibrium exchange rate.

Excercise 12.7

Use a foreign exchange market diagram with a flexible or floating exchange rate to show:

(a) how a decline in exports would affect the foreign exchange rate;

(b) how exports and imports would change to give balance of payments equilibrium at the new equilibrium exchange rate; and

(c) the effects, if any, on the holdings of official reserves.

Excercise 12.8

Use a foreign exchange market diagram to show:

(a) equilibrium with a fixed exchange rate;

(b) the effect of a decline in exports on conditions in the foreign exchange market when the exchange rate is fixed;

(c) the amount of the purchase or sale of foreign exchange reserves required if the central bank defends the fixed exchange rate; and

(d) the effects of a change in the holdings of official reserves and the monetary base as a result of the defense of the fixed exchange rate.

Excercise 12.9

Use AD/AS and foreign exchange market diagrams to show why monetary policy is powerful and fiscal policy is weak when a country has a flexible exchange rate regime.

Exercise 12.10

Use AD/AS and foreign exchange market diagrams to show why the choice of a fixed exchange rate makes fiscal policy a more powerful tool for demand management. What happens to the domestic money supply when a government austerity program cuts its expenditures on goods and services and raises taxes?

Chapter 13

Economic growth

In this chapter we will explore the following topics.

- 13.1 Patterns of economic growth across countries
- 13.2 Accounting for growth
- 13.3 Growth in real per capita GDP
- 13.4 Technology and growth in per capita output
- 13.5 Recent growth studies and policy issues

Economic growth is one of the most historic, challenging and important topics in macroeconomics. Standards of living within a country are measured by real GDP *per capita*. Over time, growth in real GDP that exceeds population growth raises per capita real GDP and standards of living. But growth that falls persistently short would validate Thomas Malthus' prediction in his *An Essay on the Principle of Population* (1798) that population growth would exceed output growth causing starvation and the end of population growth. The big

question is: what determines growth in real GDP and real GDP per capita? A theory of economic growth is needed to answer that question.

Observations on the recent history of economic growth raise four questions.

1. What is long-term growth?
2. What are the causes or sources of growth?
3. What are the effects of economic growth, both positive and negative?
4. Can economic policies affect growth?

Although the focus here is mainly on industrial countries, the growth or lack of it in poor countries is also an extremely important issue for the economics of development. To see many other interesting dimensions of growth compared across a much larger sample of countries over longer time periods, visit *Gapminder World* on the web site www.gapminder.org.

13.1 Patterns of economic growth across countries

Recall, from Chapter 4, that the growth rate of a variable is its percentage change over time. To define economic growth we must specify both the variable to measure and the period over which to measure it. Percentage changes in real GDP and real GDP per person over periods of one year are used to measure annual rates of **economic growth**.

> **Economic growth**: the annual percentage change in real GDP or per capita real GDP.

Figure 13.1 illustrates the growth of real GDP and real GDP per capita in Canada from 1995 to 2021. In that time frame the index of real GDP, with 1995 as the base year, increased by about 45 percent from 1995 until the financial crisis of 2008, and then declined during the

Great Recession before resuming growth in 2010, and plummeting again at the beginning of the pandemic in 2020. In the third quarter of 2021, real GDP was slightly higher than in the last quarter of 2019 (the last quarter before the pandemic). Over the full 1995–2021 period real GDP grew by 97 percent, which is an annual growth rate over 36 years of just under 1.9 percent.

[Figure 13.1 here using data from Tables 17-10-0009-01 and 36-10-0123-01. XX] [Update to 2021. XX]

Population in Canada was also growing in the 1995–2021 period, by 36 percent over the 36 years. As a result the growth in per capita real GDP was less than in real GDP. Figure 13.1 shows that growth in real GDP per capita was about 44 percent over the 1995–2021 period, an annual growth rate of just over one percent. This is a rough measure of the improvement in standard of living for the average Canadian over that time. But there are questions about the distribution of the changes in standard of living.

Structural change in economic output and employment are an integral part of economic growth. In industrial economies evolving supply and demand conditions lead to higher rates of growth in service sector output and employment relative to the goods sector. Different underlying trends in investment in physical and human capital, technology and entrepreneurial experience by sector, together with differences in sector income and price elasticities of demand, explain the longer term evolution of output structures. Table 4.2 showed that in Canada by 2018 the service sector produced 70 percent of real GDP and the goods sector approximately 30 percent.

Structural changes leading to this distribution of output have also had important effects on employment by sector in Canada. Different sector rates of investment and change in technology have resulted in higher productivity growth but slower rates of employment growth in the goods producing sector. Figure 13.2 uses indexes of employment to show the Canadian

experience. From 1995 to 2004 goods sector employment increased by about 15 percent and service sector employment by about 18 percent. After that, from 2004 to 2018, goods sector employment fell by about 6 percent. However, service sector employment increased by 18 percent. As a result employment in the goods producing sector fell from about 29 per cent of total employment in 1995 to about 24 per cent in 2018. These changes have implications for the future growth in output, employment, real incomes and the ways in which the per capital real income gains from growth are shared.

[Figure 13.2 here using data from Table 14-10-0289-01. XX] [Update to 2021. Update text as well. XX]

Effects of differences in growth rates

Another interesting aspect of growth in real GDP or any other variable is the importance of small differences in compound annual growth rates on growth paths over time. Table 13.1 provides an illustration for selected time periods from one year to 40 years. Annual growth rates in the range of about 0.5% to 4.0% in real GDP and per capita real GDP are common among industrialized countries.

Table 13.1: **Importance of small differences in annual growth rates**

Growth rate	**0.5%**	**1.0%**	**2.0%**	**3.0%**	**3.5%**	**4.0%**
Initial value	100	100	100	100	100	100
Year 1	100.5	101.0	102.0	103.0	103.5	104
Year 5	102.5	105.1	110.4	115.9	118.8	121.7
Year 10	105.1	110.5	121.9	134.4	141.5	148.0
Year 20	110.5	122.0	148.6	180.6	199.0	219.1
Year 40	122.1	148.9	220.8	326.2	395.9	480.1

Over a twenty year period an annual growth rate of 2.0 percent would increase per capita real GDP by almost 50 percent, a growth rate of 3.0 percent would increase it by 80 percent and a growth rate of 3.5 percent would double it. Even over a shorter period like the Great

Recession and recovery of 2007–12, a drop in the average annual growth rate from 3.0 percent to 1.0 percent would mean a GDP 10 percent lower than it would have been under steady 3.0 percent growth.

Table 13.2 illustrates the actual variations in growth rates of per capita real GDP across selected industrial economies from 1995 to 2021. Differences in growth rates in 1995–2001 were relatively small and in the range of 2.3 percent and 3.5 percent for most countries in this sample, except for Japan and Korea with rates of 0.5 percent and 4.6 percent respectively. The standard of living was catching up with those in other countries while that in Japan was roughly constant. Except for Japan, all these growth rates by country declined in the next two time periods reported, with particularly large declines as a result of the international financial crisis and recession after 2008. The underlying causes of this slowdown in growth will be examined in terms of a basic theory of economic growth.

Table 13.2: **Growth rates in per capita real GDP: Selected countries**

	(Average annual % change)			
	1995–2001	2002–2008	2009–2015	2016–2021
Australia	2.7	1.9	0.9	
Canada	2.7	1.6	0.5	

Source: International Monetary Fund, *World Economic Outlook*, October 2022, and authors' calculations.

[Update Table 13.2 using data from World Economic Outlook database or from the World Bank. XX] [Add a sentence or two to the last paragraph before the table. XX]

13.2 Accounting for growth

Basic economic growth theory steps back from short-run variations in growth rates. It applies to the **very long run**, a time frame in which wages and prices are fully flexible, and the labour force, the stock of capital equipment, knowledge and the technology used in

production can change. In this time frame, output fluctuations around potential output are swamped by the growth of potential output itself.

> **Very long run**: the time required for changes to occur in the stock of capital, the size of the labour force, and the technology of production.

An **aggregate production function** describes the links between inputs to production and real GDP produced. Recall that, for the whole economy, Y is real GDP produced by using inputs of labour (N) and capital (K). The function F tells us how much real GDP we get out of particular amounts of labour and capital used in the production process.

$$Y = A \times F(N, K).$$

The function $F(\cdot)$ does not change, but changes in N and K cause changes in output Y. Technical progress or improvements in technology are captured separately through A, which measures the state of technology at any date. As technology improves, A increases and more real GDP is produced from the same inputs of labour and capital. A 10 percent increase in A gives 10 percent more real GDP from the same inputs of labour and capital. We describe this as an increase in productivity because outputs per worker and per unit of capital increase. A is often called a measure of **total factor productivity** (TFP).

> **Aggregate production function**: the link between labour and capital inputs to production, technology and the output as measured by real GDP.

> **Total factor productivity**: output relative to the combined inputs of labour and capital, the total factor inputs to production.

Potential output is the real GDP produced when labour and capital are employed at equilibrium rates using the best available technology. Using the concept of an aggregate

production function, we can write

$$Y_P = A \times F\left(N_F, K_0\right).$$

Here, Y_P is potential output produced by operating plants and machinery at their designed capacity (K_0) and using the full employment equilibrium supply of labour services (N_F). At is the state of knowledge and technology used in the production process and reflected in the productivity of labour and capital.

Any growth in the potential output of goods and services then comes from growth in labour inputs to production, growth in capital inputs to production, and changes in factor productivity as a result of new and improved technology.

Growth accounting measures the sources of growth in real GDP. From the production function, the following relationship must hold:

$$\text{Real GDP growth} =$$

$$\text{Effect of TFP growth} + \text{Effect of growth in } N + \text{Effect of growth in } K.$$

> **Growth accounting**: measurement of the contributions of labour, capital, and technology to growth in output.

The way that growth in capital and labour affects the growth in total output can be measured by the incomes they receive. For example, the income approach to the measurement of net domestic product and GDP identifies these factor income shares in Canada in 2013 as the sum of:

- employee compensation — $957 billion;
- net corporate surplus — $240 billion; and

- net mixed income — $168 billion.

[XX These numbers are not sourced in the last edition. Update and include the source in a footnote.]

This gives a total factor income of $1,365 billion. From these data, employment income was about 70 percent of factor income. This is higher than the longer-term average share of employment income in total factor income, but it shows where the measure comes from. Labour's average contribution to and share of national income, measured over time periods of many years, is approximately two-thirds of total factor income. Capital's contribution and share is the remaining one-third of factor income.

The growth in GDP over time can then be expressed as the growth in total factor productivity plus the weighted sum of the growth in the capital and labour inputs to production as follows:

$$\text{Growth in } Y = \text{growth in } A + (2/3) \times (\text{growth in } N) + (1/3) \times (\text{growth in } K)\,.$$

This is the basic *growth accounting equation*.

The weights (2/3) and (1/3) applied to growth in labour and capital inputs are based on their shares in national income. They determine the rate of growth in real GDP as a result of growth in the inputs of capital and labour. By these weights, a 10 percent increase in labour input, capital and technology held constant, would result in an increase in real GDP of $2/3 \times 10$ percent, which is 6.6 percent. Similarly, a 10 percent increase in capital input would result in a $1/3 \times 10$ percent, or a 3.3 percent increase in real GDP. However, if both N and K grow by 10 percent real GDP grows by 10 percent.

This text box is more advanced than the rest of this section. Students comfortable with the assertion that the growth in labour and capital should be weighted by their shares in

national income to measure their contribution to growth can skip this section. Students interested in understanding why this is the case can read this text box.

We use the following relationships.

First, let the variables A, B and C be related by

$$C = A \times B.$$

For small changes in these variables (measured by Δ), the following relationship holds approximately:

$$\Delta C \approx \Delta A \times B + A \times \Delta B,$$

where "$\approx$" stands for "approximately equal." If variable C depends on the following functional relationship,

$$C = F(A, B),$$

the following relationship holds approximately:

$$\Delta C \approx \frac{\Delta F(A, B)}{\Delta A} \Delta A + \frac{\Delta F(A, B)}{\Delta B} \Delta B,$$

where $\frac{\Delta F(A,B)}{\Delta A}$ gives the impact on the value of function $F(\cdot)$ of a small change in A.

Now, consider our aggregate production function

$$Y = A \times F(N, K)$$

Using the above two approximate relationships, we get

$$\Delta Y \approx \Delta A \times F(N, K) + A \times \frac{\Delta F(N, K)}{\Delta N} \Delta N + A \times \frac{\Delta F(N, K)}{\Delta K} \Delta K.$$

Divide both sides of this equation by Y to get

$$\frac{\Delta Y}{Y} \approx \Delta A \times \frac{F(N,K)}{Y} + \frac{A}{Y} \times \frac{\Delta F(N,K)}{\Delta N}\Delta N + \frac{A}{Y} \times \frac{\Delta F(N,K)}{\Delta K}\Delta K.$$

We can multiply the first term on the right hand side of this approximation by $\frac{A}{A}$ without changing its value. Similarly, we can multiply the second term by $\frac{A}{A} \times \frac{F(N,K)}{F(N,K)} \times \frac{N}{N}$ without changing its value. Finally, we can multiply the third term by $\frac{A}{A} \times \frac{F(N,K)}{F(N,K)} \times \frac{K}{K}$ without changing its value. Doing this, and rearranging terms, we get

$$\frac{\Delta Y}{Y} \approx \frac{\Delta A}{A} \times \frac{A \times F(N,K)}{Y}$$

$$+\frac{A \times F(N,K)}{Y} \times A \times \frac{\Delta F(N,K)}{\Delta N} \times \frac{N}{A \times F(N,K)} \times \frac{\Delta N}{N}$$

$$+\frac{A \times F(N,K)}{Y} \times A \times \frac{\Delta F(N,K)}{\Delta K} \times \frac{K}{A \times F(N,K)} \times \frac{\Delta K}{K}.$$

Simplifying by replacing $A \times F(N,K)$ with Y and cancelling terms gives

$$\frac{\Delta Y}{Y} \approx \frac{\Delta A}{A}$$

$$+\frac{A \times \Delta F(N,K)}{\Delta N} \times \frac{N}{Y} \times \frac{\Delta N}{N} + \frac{A \times \Delta F(N,K)}{\Delta K} \times \frac{K}{Y} \times \frac{\Delta K}{K}.$$

Now the term

$$\frac{A \times \Delta F(N,K)}{\Delta N}$$

is the effect of a small increase in labour on real GDP. In other words, it is the marginal product of labour, which we know is just equal to the real wage in equilibrium, which we can denote by w. Simlarly, the term

$$\frac{A \times \Delta F(N,K)}{\Delta K}$$

is just the marginal product of capital, which in equilibrium is equal to the rate of return on capital, which we can denote by r. So we can write

$$\frac{\Delta Y}{Y} \approx \frac{\Delta A}{A} + \frac{w \times N}{Y} \times \frac{\Delta N}{N} + \frac{r \times K}{Y} \times \frac{\Delta K}{K}.$$

Finally, $w \times N$ is the total amount paid to labour in real wages, so $\frac{w \times N}{Y}$ is the share of labour in national income. Similarly, $\frac{r \times K}{Y}$ is the share of the return to capital (profits) in national income.

This is just the basic *growth accounting equation* in the text above.

The increase in productivity from improvements in technology cannot be seen and measured directly. As a result, growth accounting classifies these effects as a residual. The difference between the growth in real GDP and the weighted sum of the growth in labour and capital inputs is called the **Solow residual**, named after Professor Robert Solow, whose work on growth theory was recognized with a Nobel Prize. The Solow residual is a measure of the contribution to growth made by improvements in the technology of production that raise the productivity of both labour and capital.

Solow residual: the growth in real GDP or per capita real GDP not caused by growth in factor inputs, but attributed to improved technology.

The Solow residual measured by growth in A is found by rearranging the growth accounting equation as follows:

$$\text{Growth in } A = \text{Growth in } Y - \frac{2}{3} \times \text{Growth in } N - \frac{1}{3} \times \text{Growth in } K.$$

The numerical example in Table 13.3 illustrates the procedure. It assumes data are available

for a specific sample period; say 10 years, for the growth rates of real GDP, capital stock, and employment, measured as average annual percentage changes.

Table 13.3: **An estimate of the Solow residual using growth accounting**

Observed growth rates (%), in:
Real GDP (Y): 5.0 Employment (N): 2.4 Capital stock (K): 3.9
By growth accounting:
Growth in $A = 5.0 - (2/3) \times (2.4) - (1/3) \times (3.9) = 2.1$
Contribution of growth in TFP to growth in Y:
2.1%

The calculation made using growth accounting shows that the increased productivity of both labour and capital resulting from improvements in technology was the source of 2.1 percent of the 5.0 percent growth in real GDP in this example.

Earlier research at the Bank of Canada (Kuszczak and Dion 1998) estimated the sources of growth in real GDP and potential GDP in Canada over the period 1950 to 1996 and projections for future growth in potential GDP. The contributions of capital and labour inputs are weighted as in the simple example above. Growth in actual and potential real GDP are the result of growth in factor inputs and the growth in productivity coming from improvements in the technology of production.

That work shows growth in real GDP and potential GDP declined over the 1950 to 1996 period. This slowdown was partly a result of a slowdown in the growth of population, and labour and capital inputs to production. But, starting in the 1970s there was also a slowdown in productivity growth, which reduced the rate of growth of output per worker. This slowdown in productivity is examined in more detail later in this chapter. It had important implications for the standard of living in many countries, including Canada. Some further research on productivity growth in Canada, by the Centre for the Study of Standards of Living, (www.csls.ca) and at the Bank of Canada, has uncovered another productivity slowdown in Canada relative to the United States after the year 2000, which has continued

and is a current source of concern.

13.3 Growth in real per capita GDP

Growth in potential GDP measures the increase in the size of the economy, but it does not tell us what is happening to per capita GDP and *standards of living*. To discover the sources of growth in per capita GDP and improvements in standards of living, we need to study the production function in more detail. Then we can use growth accounting to uncover the sources of past growth in per capita GDP.

Consider the same production function we have used for total GDP:

$$Y = A \times F(N, K).$$

Again, assume that if technology (A) is constant, real GDP (Y) will grow by 2/3 of the growth in labour input and 1/3 the growth in capital input. If, for example, labour force growth increases employment by 10 percent, with fixed capital stock (K), and technology (A), GDP will increase by 6.67 percent. A similar calculation shows the effects of growth in the capital stock. The weights 1/3 and 2/3 are the *elasticities* of output with respect to the inputs of labour and capital based on factor income shares in national accounts.

Per capita GDP and standards of living

Discuss this here rather than in Chapter 4. We will be able to incorporate simple notions from growth theory and the concept of PPP.

[XX]

Factor contributions and scale economies

The increase in total output when an additional unit of a factor (labour or capital) is used in the production process, and other inputs are held constant, is the **marginal product** of that added factor. The production functions widely used in economics have diminishing marginal productivity. As more and more workers are employed using a fixed number of machines, each additional worker adds less and less to total output. The marginal product of labour, the change in total output as a result of using one more worker ($\Delta Y/\Delta N$), falls. Furthermore, because each additional input of labour adds less to total output than the unit before it, output per worker, Y/N, also falls.

> **Marginal product**: the change in total output caused by a change of one unit in the input of that factor to production.

It is often assumed that production involves **constant returns to scale**. Instead of increasing just one input to production, suppose all inputs are increased together, in the same proportions. Labour and capital inputs might both be doubled, for example. Then, if output increases in exactly the same proportions as inputs have increased, there are constant returns to scale.

> **Constant returns to scale**: equal percentage increases in inputs of labour and capital increase output by the same percentage.

The production functions used in growth accounting have these properties. Consider the following example. Holding technology constant at $A = 1$ to simplify matters, we can write:

$$Y = N^{2/3} \times K^{1/3},$$

using the weights we have used in growth accounting to measure the contributions of labour and capital to output, based on their shares in national income, as the exponents on labour

and capital inputs. Table 13.4 gives numerical examples of the way this production function works.

Table 13.4: **Changes in outputs as factor inputs change**

Production function:		$Y = N^{2/3} \times K^{1/3}$			
Labour input (N)	**Capital input** (K)	**Output** (Y)	$\%\Delta N$	$\%\Delta K$	$\%\Delta Y$
50	20	36.8	—	—	—
55	20	39.3	10.0	0	6.6
55	22	40.5	0	10.0	3.3
60.5	24.2	44.6	10.0	10.0	10.0

The first row of the table shows that a labour input of 50 units combined with a capital input of 20 units gives an output of 36.8 units.

The next three rows illustrate the underlying diminishing returns and constant returns to scale in this production process. An increase of either labour input of 10 percent or capital input of 10 percent with the other input constant increases output, but by less than 10 percent in each case. Because output grows by less than the growth of the input in each case, output per worker or per unit of capital falls.

However, when only one input grows, output per unit of the factor held constant rises. In the second row of the table, capital input is constant when labour input grows. More labour inputs increase total output and output per unit of capital. Similarly, in the third row an increase in capital input increases labour productivity.

The fourth row of the table shows constant returns to scale. When labour and capital inputs both increase by the same proportion, output also increases by that proportion, 10 percent in this example. As a result, output per worker and output per unit of capital are constant. In terms of economic growth, equal growth rates of labour input and capital stock make total GDP grow at that same rate, *but leave per capita GDP unchanged.*

To see the sources of growth in *per capita GDP*, we can manipulate the production function

and apply growth accounting. To get per capita GDP, simply divide both sides of the production function in Equation 13.4 by N to give output per worker as follows:

$$Y = A \times N^{2/3} \times K^{1/3}$$

which gives

$$(Y/N) = A \times (K/N)^{1/3}.$$

Using lower case letters to indicate *output per worker* ($y = Y/N$) and *capital per worker* ($k = K/N$), we get

$$y = A \times k^{1/3}.$$

Figure 13.3 illustrates this production function in a diagram. The ratio of capital stock to labour, k, is measured on the horizontal axis. Output per worker, y, is measured on the vertical axis. Two per-worker production functions are used to distinguish between the effects of increases in capital stock and the effects of improvements in technology.

[XX Figure 13.3 about here.]

The declining slopes of both production functions illustrate the diminishing returns that lead to the smaller and smaller changes in output per worker as the capital/labour ratio increases. For example, starting at point C, an increase in the ratio of capital to labour moves the economy along the production function to point D. Output per worker increases at a decreasing rate. This shows that increased capital to labour ratios can increase output per worker until diminishing returns set in and limit sustained increases in output per worker. **Sustained growth in per capita real GDP**, in this basic model of growth, depends on improvements in technology to overcome the diminishing returns to increases in the capital to labour ratio.

Sustained growth in per capita real GDP: improvements in technology overcome the diminishing returns to increases in the capital to labour ratio.

An improvement in technology that increases productivity ($A_2 > A_1$) shifts the production function up. At capital to labour ratio k_2, for example, the increased productivity moves the economy from D to E as output per worker rises from y_2 to y_3 . This shows that growth in per capita output, moving from y_1 to y_3, points C to E in Figure 13.3, is a result of both the growth in the capital to labour ratio and improvements in productivity.

Once again, growth accounting allows us to sort out the effects of these two factors on growth in output per worker and per capita GDP. Table 13.5 uses Canadian experience from 1990 to 2020 as an example.

Table 13.5: **Sources of growth in per-worker GDP in Canada, 1990–2020**

	Y	N	K	$Y/N = y$	K/N	$\%\Delta y$	$\%\Delta k$	$\%\Delta k/3$	$\%\Delta A$
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)=(7)/(3)**	**(6)−(8)**
1990	993	13.1	1,427	75.98	109.18	—	—	—	—
1995	1,082	13.3	1,491	81.54	112.36	7.3	2.9	1.0	6.4
2000	1,328	14.8	1,603	89.97	108.60	10.3	-3.3	-1.1	11.5
2005	1,502	16.2	1,739	92.83	107.48	3.2	-1.0	-0.3	3.5
2010									—
2015									—
2020									—

Source: Statistics Canada Tables: 36-10-104-01, 14-10-0287-03, 36-10-0098-01.

[Update this table. XX]

The first three columns of the table give data on real GDP, employment, and real capital stock for four selected years over the 1990 to 2020 period. Columns **(4)** and **(5)** use these data to calculate the output per worker and capital per worker that we see in our per-worker production function. The growth in output per worker and the growth in capital per worker are reported in columns **(6)** and **(7)** as the percentage changes over six five-year periods.

Growth accounting divides the sources of growth in output per worker between increases in capital per worker and increases in productivity based on improvements in technology. From the production function, we know that an increase in the capital/labour ratio increases output per worker by a factor of 1/3. Column **(8)** in the table reports this weighted contribution of the increase in capital per worker to the increase we see in output per worker. Subtracting these contributions from the increases in output per worker gives the Solow residual, column **(9)**, which again is a measure of the effect of improvements in technology on output per worker.

[XX Rewrite and streamline the description of features of Table 13.5.]

These examples and the discussion of the sources of growth emphasize two key aspects of the growth process. One aspect is the growth in the stock of capital, which comes from the flow of savings and investment in the economy. The other is changing technical knowledge and technology of production. These are the keys to sustained growth in total output and standards of living, but their sources are more obscure than the sources of growth in capital stock. Indeed, pessimism about the fate of society was based on both the inadequacy of investment and stagnant technology.

13.4 Technology and growth in per capita output

Advances in knowledge based on research and development and experience are the key to sustained rates of productivity growth and improvements in standards of living.

Technical knowledge

Every society has some level of technical knowledge about production practices. Part of this knowledge is recorded in technical documents, books, and plans. But it develops and is often

captured in current working practices based on experience. This technical knowledge grows through **invention** that uncovers new understanding and knowledge. What usually follows is **innovation** that applies new knowledge to actual production techniques.

> **Invention**: the discovery of new knowledge.

> **Innovation**: the application of new knowledge into production techniques.

Industrial and economic history is often written in terms of the sequence of major inventions and innovations. Improvements in transportation from the wheel, to steam engines, internal combustion engines and aircraft transformed the size of the market and the degree of specialization and trade. The generation and transmission of electricity provided a new, more efficient and flexible source of light and power leading to improved communications and data management.

Historically, the agriculture 'revolution' was based on the application of science and technology to products and production processes. That evolution continues: New organization and techniques increased productivity; new machinery further increased labour productivity and yielded economies of scale; and new science provided better seed, fertilizer and fuels to power new mechanical equipment. Increases in agriculture productivity based on these and other advances reduced the labour and land required to supply food to the population. At the same time, increased industrialization increased the demand for labour. Economies became more sector specialized with identifiable primary, manufacturing and service sectors that worked together to improve productivity and standards of living.

Additions to human capital were as important as increases in physical capital in this growth process. Human capital is knowledge and experience with production processes. Experience improves workers' efficiency. Higher levels of education and training lets workers use more complex production equipment and techniques and contribute to cost improvements in the

organization of production. In short, productivity is enhanced by the complementarity and synergy between human and physical capital.

The role of research and development

The invention and innovation that lies behind productivity improvements has many sources. Familiarity with a product, process or production technique often suggests a better way to work, or a better product design. Experience and frustration can lead to curiosity and invention. However, most invention and innovation has its origin in specialized research and development (R&D). From this perspective the output of new ideas depends on the resources allocated to R&D. There are costs involved and the focus and usefulness of the results may not be apparent for some time, if ever. Some research is pure research that seeks new knowledge and understanding. Much of it takes place in university departments, usually funded in part by industry, in part by government and in part by private individuals. Applied research, on the other hand is usually based in and financed by industrial firms, with some support from government grants and tax incentives. New knowledge with commercial applications is the goal of this applied R&D.

Investment in R&D, like investment in human and fixed capital, is risky. It cannot be known in advance that new, useful knowledge will result. Funding is provided and committed in the hope and expectation that research projects will be successful. Even if research succeeds it may be difficult to apply the new knowledge or technology in a way that increases your market power enough to allow recovery of the costs. Success gives competitors strong incentives to copy the new product or create a close substitute for it. Patent laws and government subsidies are designed to help private companies and individuals recover their costs of R&D, recognizing that society benefits from improvements in technology.

13.5 Recent growth studies and policy issues

Basic growth theory and the basic growth accounting methodology leave a large part of aggregate growth and productivity growth in the Solow residual and unexplained. Growth in employment and capital stock, and the relationship between them, play important roles in aggregate growth and labour productivity growth, but the effects of changes in the characteristics of labour and the composition of capital stock reside in the total factor productivity estimates of the Solow residual. This residual captures changes in technology along with other undefined factors.

Recent work on productivity growth still uses the growth accounting methodology, but it focuses on particular sectors of the economy and with extensions designed to unpack some things previously left in the residual. These include, in particular, investment in different components of the capital stock and changes in the composition and quality of labour.

Increases in capital per worker or per hour of work — capital deepening — continues to be important, but increases in capital stock are disaggregated into investment into several categories such as:

- information and communications technology (ICT);
- machinery and equipment; and
- physical structures.

Changes in educational qualifications, gender structure, and age structure are used as indicators of changes in the composition and quality of the labour force. To the extent that these measures of change in characteristics and structure affect productivity less remains in the residual. More importantly, these are areas in which policies to support education, training, and labour force participation could affect productivity growth. Table 13.6 gives an example of some recent results based on this approach.

The estimates in the table show the effect of increases in the information, communications, and technology components of the capital stock. Particularly over the 1997 to 2000 period, the increase in ICT capital per unit of labour input was the largest part of capital deepening. This is also the period of strongest growth in labour productivity and the largest increase in total factor productivity. The latter captures the effects of other improvements in technology.

Table 13.6: **Sources of Canadian business sector labour productivity growth, 1974–2005**

	1974–1996	**1997–2000**	**2000–2005**
Labour productivity	1.4	3.0	1.0
Capital deepening	1.1	1.0	0.7
Info & communications technology (ICT)	0.4	0.7	0.3
Non-ICT	0.7	0.4	0.4
Labour quality	0.4	0.4	0.4
Total factor productivity	0.0	1.6	-0.1

Source: Dion (2007).

The estimated contributions of changes in labour quality to labour productivity growth provide an interesting refinement of the growth accounting methodology. Ignoring this change, as the simple accounting process did in earlier examples, leaves the contribution of changes in the structure and characteristics of the labour force in the residual measure of total factor productivity. The results in the table extract and quantify this important source of productivity growth.

Changes in the structure of investment and in the quality of labour are both areas in which public policy plays a role. Government tax policy can be designed to encourage producers to direct investment to areas like communications and information technology. Some of this investment has effects confined to specific industries. Other parts create and strengthen national capacity and efficiency that is widely available and used by business and households, for example high-speed internet service and expanded wireless service and capacity. Educational policy and other human resource policies contribute to the quality, adaptability, and mobility of the labour force.

Endogenous growth theory

Another interesting strand of work makes more fundamental changes in growth theory. The simple neoclassical growth theory made economic growth depend on **exogenous variables**, the rate of population growth, the saving rate, and the rate of capital accumulation, whose values are determined outside the growth model. The subsequent work on catch-up and convergence makes technical progress respond to economic and political factors. But it would be nice to have a stronger link between economic behaviour and the rate of economic growth. We want to make growth endogenous, or determined within our model. **Endogenous growth** implies that the steady-state growth rate is affected by economic behaviour and economic policy.

> **Exogenous variable**: a variable with a value determined outside the model.

> **Endogenous growth**: growth determined economic behaviour and policy within the model.

Professor Paul Romer of New York University received the Nobel Prize in Economics for his pioneering work on endogenous growth theory. Growth theories are built on the saving that drives investment and capital accumulation. While the production function used the basic growth model, increasing the stock of capital and the capital labour ratio leads to a diminishing marginal product of capital. Output and output per worker increase at a decreasing rate but in the steady state output grows at the rate of growth of population and labour force. Output per worker cannot grow indefinitely.

Endogenous growth theory is based on a different view of the roles capital plays in the growth process. It retains the assumption that, for the individual firm, the marginal product of capital decreases as capital stock increases. But it adds the insight that in the aggregate economy there may be significant positive externalities to the increase in capital stock. In

other words increases in capital stock by one firm may result in improved productivity and output in other firms. Improved internet speed and access, or faster wireless voice and data transmission comes from investment by internet service providers and wireless companies. Using the new capacity provided improves the efficiency and productivity of production in other companies. Aggregate productivity and output grows as a result of increased investment by individual producers.

This line of argument is illustrated by the shapes of the production functions. For the individual firm the production function still looks like that in Figure 13.1, concave to the horizontal axis. Increases in the capital/labour ratio increase output per worker at a decreasing rate. For the aggregate economy, according to endogenous growth theory, increases in capital per worker do not face diminishing returns because of the externalities that come with increases in the capital stock. As a result, the aggregate production function has constant returns to capital. It is a straight line rising from the origin with a constant slope. Growth in the capital/labour ratio produces a constant rate of growth in output per worker and aggregate output. A 10 percent increase in capital per worker gives a 10 percent increase in output per worker.

Constant returns to increases in the aggregate capital to labour ratio in the economy allows an escape from the key growth limitation in the neoclassical theory. It makes growth endogenous and dependent upon parameters that could be influenced by private behaviour or public policy. Any policy that succeeded in raising the rate of investment would permanently raise the growth rate. Similarly, any policy achieving a one-time improvement in technology (for example, greater workplace efficiency) would permanently raise the growth rate of capital per worker. This would mean permanently faster output growth.

Not only can government policy affect growth in this framework, government intervention may also increase efficiency. In the simple endogenous model described here, there are externalities to capital accumulation. Individual producers may not realize that by investing to

increase their capital stock they may also improve productivity in other firms. Public policy that recognizes this economy wide effect can subsidize investment to increase investment and aggregate economic growth. By the same argument, externalities to investment in human capital support government subsidies to education and training.

However, endogenous growth theory faces criticism based on the assumption that there are exactly constant returns in the aggregate from accumulating one factor of production. The diminishing returns in the basic model make long-run growth exogenous. An economy with increasing returns experiences continuously increasing capital stock and output. This sort of explosive growth does not correspond to any empirical observation.

New growth theory emphasizes the roles of research and development, innovation, education and "learning by doing" as sources of improved technology and productivity. Research, development, and innovation come from decisions to invest in new knowledge and to apply it to production processes. Education comes from decisions to invest in human capital. Learning by doing is a natural outcome of employment experience. All these are ongoing processes, although they may be pursued unevenly over time as economic conditions and economic policies change.

As a result, increases in the stock of capital and the level of employment always embody new technology and knowledge. There is no separation between increases in the capital to labour ratio and the state of technology, as in the basic neoclassical model. But if new capital stock and new employees bring new technology to the production process, the per worker production function shifts up as capital per worker increases. As capital per worker increases, the economy moves up and along a new per worker production function because the embodied technological improvements offset otherwise diminishing returns.

Recent studies of the sources of productivity growth based on growth accounting are consistent with this approach to reconciling neoclassical and new growth theory. The findings

reported in Table 13.6 above show the contributions to productivity growth made by different types of capital equipment and changes in labour force structure. These changes in "technology" are made integral parts of the growth in capital stock and employment rather than left as exogenous residuals.

The costs of growth

Can the benefits of economic growth be outweighed by its costs? Pollution, congestion, and a hectic lifestyle are a high price to pay for more cars and trucks, washing machines, video games, smart phones and tablets.

Since GDP is an imperfect measure of the true economic value of goods and services produced by the economy, there is no presumption we should want to maximize the growth of measured GDP. Without government intervention, a free market economy can produce too much pollution. But the elimination of all pollution is also wasteful. Society should undertake activities accompanied by pollution up to the point at which the marginal net benefit of the goods produced equals the marginal pollution cost imposed on society. Government intervention, through pollution taxes or regulation by environmental standards, can move the economy towards a more efficient allocation of resources and a higher standard of living, broadly defined to include the quality of the environment.

The full implementation of such a policy would (optimally) reduce growth of measured GDP to below the rate when there is no restriction on pollution and congestion. This is the most sensible way in which to approach the problem. It tackles the issues directly.

In contrast, the "zero growth" solution is a blunt instrument. It does not differentiate measured outputs that have social costs, from outputs without new social costs. As a result there are no new incentives to minimize the externalities already caused by pollution, congestion and environmental degradation. These call for taxes or incentives to reduce

current social costs.

A more extensive and inclusive measure of GDP would be a step toward recognizing and dealing with the costs of growth. Such a measure might include both positive aspects of production and consumption that contribute to welfare, such as environmental quality and low levels of congestion. It might also adjust to give a more complete measure of both private and social costs of different patterns of production, consumption and leisure. We have seen one way to approach this in the United Nations Human Development Index in Chapter 4, but a broader based index is needed.

Conclusions

This completes the introduction to the theory and modelling needed to study the major performance and policy issues in the macro economy. This approach has integrated household and business expenditure decisions, government taxation, expenditure and budget balances, and the monetary, financial sectors and monetary policy, to explain the causes and effects of business cycle fluctuations in national output and employment. It also defines and explains monetary and fiscal policy stabilization roles for the central bank and the government. The brief discussion of the theory of economic growth puts a longer-term perspective on the changes in standards of living over time. Perhaps most importantly, modelling the macro economy emphasizes the complex linkages and interdependencies that determine the modern industrial economy's responses to aggregate demand and supply disturbances.

KEY CONCEPTS

- **Economic growth**: the percentage annual increase in real GDP or per capita real GDP. It is an imperfect measure of the rate of increase of economic well-being because of the limitations of the measurement of GDP.
- **Very long run**: the time required for changes to occur in the stock of capital, the size of the labour force, and the technology of production.
- (Total factor productivity (TFP)): output relative to the combined inputs of labour and capital, the total factor inputs to production.
- **Growth accounting**: a method of measuring the contributions of growth in inputs of labour and capital and the state of technology to overall growth.
- **Solow residual**: the growth in real GDP or per capita real GDP not caused by growth in factor inputs, but attributed to improved technology.
- **Sources of growth**: growth in per capita real GDP has two main sources: first growth in the ratio of capital to labour in the production process, and; second, improvements in technology. Growth accounting provides a way of measuring the sources of growth in per capita real GDP.
- **Marginal product**: the change in total output caused by a change of one unit in the input of that factor to production.
- **Sustained growth in per capita real GDP**: improvements in technology overcome the diminishing returns to increases in the capital to labour ratio.
- **Invention**: the discovery of new knowledge.

- **Innovation**: the application of new knowledge into production techniques.
- **Exogenous variable**: a variable with a value determined outside the model.
- **Endogenous growth**: growth determined economic behaviour and policy within the model.

Exercises for Chapter 13

Exercise 13.1

(a) What is the distinction between growth in potential GDP and growth in per capita real GDP?

(b) Why is this distinction important to an evaluation of the relationship between economic growth and growth in standards of living?

(c) Which grows more rapidly, potential GDP or per capita real GDP?

Exercise 13.2

Consider two countries with the same level of potential GDP, say $100 billion, today. Suppose potential GDP grows at an annual rate of 3.5 percent (0.035) in one country and 3.25 percent (0.0325) in the second country. Based on this information:

(a) What do you predict for the percentage difference in potential GDP between the two countries 10 years in the future?

(b) 20 years in the future? [Note that the growth rates will compound to determine real GDP according to the following formula: $Y_t = Y_0(1 + \text{growth rate})^t$.]

Exercise 13.3

Suppose you have the following information about an economy concerning annual average growth rates from 1998 to 2008:

- potential GDP – 3.5%;

- labour force – 2.1%; and
- capital stock – 3.0%.

The share of labour income in national income is 2/3. Using growth accounting, find the contribution to the annual growth in potential GDP that came from:

(a) growth in the labour force;

(b) growth in the capital stock; and

(c) improved productivity as measured by the Solow residual.

Exercise 13.4

If technology were constant while the labour force grew at a rate of 2.5% a year, the capital stock grew at 1.5% per year, and the share of labour income in national income was 70%, how fast would potential GDP grow?

Exercise 13.5

Suppose you have the following information on average annual growth rates for two economies:

	Country A	**Country B**
Labour force	2.5%	4.0%
Capital stock	3.5%	3.5%

The share of labour income in both countries is 2/3.

(a) Assuming a constant state of technology, which of these two countries will have the faster rate of growth in total real GDP?

(b) Which of the two countries will have the faster rate of growth in per capita real GDP?

(c) What differences, if any, do you see in the growth rates of the capital to labour ratios in the two countries?

(d) Explain the reasons for the differences in growth rates you have found.

Excercise 13.6

In Wonderland, labour force and capital stock both grow at the rate of 2.5% per year but technology is constant. At what rate will potential GDP grow? At what rate will per capita GDP grow? If improvements in technology increased total factor productivity by 1.5% per year, how fast would per capita real GDP grow?

Exercise 13.7

(a) Why do economists emphasize that improvements in technology are the key to improvements in standards of living?

(b) Using a diagram that shows the relationship between capital per worker and output per worker, illustrate and explain why growth in capital per worker cannot provide sustained growth in output per worker and standards of living.

(c) In the diagram in part (b), show how an improvement in productivity coming from improved technology could provide sustained increases in standards of living.

Glossary

The numbers in parentheses refer to the section where the concept is introduced.

AD/AS model: a framework used to explain the behaviour of real output and inflation in the national economy.(5.1)

Aggregate demand: planned aggregate expenditure on final goods and services at different rates of inflation, all other conditions remaining constant. (5.1)

Aggregate expenditure: planned expenditure by businesses and households. (6.1)

Aggregate production function: the link between labour and capital inputs to production, technology and the output of real GDP. (13.2)

Aggregate supply: the output of final goods and services businesses would produce at different rates of inflation, all other conditions held constant. (5.1)

Appreciation of the national currency: an increase in the value of the currency relative to other national currencies, which results in a fall in the domestic currency price of foreign currencies. (9.4)

Automatic stabilizers: tax and transfer programs that offset the effects of transitory fluctuations in autonomous expenditures on equilibrium GDP. (7.5)

Autonomous expenditure: planned expenditure that does not depend on current income.

(6.2)

Balance of payments: the sum of the balances in current accounts and financial accounts, minus the change in the holdings of official reserves. (12.1)

Balanced budget: revenues are equal to expenditures. (7.3)

Bank of Canada: Canada's central bank. (8.3)

Bank rate: the interest rate the central bank charges on its loans to commercial banks. (10.2)

Bank reserves: cash (legal tender) held by banks to meet possible withdrawals by depositors. (8.1)

Bankers risk: the risk that a larger number of customers than expected may demand cash for their deposits. (8.3)

Barter exchanges: direct exchanges of goods or services for goods or services without the use of money as a means of payment. (8.1)

Bond: a financial contract that makes one or more fixed money payments at specific dates in the future.

Bond coupon: the fixed money payment paid to a bond holder at regular intervals. (9.1)

Bond price: the present value of future payments of interest and principal. (9.1)

Boom: a period of high growth that raises output above normal capacity output. (1.6)

Budget deficit: revenues are less than expenditures. (7.3)

Budget function: the relationship between the level of national income and the budget balance. (7.3)

Budget surplus: revenues are greater than expenditures. (7.3)

Business cycles: short-term fluctuations of actual real GDP. (5.4)

Capital stock: the buildings, machinery, equipment and software used in producing goods and services. (1.6)

Central bank foreign exchange market intervention: purchases or sales of foreign currency intended to manage the exchange rate. (12.3)

Central bank: an institution that conducts monetary policy using its control of monetary base and interest rates. (10.1)

Centralized e-money: a payment card denominated in a national currency. (8.1)

Change in official international reserves: the change in the Bank of Canada's foreign currency balances. (12.1)

Circular flow diagrams: show the flows of money payments, real resources, and goods and services between households and businesses. (4.3)

Clearing balances: cash balances used by a bank to settle any differences between its customers' payments and receipts involving other banks. (8.3)

Comparative static analysis: compares an initial equilibrium with a new equilibrium, where the difference is due to a change in one of the conditions behind the initial equilibrium. (3.4)

Complementary goods: when a price reduction (rise) for a related product increases (reduces) demand for a primary product it is a complement for the primary product. (3.3)

Constant returns to scale: equal percentage increases in inputs of labour and capital increase output by the same percentage. (13.3)

Consumer price index (CPI): a measure of the cost of living in any one year to the cost of living in a base year. (4.1)

Consumption possibility frontier (CPF): the combination of goods that can be consumed as a result of a give production choice. (1.4)

Convertible currency: a national currency that can be freely exchanged for a different national currency at the prevailing exchange rate. (12.3)

Cost of credit: the cost of financing expenditures by borrowing at market interest rates. (9.4)

Credit easing: the management of the central bank's assets designed to support lending in specific financial markets. (10.4)

Credit money: XXX (8.1)

Cross-section data: values for different variables or different economic units recorded at a point in time. (2.1)

Cryptocurrency: a decentralized e-money with no centralized issuer and not denominated in any national currency. (8.1)

Currency appreciation: a rise in external value of the domestic currency that lowers the domestic currency price of foreign currency. (12.2)

Currency depreciation: a fall in external value of the domestic currency that raises domestic currency price of foreign currency. (12.2)

Current account: a record of trade in goods, services, and transfer payments. (12.1)

Cyclical unemployment: would be eliminated by higher levels of economic activity. (4.1)

Data: recorded values of variables. (2.1)

Decentralized e-money: has no centralized issuer and is not denominated in any national currency. It is a cryptocurrency such as a bitcoin. (8.2)

Deflation: a persistent fall in the general price level. (11.6)

Demand curve: a graphical expression of the relationship between price and quantity demanded with all other influences unchanged. (3.3)

Quantity demanded: the quantity of a good or service that buyers wish to purchase at each possible price with all other influences on demand remaining unchanged.(3.2)

Demand for Money: is demand to hold real money balances measured in terms of purchasing power over goods and services. (9.2)

Deposit multiplier: increase in bank deposits as the result of an increase in monetary base. (8.5)

Devaluation (revaluation): a reduction (increase) in the international value of the domestic currency. (12.3)

Discretionary fiscal policy: changes in net tax rates and government expenditure intended to offset persistent autonomous expenditure shocks and stabilize aggregate expenditure and output. (7.5)

Disinflation: a persistent fall in the inflation rate. (11.6)

Disposable income: national income minus net taxes. (7.2)

E-monies: are multi-purpose pre-paid payment cards, and stored-value cards and gift cards for purchases at specific companies. (8.2)

E-payments: payments made using mobile access to bank accounts eg. by internet ot telephone. (8.2)

Economic equity: the distribution of well-being among members of the economy. (2.2)

Economic growth: an increase in real GDP. (4.1)

Economic recession: a pronounced, persistent, and pervasive decline in aggregate economic activity.(1.6)

Economy-wide PPF: the set of goods and services combinations that can be produced in the economy when all available productive resources are in use. (1.5)

Effective lower bound (ELB): A bank's policy interest rate cannot be set below a small positive number. (10.4)

Employment rate: percent of the population 15 years of age and over that is employed. (4.1)

Employment: number of adults employed full-time and part-time and self-employed. (4.1)

Endogenous growth: growth determined economic behaviour and policy within the model. (13.5)

Equilibrium GDP: the level of output at which aggregate demand equals aggregate supply. (5.1)

Equilibrium price: the price at which quantity demanded equals quantity supplied. (3.2)

Excess demand: amount by which quantity demanded exceeds the quantity supplied at the current price. (3.2)

Excess supply: amount by which quantity supplied exceeds the quantity demanded at the current price. (3.2)

Exchange rate regime: the policy choice that determines how foreign exchange markets operate. (12.3)

Exchange rate target: monetary policy maintains a fixed price for foreign currency in terms of domestic currency. (10.3)

Exogenous variable: a variable with whose value is determined outside the model. (13.5)

Expenditure-based nominal GDP: the sum of the market value of all the final goods and services bought in a given time period, say one year. (4.4)

Fiat money: money which the government declares as legal tender. (8.1)

F**inal goods and services**: goods and services are purchased by the ultimate users. (4.4)

Financial accounts: record of international flows of funds arising from ineternational purchases and sales of real and financial assets. (12.1)

Financial intermediary: a business that specializes in bringing borrowers and lenders together. (8.3)

Financial panic: a loss of confidence in banks and rush to withdraw cash. (8.4)

Financial portfolio: a mixed holding of money and other financial assets, such as bonds and equities, structured to balance expected return and risk. (9.2)

Fintech: the rapidly growing, innovative, applications of computer and internet technologies to facilitate the flow of payments and financial information. (8.1)

Fiscal austerity: cuts in government expenditure and /or increases in taxes aimed at improving the government's budget balance. (7.4)

Fiscal policy: government expenditure and tax changes designed to influence AD. (5.6)

Fixed exchange rate: an exchange rate set by government policy that does not change as a result of changes in market conditions. (12.3)

Flexible exchange rates: foreign exchange rates as determined by the supply and demand

in the foreign exchange market without central bank intervention. (12.3)

Foreign exchange rate: the domestic currency price of a unit of foreign currency. (9.3)

Forward guidance: information on the timing of future changes in the central bank's interest rate setting. (10.4)

Frictional unemployment: a result of the time involved in adjusting to changing labour force and employment opportunities. (4.1)

Full employment output: the output produced with the number of workers equal to the full-employment level. (1.6)

GDP deflator: index of the value of GDP measured with current final output prices relative to the value using base year prices. (4.5)

GDP: the national accounts measure of the value of final goods and services produced in the economy. (6.2)

Government budget: planned government spending and revenue. (7.3)

Government expenditure: government spending on currently produced goods and services. (7.2)

Growth accounting: a measure of the contributions of labour, capital, and technology to the growth in output. (13.2)

Growth in potential output: the result of growth in full employment labour and capital inputs combined with improvements in technology. (5.3)

High (low) frequency data: series with short (long) intervals between observations. (2.1)

Income-based GDP: sum of the factor costs of production of all goods and services plus the net in direct taxes included in market price. (4.4)

Index number: value for a variable, or an average of a set of variables, expressed relative to a given base value. (2.1)

Induced expenditure: planned expenditures on consumption and/or imports that change when income changes. (6.2)

Inferior good: a good for which demand falls in response to higher incomes. (3.4)

Inflation (deflation) rate: the annual percentage increase (decrease) in the level of consumer prices. (2.1)

Inflation rate target: monetary policy objective defined as an announced target inflation rate. (10.3)

Inflation: a persistent rise in the general price level. (4.1)

Inflationary gap: the amount by which actual real GDP exceeds potential GDP. (5.4)

Innovation: the application of new knowledge in production techniques. (13.4)

Interest rate: the current market rate paid to lenders or charged to borrowers. (9.1)

Intermediate inputs: services, materials, and components purchased from other businesses and used in the production of final goods. (4.4)

Invention: the discovery of new knowledge. (13.4)

Investment function: explains the level of planned investment expenditure as a function of its determinants, including interest rates, current income, etc. (9.4)

Labour force: the number of adults employed plus those not employed but actively looking for work. (4.1)

Legal tender: money that by law must be accepted as a means of payment. (8.1)

Liquidity: the cost, speed, and certainty with which asset values can be converted into cash. (8.3)

Longitudinal data: data which follow the same units of observation through time. (2.1)

Macroeconomics: the study of the economy as a complete system that determines national output, employment and prices. (1.1)

Marginal product: the change in total output caused by a change of one unit in the input of that factor to production. (13.3)

Marginal propensity to consume: the change in consumption expenditure resulting from a given change in income, all other things held equal. (6.2)

Marginal propensity to import: the change in imports caused by a change in income, all other things held equal. (6.2)

Market demand: the horizontal sum of individual demands. (3.7)

Market value of output: must by construction equal total expenditure, the market value of factor services, and household income. (4.3)

Means of payment: a commodity or token generally accepted in payment for goods and services or the repayment of debt. (8.1)

Microeconomics: the study of individual behaviour in the context of scarcity. (1.1)

Mixed economy: goods and services are supplied both by private suppliers and by government. (1.1)

Model: a formalization of theory that facilitates scientific inquiry and makes predictions about the real world. (1.2)

Monetary base: legal tender comprising notes and coins in circulation plus the settlement

balances held by banks and other major financial institution with the central bank. (8.5)

Monetary policy instrument: the monetary variable the central bank manipulates in pursuit of its policy target. (10.3)

Monetary policy: central bank action to control inflation and support economic growth through control of the money supply, interest rates, and exchange rates to change aggregate demand and economic performance. (10.1)

Monetary policy: changes in interest rates and money supply designed to influence AD. (5.6)

Monetary policy rule: central bank interest rate setting based on inflation rate and output gap targets. (10.2)

Monetary policy indicators: variables that provide information about the stimulus or restraint coming from the central bank's policy. (10.5)

Money supply: notes and coin in circulation outside banks plus bank deposits and other liquid assets. (8.2, 8.5)

Moral suasion: a central bank persuades and encourages banks to follow its policy initiatives and guidance. (10.4)

Multiplier: in general, the change in desired expenditure relative to a given change in income, all other things being equal. (6.4)

NAIRU: the "non-accelerating inflation rate of unemployment" which corresponds to the unemployment rate at full employment. (11.2)

National accounts: a framework for measuring GDP and GNP, based on expenditures on goods and services and incomes earned. (4.3)

Natural unemployment rate: the unemployment rate at "full employment" and potential

GDP (4.1)

Net interest income: the excess of loan interest earned over deposit interest paid. (8.3)

Net taxes: taxes on incomes minus transfer payments. (7.2)

Neutral rate of interest: the interest rate which, in the judgment of the central bank, is consistent with actual real GDP equal to potential real GDP inflation at its target. (10.4)

Net exports: balance of trade in goods and services in the current account of the balance of payments. (12.1)

Nominal exchange rate: the domestic currency price of a unit of foreign currency. (12.1)

Nominal GDP: the value of the output of final goods and services, the incomes generated by the production of that output, and expenditure on the sale of that output measured at current prices in a specific time period. (4.4)

Normal good: a good for which demand increases in response to higher incomes. (3.4)

Normative economics: economics which offers recommendations incorporating value judgments. (2.2)

Official exchange reserves: government foreign currency holdings managed by the central bank. (12.3)

Official financing: balance of payments entry that records changes in government holdings of foreign currencies. (12.3)

Open market operation: central bank purchases or sales of government securities in the open financial market. (10.2)

Opportunity cost: what must be sacrificed when a choice is made. (1.3)

Output gap: the difference between actual output and potential output. (5.4)

Overnight rate: the interest rate large financial institutions receive or pay on loans from one day until the next. (10.3)

Participation rate: percent of the population that is either working or unemployed. (4.1)

Per capita real GDP: real GDP per person. (4.6)

Percentage change: $\frac{\text{change in value}}{\text{initial value}} \times 100$. (2.1)

Perfect capital mobility: when very small differences in expected returns cause very large international flows of funds. (12.1)

Positive economics: studies objective or scientific explanations of how the economy functions. (2.2)

Potential output: the real GDP the economy can produce on a sustained basis with current labour force, capital and technology without generating inflationary pressure on prices. (5.2, 11.2)

Present value: the discounted value of future payments. (9.1)

Price controls: government rules or laws that inhibit the formation of market determined prices. (3.7)

Price index: a measure of the price level in one year compared with prices in a base year. (4.1)

Price level: a measure of the average prices of all goods and services produced in the economy. (4.1)

Price of a marketable bond: the current price at which the bond trades in the bond market. (9.1)

Primary budget balance: the difference between a government's net tax revenues and its

program expenditures. (11.5)

Prime lending rate: the base for setting the interest rates charged by banks on loans and lines of credit. (10.3)

Production function: outputs determined by technology and inputs of labour and capital. (11.2)

Production possibility frontier: the combination of goods that can be produced using all resources available. (1.4)

Productivity of labour: the output of goods and services per worker. (1.6)

Productivity: output per unit of input. (11.2)

Public debt: the outstanding stock of government bonds issued to finance government past budget deficits. (7.6)

Public debt ratio: the ratio of outstanding government debt to GDP. (7.6, 11.5)

Quantitative easing: central bank purchases of financial assets to increase its asset holdings and the monetary base. (10.4, 11.6)

Quantity demanded: the amount purchased at a particular price. (3.2)

Quantity supplied: the amount supplied at a particular price. (3.2)

Quotas: are physical restrictions on output. (3.7)

Rate of economic growth: the annual percentage change in real GDP. (4.1)

Real exchange rate: the relative price of goods and services from different countries measured in a common currency. (12.1)

Real GDP: the quantity of final goods and services produced by the economy in a specified

time period. (4.1)

Real money supply: the nominal money supply M divided by the price level P. (9.2)

Real price: the actual price adjusted to a base year value using the consumer price index, the CPI. (2.1)

Recession: decline in economic activity, often defined as two consecutive quarters of negative growth in real GDP. (4.2)

Recessionary gap: amount by which actual real GDP (Y) is less than potential GDP (Yp). (5.4)

Regression line: representation of the average relationship between two variables in a scatter diagram. (2.2)

Repeated cross-section data: cross-section data recorded at regular or irregular intervals. (2.1)

Required reserve ratio: a legal minimum ratio of cash reserves to deposits. (10.2)

Reserve ratio: the ratio of cash reserves to deposit liabilities held by banks. (8.4)

Settlement balances: deposits held by banks and other members of Payments Canada with the Bank of Canada, used to settle payments among themselves.

Short run: a time frame in which factor prices, supplies of factors of production, and technology are fixed by assumption. (5.1)

Short run production function: the relationship between the inflation rate and the level of real GDP. (11.2)

Short-run equilibrium output: output when desired aggregate expenditure equals desired output by firms. (6.3)

Solow residual: the growth in real GDP or per capita real GDP not caused by growth in factor inputs, but attributed to improved technology. (13.2)

SPRA: A Bank of Canada purchase of securities one day combined with an agreed resale of the securities the next day. (10.3)

SRA: A Bank of Canada sale of securities one day combined with an agreed repurchase of the securities the next day. (10.3)

Standard of deferred payments: the units in which future financial obligations are measured. (8.1)

Store of value: an asset that carries purchasing power forward in time for future purchases. (8.1)

Structural budget balance (SBB): the government budget balance at potential output. (7.4)

Structural primary government balance: the difference between net tax revenue at potential output and government program expenditure. It excludes interest payments on the public debt and the effect of output gaps. (11.5)

Structural unemployment: caused by changes in economic structure relative to labour characteristics. (4.1)

Substitute goods: when a price reduction (rise) for a related product reduces (increases) demand for the primary product, then it is a substitute for the primary product. (3.4)

Supply curve: a graphical expression of the relationship between price and quantity supplied with all other influences unchanged. (3.3)

Supply: the quantities of a good or service that sellers are willing to sell at each possible price with all other influences on supply reaming unchanged. (3.2)

Sustained growth in per capita real GDP: improvements in technology overcome the diminishing returns to increases in the capital to labour ratio. (13.4)

Taylor rule: explains the central bank's policy interest rate settings based on the economy's performance relative to the bank's inflation and output targets. (10.4)

Theory: a logical view of how things work. Frequently formulated on the basis of observation. (1.2)

Time-series: a set of measurements made sequentially at different points in time. (2.1)

Token money: convertible claims on commodity money. (8.1)

Total factor productivity: measures by the economy's real output relative to the combined inputs of labour and capital, the total factor inputs to production. (13.2)

Transmission mechanism: links money, interest rates, and exchange rates through financial markets to output and employment and prices. (9.4)

Unemployment rate: the number of unemployed persons as a percentage of the labour force. (4.1)

Unemployment: number of adults not working but actively looking for work. (4.1)

Unit of account: the standard in which prices are quoted and accounts are kept. (8.1)

Unplanned changes in business inventories: changes in inventories due to the discrepancy between forecasted and actual expenditures. (6.3)

Value added: the difference between the market value of the output of the business and the cost of inputs purchased from other businesses. (4.4)

Variables: measures that can take on different values. (2.1)

Very long run: the time required for changes to occur in the stock of capital, the size of

the labour force, and the technology of production. (13.2)

Wealth effect: the change in expenditure caused by a change in real wealth. (9.4)

Yield on a bond: the return to a bond holder expressed as an annual percentage. (9.1)

Zero-sum game: an interaction where the gain to one party equals the loss to another party. (1.4)

Solutions to exercises

13.6 Chapter 1 solutions

Exercise 1.1

13.7 Chapter 2 solutions

Exercise 2.1

13.8 Chapter 3 solutions

Exercise 3.1

13.9 Chapter 4 solutions

Exercise 4.1

13.10 Chapter 5 solutions

Exercise 5.1

13.11 Chapter 6 solutions

Exercise 6.1

X

13.12 Chapter 7 solutions

Exercise 7.1

X

13.13 Chapter 8 solutions

Exercise 8.1

X

13.14 Chapter 9 solutions

Exercise 9.1

X

13.15 Chapter 10 solutions

Exercise 10.1

X

13.16 Chapter 11 solutions

Exercise 11.1

X

13.17 Chapter 12 solutions

Exercise 12.1

X

13.18 Chapter 13 solutions

Exercise 13.1

X

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