1 Introduction

Public utility services matter. Around the world, access to clean water and sanitation facilities, effective telecommunications and Internet services and reliable energy and transport services are indispensible to individuals, societies and economies. Given their critical importance, the public utility industries have long been subject to government regulation. The pages that follow seek to describe, at a general level, how these industries are regulated across different industries and countries, and to draw on the evidence, where available, of the impacts of regulation: in essence, which policies and strategies have worked, and which have not.

This book is intended to be accessible to a general audience and to provide an entry point to what has become a highly technical and specialised area. It aims to help those who wish to develop a general understanding of the rationales, institutions and principles of economic regulation of the public utility industries and, in particular, to describe how regulation has evolved in different jurisdictions, and across different industries in the last thirty years, since the introduction of restructuring policies in many parts of the world, and the publication of many seminal books in this area.

The book has three essential aims. First, it seeks to examine the various rationales for the widespread application of economic regulation to what I have termed 'the public utility industries' (namely the electricity, gas, telecommunications, transport and water industries), and to consider how these rationales relate to specific regulatory policies and interventions, and indeed to the various alternatives to economic regulation that have been proposed, or tried, in these industries. Second, it seeks to elucidate the most important economic principles from analytical work (theory) as to how to regulate the public utility industries. In this respect, an important distinction is drawn between principles related to the regulation of the 'core' or natural monopoly-type activities where there is no competition (i.e. typically the electricity wires, gas pipelines, telecommunications cables and wires, railway tracks and water and wastewater pipes) and principles relevant to activities that are competitive or potentially competitive. The third aim is to describe, in a general way, how economic regulation is applied in practice. This includes a description of the main conceptual approaches that have been adopted to controlling the prices and conduct of public utility firms, as well as a more specific focus on how regulation is applied in four public utility industries – electricity, gas, telecommunications and water and wastewater. In examining these four industries, this book draws on available evidence as

to the effects of regulation in different industries and jurisdictions as well as highlighting contemporary regulatory issues in each industry.

The main jurisdictions examined are those that introduced restructuring policies in the 1980s and 1990s, such as the USA, EU Member States (including the UK, a pioneer of restructuring reforms), some Latin American countries (such as Chile and Argentina) and Australia and New Zealand. However, consideration is also given at various points to approaches adopted in developing and transitional economies.

ISSUES OF TERMINOLOGY

Before getting started, it is important to make some brief comments about the terminology used in this book, as different terms are used to refer to the same things across different countries. First, when collectively referring to the industries of interest – namely the electricity, gas, water and wastewater, transport and telecommunications industries – the term 'public utility industries' is adopted.[1] This differs from other texts, particularly European texts, where writers frequently use the term 'utilities' or 'network industries' to refer to the same industries. Second, while many earlier texts use the term 'natural monopoly' to refer to all of the activities in the supply chain of particular public utility services (i.e. gas, electricity, water), this is arguably no longer appropriate in most public utility industries as a result of policies which have sought to separate, or 'unbundle', those activities in the supply chain which have the attributes of a natural monopoly from those activities which are potentially competitive. In this book, the term 'core network' is used to refer to those activities within a supply chain that have attributes similar to that of a natural monopoly. In most public utility industries this generally refers to the transportation element of the supply chain, and includes assets such as pipes, wires, rails and poles. A third terminological issue relates to the term 'restructuring policy', which is used within this book to refer to various policies introduced, generally in the 1980s and 1990s, to change the structure of a public utility industry. Although there is considerable variation across jurisdictions and industries, these policies typically: removed statutory restrctions on entry, and introduced competition, at one or more stages of the supply chain; required that an incumbent operator provide access to core network activities on non-discriminatory terms; and/or required the vertical and horizontal separation of incumbent public utility operators. Such policies are sometimes referred to as 'liberalisation' policies or 'deregulation' policies in other texts.[2] Finally, the term 'jurisdiction' is used, rather than 'country', to refer to specifically autonomous geographical areas, such as the states or provinces within a federal country. This is important because, as we shall see, different jurisdictions (i.e. states/provinces) within a country such as the USA, Australia or Canada, or different

[1] Telecommunications is not always included within the notion of 'public utilities'. However, it has been included within the scope of the term in this book in recognition of the fact that most public utility regulators include telecommunications as part of their remit.

[2] The term 'liberalisation' is avoided because it can sometimes have ideological overtones. The term deregulation is avoided because it is not accurate that regulation has been fully withdrawn and replaced with competition in the public utility industries. Rather policies have generally introduced different forms of regulation and oversight of these industries.

Member States of the European Union, have often adopted different approaches to public utility regulation.

1.1 WHAT IS MEANT BY ECONOMIC REGULATION?

The term 'regulation' can be used to refer to myriad measures and forms of intervention – introduced by the state or other actors (e.g. industry bodies) – which are intended, in one way or another, to guide or control the behaviour of a firm or individuals. In this book, the term 'economic regulation' is used primarily to refer to interventions which, among other things, impact on the structure of an industry (for example, by restricting the number of firms that can be involved in the supply of a service, requiring separate entities to undertake different activities in a supply chain, or requiring that access to infrastructure facilities be provided to third parties), or which attempt to guide or control the behaviour of firms in terms of their decisions in respect of pricing, investment, quality and coverage of service, as well as the terms on which access is provided to other firms, including competitors. Of course, as we will see, many other areas of public policy are directed at controlling or guiding the behaviour of firms operating in the public utility industries, including health and safety policies, environmental policies and social policies. While these policies are sometimes considered to be examples of social regulation rather than economic regulation, such a sharp distinction is not easily made in relation to the public utility industries. For example, it is not possible to talk about the economic regulation of the electricity and water industries without considering environmental policies (where financial subsidies and incentives are frequently used to encourage more environmentally friendly production and consumption decisions), nor is it possible to consider gas or water regulation without considering health and safety considerations (as higher safety standards can impact on the costs associated with operating and maintaining these networks), while social inclusion policies, such as providing universal access to certain services, have always been an important part of telecommunications regulation, and continue to be so, with 'broadband for all' policies being adopted around the world.

Economic regulation is, in this sense, conceived broadly in this book to capture both 'traditional' interventions – to control prices, entry, quality and other aspects of economic behaviour of firms operating in the public utility industries – as well as interventions that are intended to guide or compel firms in these industries (principally through financial incentives or disincentives) toward behaviour consistent with wider social or environmental policy objectives.

1.1.1 Why focus on the regulation of the public utility industries?

Public utility industries are indispensable to modern life. One only needs to imagine a widespread failure in one or more of these industries – a prolonged electric power blackout, gas disruption, telephone or Internet connection failure, water or sewerage contamination, or shutdown of a rail network – to appreciate their significance to individuals, societies and economies. Moreover, such services are ubiquitous – each day we all consume at least some, if not all, of the services discussed in this book both directly as retail customers, but also indirectly, through other products and services we consume

which have been manufactured using the public utility services. For many households around the globe, the proportion of their average annual income which is spent on the consumption of services supplied by public utility industries – electricity, gas, water, wastewater and telecommunications services – is significant, and growing.[3] In the USA, for example, as shown in Figure 1.1, it has been estimated that, on average, a four-person household spent around $4,500, or 7.2 per cent of total household expenditure, on utilities in 2010.[4] Beyond the household, the secure, reliable and efficient provision of public utility services – the Internet, electric power and clean water – is an extremely important contributor to the economic and social development and growth of countries. In most developed countries the value-added of the public utility industries to gross domestic product (GDP) is estimated to be between 4 per cent and 6 per cent.[5]

Public utility services are, however, frequently provided by firms that occupy strong, and often monopoly, market positions in one or more activities in the supply chain. In some cases, this is the natural result of the demand, cost and technological characteristics of the industry, while in others it reflects public policy decisions. Firms in such positions may, if left unregulated, behave in ways that are inefficient from a social welfare perspective,

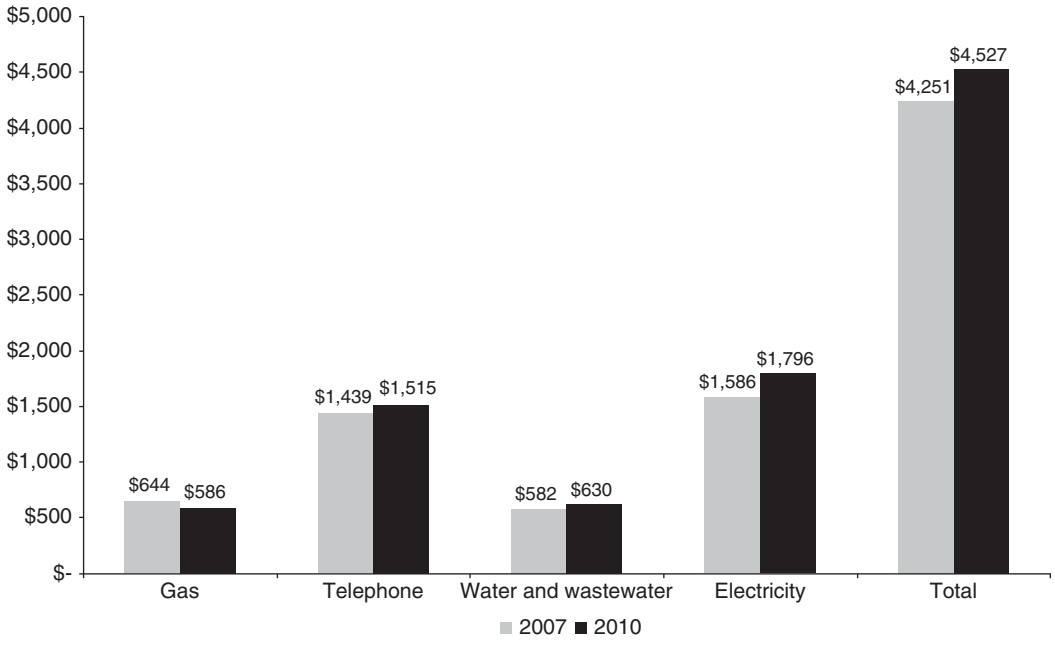

Figure 1.1 Consumer expenditures on public utilities for a four-person household in the USA
Source: Beecher (2009) and Beecher (2012) based on US Department of Labor, Bureau of Labor Statistics (BLS) annual data on household expenditures

[3] In the UK, it is estimated that the average price of gas and electricity paid by households increased by 18 per cent (9 per cent in real terms) in the period 2010–2013, while the increase over the period 2007–2013 is estimated at 41 per cent (or 20 per cent in real terms). See DECC (2013:8).
[4] This includes natural gas, telephone, electricity and water. See Beecher (2009) and Beecher (2012).
[5] See Guthrie (2006: 927), based on 2001 data from the STAN database of the OECD.

and exploit their position of power by raising prices, reducing quality or failing to invest and innovate. This potential, coupled with the essential nature of public utility services, has created longstanding questions for governments, policy makers and academics about how to most effectively guide and control the behaviour of public utility firms.

For this reason, public utility regulation is one of the oldest, and most established, areas of regulatory inquiry, and has been at the fore of debates about the appropriate role of government in business activities for some time. The experience to date of the regulation of these industries, which extends back over a century in the USA, and two to three decades in many other developed countries, provides a rich case-study of the regulatory challenges that have arisen in the face of changes in 'production' (such as the disaggregation of the supply chain in some public utility industries into competitive and monopoly activities), changes in technology (including the enormous changes in recent years in telecommunication platforms), and changes in policy goals (such as the emerging prominence of environmental objectives in energy and water regulation). Public utility regulation has also amply demonstrated the perennial challenge of balancing the traditional regulatory goals of efficiency and fairness.

1.2 WHAT IS 'MODERN' ABOUT ECONOMIC REGULATION?

As we have observed, the application of economic regulation to the public utility industries is not a new phenomenon. The first regulatory commissions were established in the USA in the late 1880s, while the expansion of electricity, gas, water and telecommunications services in many other countries led to the development of a range of governance arrangements (including state ownership) all of which, in different ways, sought to establish controls on the prices and quality of public utilities services. Indeed, many of the issues addressed in this book have challenged regulators and policy makers for over a century. There is an equally long history of academic scholarship focused on the economic regulation of the public utilities,[6] and many classic texts cover some of the central issues in regulatory economics of the public utilities.[7]

Against this background, it would seem that there is very little 'new' to be said, and very little 'modern' about economic regulation of the public utilities. In part, this is true,

[6] One hundred years ago, a special edition of the Annals of the American Academy of Political and Social Science titled *'State Regulation of the Public Utilities'* considered many of the issues that are discussed in the chapters that follow such as: rate-setting procedures; regulating quality of public service utility service; the independence of public utility commissions; and judicial review of regulatory decisions. See *Annals of the American Academy of Political and Social Science*, May 1914.

[7] James Bonbright's *Principles of Public Utility Rates* (1961) and Alfred Kahn's *Economics of Regulation* (1971) are classic texts that cover many of the central issues in regulatory economics of the public utilities. Likewise, work published in the 1980s and 1990s such as Baumol, Panzar and Willig's *Contestable Markets and the Theory of Industry Structure* (1982) and Laffont and Tirole's *A Theory of Incentives in Procurement and Regulation* (1993) introduced new analytical dimensions to different aspects of economic regulation. These analytical developments were accompanied by work, mainly by British scholars, which examined the early impacts of restructuring policies in the utilities (such as privatisation and the establishment of independent regulatory offices) in that country. For example, Vickers and Yarrow *Privatisation: An Economic Analysis* (1988); Armstrong, Cowan and Vickers *Regulatory Reform: Economic Analysis and British Experience* (1994); and Newbery *Privatisation, Restructuring, and Regulation of Network Utilities* (1999).

and many of the general principles of economic regulation, particularly in relation to the core network activities, remain as relevant today as when they were first established. However, the context in which economic regulation is applied in many jurisdictions has changed dramatically over the past two to three decades, and this has given rise to new policy issues and areas of academic inquiry.

This book is being published exactly three decades after what were arguably two of the most important turning points in the modern economic regulation of the utilities. The first event (described in Chapter 10) was the court-endorsed separation of the incumbent telecommunications company in the USA, AT&T. The effect of this break-up was to create an industry structure where incumbent regional monopoly firms coexisted with potentially competitive firms, and which raised a number of important new challenges for regulation relating to the terms on which access and interconnection are provided. The second turning point (discussed in Chapter 5) was the introduction, in 1984, in Britain's newly restructured telecommunications industry, of RPI – X price caps, rather than US-style rate of return regulation. This shift away from traditional rate of return regulation, alongside the creation of new independent regulatory offices, has been seen as the catalyst for the introduction of similar policies and forms of regulation in many parts of the world.

A considerable body of new scholarship on, and practical experience in, economic regulation has developed since these two events and while it is beyond the scope of a work of this size to summarise this research and experience comprehensively, it is among the purposes of this book to identify its most important findings and conclusions.

More generally, and as we will see in the chapters that follow, economic regulation is not a static area either in theory or in practice.[8] An important aspect of the changed context across the public utility industries in recent decades is the significant advances that have occurred in information and communications technology (ICT). Developments in ICT have transformed the supply of telecommunications services, where there is now not only a range of new services and applications offered, but a range of different networks which can supply these services, such as cable networks, fibre networks and mobile networks. However, ICT developments have also had a dramatic impact on the supply and trading arrangements for other public utilities, including allowing for the development in some industries (such as gas and electricity) of close-to-real-time trading arrangements, and so-called 'smart' networks and metering devices which provide real-time information to end-users which can influence consumption decisions.

The changed context of regulation also reflects wider societal changes, such as greater community concern for the environmental and social impacts associated with the supply of public utility services. In some cases, this has led to the introduction of policies directed at changing the way in which public utility services are supplied, including policies focused on a shift away from heavily polluting forms of electricity generation toward cleaner generation produced from renewable or low-carbon sources; policies encouraging, or in some countries restricting, the extraction of certain types of unconventional gas sources such as shale gas; and sustainability policies in the water and wastewater industry relating to water extraction, water trading and treatment procedures.

[8] Crew and Kleindorfer (2012) present a useful overview of the major developments in regulated industries, regulatory theory and practice over the past three decades.

The remit of modern utility regulators has also broadened. In many jurisdictions, the tasks of a regulator are no longer limited to implementing price regulation and ensuring that the quality of supply is adequate. They now encompass other tasks that arise in the 'modern' context including: facilitating a structural transition from monopoly to competitive market structures; ensuring that consumers are able to 'engage' in a market; implementing policies which allow for a shift to environmentally friendly forms of production and supply (such as low-carbon generation of electricity); and introducing tariff structures to reduce consumption for some services (such as electricity and water, to reduce environmental impacts) or, alternatively, to encourage increased consumption of a service (such as mobile telephone services, to harness the positive network externalities associated with such services). Indeed, despite expectations by some, particularly those writing in the early 1980s, that economic regulation would gradually be withdrawn in some public utility industries over time, in many jurisdictions the size of economic regulators has expanded rather than contracted. Moreover, regulatory agencies have now been established in a great many parts of the world, accompanying the restructuring of the public utility industries in these countries. In this respect, public utility regulation is no longer only a topic of interest to those in the USA, the UK or other developed economies.

1.3 NEW EXPERIENCE AND ANALYSIS

Modern public utility regulation comprises a mix of new questions, arising from changes in context, technology and public policies, and older, more enduring questions, such as: how best to incentivise regulated firms to behave efficiently; how to address problems associated with asymmetric information; and the desirability of different industry structures across the public utility industries.

Research on the public utilities has grown in size over the past three decades. In part, this has reflected the changes in industry structure described above, particularly the introduction of competition in some activities. This research has generated new principles and analytical approaches for regulating industries where some activities are competitive while others display traditional natural monopoly characteristics. In particular, it has sought to develop principles relating to the sharing of infrastructure facilities and, specifically, the price and other terms on which access is provided in settings where a single core network provider supplies an essential input to firms operating in related activities at different stages in the production chain (one-way access), or to contexts where a core network access provider supplies some products as inputs to other firms and, at the same time, purchases products from other core network access providers as an input into its own production process (two-way access). Restructuring policies have also raised new issues in some industries relating to the coordination of investment and operational activities where separate entities now engage in these activities. This has fuelled considerable academic and policy debate on the desirability of alternative industry structures for supply (i.e. vertical integration versus separation) in different public utility industries.

In some industries, the advent of 'infrastructure competition' between different competing network providers (for example, different telecommunications network operators, or different operators of long-distance gas pipelines) has also raised new questions about

the appropriate interaction between the different ways of controlling firms with market power, such as *ex ante* forms of economic regulation (i.e. up-front price controls) and *ex post* approaches, such as a reliance on competition or antitrust law.

At the same time, the restructuring 'experiments' of recent decades have now begun to be assessed. These assessments, which are considered in more detail in Chapters 8–11, have varied by jurisdiction and industry but, in general, can be seen to give rise to a range of new policy questions. For example, some studies have indicated that the restructuring policies introduced in the public utilities to facilitate competition may not have resulted in clearly visible benefits to households.[9] Assessments have also emerged which highlight the limitations of the dominant regulatory approaches,[10] and in particular, the traditional assumption underlying some approaches to regulation – that the regulator is there to represent the interests of consumers because they are unable to effectively represent their own interests. This assumption, in the view of some, may no longer be self-evident, and various alternative approaches to the traditional price control processes have been introduced, in particular those that facilitate higher levels of direct negotiation and agreement between public utility companies and consumer representatives.[11] Separately, assessments of restructuring policies in the developing world have suggested a poor fit between these policies and the institutional context of many countries in which they were implemented, leading to new questions about 'one-size-fits-all' approaches to economic regulation.[12]

Finally, in restructured public utility industries, challenges are arising which have not confronted regulators, or the industries themselves, before. For example, in industries where there is a need for large-scale and expensive investments in new infrastructure (such as high-speed broadband networks in communications, or new transmission lines in electricity to connect remotely located electricity generation), questions are arising about whether, and how, the new regulatory frameworks can enable coordination of demand and investment, and provide returns sufficient to underwrite the investments given the risks involved.

1.4 STRUCTURE OF THE BOOK

This book comprises three parts. Part I of the book considers the rationale for public utility regulation, and the alternatives to standard economic regulation that have been proposed and tried in practice. Within Part I, Chapter 2 focuses on why the public utility industries are subject to economic regulation, and considers both normative explanations (why *should* we regulate?) as well as alternative, more positivist explanations for the existence of regulation (why *do* we regulate?). Chapter 3 considers various alternatives to the standard approaches to public utility regulation that have been proposed and tried,

[9] See for example, Pollitt (2012:128) and Florio (2013).
[10] One of the original architects of the RPI-X framework in Britain, Stephen Littlechild, has since observed that '[T]he burden of the typical UK approach is so great that it rivals the burden of the US approach in the 1970s that we sought to avoid. If we had been able to forsee present UK regulation in action, we might have been equally keen to avoid it.' Littlechild (2012a:56).
[11] See Littlechild (2008a:33); Littlechild (2009b:15).
[12] See in particular Laffont (2005).

including control approaches based around franchising or competition 'for the market', state ownership, negotiated agreements and settlements, as well as reliance on *ex post* competition law or, in relation to activities in which 'deregulatory' policies can feasibly be introduced, on the restraints imposed by competition itself.

Part II of the book considers some of the principles that underlie modern economic regulation, and the four chapters which comprise Part II draw principally upon analytical or theoretical work on public utility regulation. Chapter 4 begins by outlining some of the commonly accepted general principles developed in analytical work relevant to the regulation of core network activities. It considers these principles under a range of different assumptions, including different information conditions, single- and multiple-product settings, and single- and multi-period contexts. Chapter 5 builds on this discussion to examine the different forms of price regulation that are typically applied in practice, including rate of return regulation, price cap regulation and various adaptations to these approaches, such as earnings and revenue sharing mechanisms and approaches based on yardstick competition or benchmarking. It also considers different approaches to price regulation in contexts where an activity is considered to be partially competitive, but where an incumbent firm still occupies a strong position in the market. Chapter 6 examines the regulatory principles that are relevant in settings where entrants in competitive activities in the production chain require the services of a core network operator. The main focus of this chapter is on the different principles relevant to regulating access to core network inputs, and in particular access pricing, both in one-way and two-way access settings.

Part III of the book focuses on the *practice* of public utility regulation across jurisdictions. Chapter 7 begins by considering the institutions involved in the implementation of economic regulation, with a particular focus on the independent economic regulators established in many jurisdictions over the past three decades. It considers both the theoretical arguments in support of such independent regulators, as well as the historical evolution of regulatory agencies across a range of jurisdictions. It then examines some of the characteristics of modern regulatory institutions and the environment in which they operate, such as: their structural and organisational form; the division of powers and responsibilities with other bodies such as ministries and competition authorities; the role of the courts and judicial supervision and, finally, other aspects of regulatory oversight and accountability. Chapters 8–11 focus on the economic regulation of four public utility industries – electricity, gas, telecommunications and water and wastewater – in turn. Each industry chapter begins with a description of the economic and technical characteristics of the production and supply structure, including any trading arrangements that have developed in the industry relating to either the commodity itself or for access to the network infrastructure that transmits or transports the commodity. The chapter then discusses the general approach adopted to the regulation of the industry across different jurisdictions, such as whether a rate of return approach or price cap approach has been applied, and how issues of quality have been addressed, etc. Finally, the focus turns to contemporary issues that are impacting on the regulation of the industry. For each of the four industries examined this includes a consideration of the available evidence on the effects of restructuring policies that have been introduced over the past three decades. In addition, in each

chapter, boxes are used to present examples of specific applications, and adaptations, of some of the principles discussed in Part II in the four industries.

Chapter 12 draws out some general conclusions and themes from the book. In particular, it reflects on how the various rationales for economic regulation discussed in this book have important implications for the design of regulatory policy and institutions, particularly in the context of a transition to competition in some activities. Chapter 12 also draws conclusions about the relationship between the principles developed in analytical models and real-world regulatory practice, identifying a role for analytical models in clarifying various key concepts and in making explicit the high-level trade-offs between different types of regulatory strategies. Finally, the chapter summarises the evidence as to the effects of restructuring policies across the different public utility industries and outlines some of the future challenges likely to face modern regulators of these industries.