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International Performance Indicators

Telecommunications 1995

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Foreword

As Australia's traded industries become more exposed to the pressures of international competition there is an increasing need for infrastructure services to be supplied on an internationally competitive basis. In the absence of market forces, performance benchmarks can be used to promote productivity improvements.

In March 1991, the Prime Minister announced that the Bureau would undertake a project to develop international performance benchmarks for the more significant infrastructure service industries and monitor performance relative to these benchmarks through time. To date reports covering the electricity, rail freight, telecommunications, road freight, waterfront, coastal shipping, aviation and gas supply industries have been published. This report on the telecommunications industry represents the third in the series of update reports.

The Bureau would like to thank representatives of Telstra, Optus, the International Telecommunications Union (ITU), the Organisation for Economic Cooperation and Development (OECD), AUSTEL, the Department of Communications and the Arts, the Bureau of Transport and Communications Economics, the Federal Communications Commission (FCC), The Australian Telecommunications Users Group (ATUG), Softek Services, AAP Telecommunications, Cathay Pacific, Alcatel, SITA and various Australian overseas posts for their cooperation and input. Gerd Hollander of the BIE and the International Benchmarking Advisory Group convened by the Business Council of Australia and also comprising representatives from the Australian Chamber of Commerce and Industry, the Australian Mining Industry Council, the Chamber of Manufactures of NSW and State Governments provided helpful comments.

The report was researched and written by John Houghton, Rosalie McLachlan and Ruth Thomson. The project was supervised by Denis Lawrence, an Assistant Director of the Bureau.

March 1995

Bob Hawkins
Director

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Executive Summary

The underlying aim of this report is to compare Australian performance in the provision of telecommunications infrastructure and services with international best practice.

The sample used for international comparisons in this report includes 30 countries from North America, Europe, and the Asia-Pacific region. Comparisons cover price, quality of service, innovation and operational efficiency from the perspective of the business user.

Prices

Simple rate and tariff basket price comparisons show that Australia performs relatively well in some areas, but poorly in others (Table 1). The overall picture from the price comparisons is one of having to run to keep pace with international counterparts, and barely managing to keep up.

Australian prices compare relatively favourably for mobile charges, international call charges and the basket of leased line services, but Australian prices are relatively high for the basket of packet-switched data network services and the basket of local and long distance services to business users.

In comparative terms Australia's position has remained unchanged over the period 1992 to 1994 in respect to the national business basket and the international call basket, improved in respect of the mobile and leased line baskets, while falling behind in respect of the packet-switched data network services basket.

Putting these services together into a composite business basket we find that Australia ranks slightly above the OECD average, at 11th out of 24. Australia's ranking in terms of this composite business basket has remained unchanged since 1989.

Time series analysis reveals that price falls for the basket of national services and for international calls in Australia were less than the OECD average, whereas the price of the mobile basket declined more in Australia than the OECD average.

Time series analysis also reveals that OECD countries with competitive market structures have experienced larger price reductions than countries with non-competitive market structures during the 1990s.

Table 1 Australia, Best and Worst Observed

Indicator	*Year*	*Best Observed*	*Worst Observed*	*Australia's Rank*
Prices				
Simple Rate Comparisons				
Business Fixed Charges	1993	United States	Canada	18th of 28
Long Distance Call Charges	1993	Luxembourg	Portugal	16th of 26
International Call Charges	1994	Norway	Japan	14th of 24
Mobile Fixed Charges	1992	Malaysia	Luxembourg	8th of 29
Mobile Call Charges	1992	Singapore	Germany	7th of 29
Basket Comparisons				
National basket	1994	Iceland	Austria	14th of 23
International call basket	1994	Australia	Turkey	1st of 24
Mobile basket	1994	Iceland	Japan	4th of 24
PSDN basket	1994	Finland	Japan	18th of 24
Leased line Basket, 9.6 Kbit	1994	Belgium	Austria	9th of 24
Leased line Basket, 64 Kbit	1994	Australia	Spain	1st of 24
Leased line Basket, 1.5/2 Mbit	1994	United Kingdom	Luxembourg	5th of 22
Composite basket	1994	Finland	Japan	11th of 22
Quality of Service				
IDD Completion Rates	1992	United States	Greece	15th of 24
Fault Clearance	1992	Netherlands	Taiwan	15th of 19
Innovation				
Mobile Penetration	1994	Sweden	Turkey	8th of 30
Digitalisation	1993	Hongkong	Austria	23rd of 30
Optical Fibre Deployment	1990-92	Sweden	Canada	6th of 12
Itemised Billing	1992	Canada/France	Denmark	5th of 13
Proportion Cardphones	1992	Japan	Norway	2nd of 25
Productivity				
Revenue per Employee	1993	Switzerland	Turkey	19th of 27
Lines per Employee	1993	South Korea	Thailand	26th of 30
Revenue per Line	1993	Switzerland	Turkey	7th of 28
Partial Labour Productivity	1992	United States	Australia	11th of 11
Partial Capital Productivity	1992	United States	Switzerland	7th of 11
Multifactor Productivity	1992	United States	Switzerland	8th of 11

Note: Caveats apply and care should be taken in the interpretation of these indicators.
Source: BIE.

Quality of Service

Quality of service comparisons show that Australia's performance was below international best practice on such quality of service indicators as call completion rates and fault clearance up to and including 1992-93.

There has been some improvement in the reliability of the network since the introduction of competition, but significant scope for improvement remains.

Innovation

Australia's performance in terms of indicators of innovation suggests that further investment in modernisation of the fixed network is required. Recently announced investment plans are likely to make a contribution to improvement when implemented.

Australia compares favourably in terms of the penetration of cellular mobile and optical fibre deployment, but ranked below most comparable countries in terms of digitalisation of fixed network mainlines, and the availability of itemised billing.

Operational Efficiency

While labour productivity in telecommunications in Australia is improving, it remains low by international standards. Australia's high network usage led to a better but still below average performance in terms of capital productivity. Out of a sample of 11 comparable countries Australia ranked last in terms of labour productivity and seventh in terms of capital productivity in 1992.

Telstra has achieved its strongest growth in Total Factor Productivity since 1992, when competition was introduced.

Our findings suggest that it may take some considerable time to restructure and reskill the workforce to take advantage of new technological opportunities, and some time to reap the full benefits of modernisation.

Summary

Overall, Australia's performance is reasonable, but there is no room for complacency. Now is certainly not the time for reform fatigue. Telecommunications prices are falling, but they have further to fall if we are to match our competitors. Quality of service is improving, but there is much further to go to even approach best practice. Operational efficiency is improving, but significant restructuring is required.

Since the introduction of competition in telecommunications Australia has moved ahead with the leading pack, but it is at the back of the leading group rather than the front. Relaxing the pace of reform would see Australia fall back into the trailing group of also-rans. Renewed effort is required to lift Australia towards international best practice.

Ongoing investment in network development and renewed effort in respect of labour productivity are the areas requiring most attention.

Chapter 1 Introduction

1.1 Background

In the Prime Minister's statement of 12 March 1991, *Building a Competitive Australia*, the Bureau of Industry Economics was directed to identify the importance of major infrastructure services in business costs, develop an understanding of relevant measures for international comparison of infrastructure services provision, and to publish international performance comparisons on a regular basis. In the 1994 white paper, *Working Nation*, this benchmarking program was extended significantly.

The request for international benchmarking was based on the recognition that the competitiveness of Australian enterprises in international markets is determined, in part, by the cost of inputs and services provided by other Australian enterprises: enterprises that may not themselves be exposed to international competition. In the case of some infrastructure services they may not even be exposed to competition in the domestic market. The development of performance indicators for such industries offers a means of introducing competitive pressures indirectly and/or assessing the impact of competition as it is introduced. Focusing on performance indicators for the various infrastructure services industries raises awareness of both relative performance and of the key drivers of performance in that industry.

In its work on international performance indicators the Bureau of Industry Economics focuses on performance from the perspective of the business user. The Bureau's studies explore infrastructure services prices and quality, and attempt to measure the operating efficiency of Australian infrastructure service providers relative to their international counterparts. The aim is to give an indication of the extent to which operational efficiency might be improved, and to identify the major areas of concern to both government and the enterprises involved. The key questions for both government and the enterprises themselves are: how do we rate against international peers and competitors; what are the major drivers of performance in this sector; and what can be done to improve performance in the future?

The Bureau has published reports on international performance indicators for the electricity supply, rail freight, telecommunications, road freight, waterfront, coastal shipping, aviation and gas supply industries. This report is an update and extension of the Bureau's initial *International Performance Indicators; Telecommunications* report, published in December 1992.

Developing appropriate performance indicators is a very difficult task involving a range of assumptions and simplifications regarding the meaning of the indicators and international comparability. Taken individually each of the indicators has shortcomings. Nevertheless, by employing a range of indicators for each of the major dimensions of performance; price, quality of service and operational efficiency, an overall picture does emerge. Moreover, an examination of performance on the same set of indicators over time reveals something of Australia's dynamic relative performance over time.

1.2 The Context of the Study

This update of Telecommunications International Performance Indicators focuses on the performance of the telecommunications industry in Australia relative to international best practice. It examines performance in relation to key indicators, including price, quality of service and operating efficiency. It also seeks to develop a set of telecommunications performance indicators suitable to the period of transition to full competition in telecommunications in 1997, and beyond.

Telecommunications is an important part of the Information Technology (IT) sector, and is a rapidly growing industry in its own right. The global telecommunications services market was worth $797 billion in 1993, with a forecast compound annual growth rate of 7.7 per cent over the 1990-97 period (Budde 1994, p.20). This growth is due to both network extension, especially in developing and newly industrialised countries, and network intensification in developed countries, where there is burgeoning traffic growth in long distance and international markets.

In Australia the telecommunications services market was worth some $14.6 billion in 1994 (excluding equipment), and is growing at between 8 and 9 per cent annually (Budde 1994, pp.38-9). With a relatively high level of telephone penetration, usage increases and the introduction of new services are the main engines of growth. International calls from Australia increased by more than 20 per cent between 1990 and 1993, and such new markets as mobile telephony have exhibited even more rapid growth. Minutes of International Telecommunication Traffic (MiTTs) grew at a compound annual rate of almost 20 per cent in Australia between 1983 and 1992, compared to the OECD average over the same period of less than 14 per cent (OECD1994a).

In Australia, as elsewhere, there is a growing awareness of the importance of communications to both participation in increasingly information intensive trade, and to the integration of Australia (despite its distance disadvantages) into the global economy. Australia is above the international average in terms of public telecommunications revenue as a percentage of Gross Domestic Product (GDP) at 3.2 per cent in 1992, compared to an OECD average of 2.1 per cent. Australia is also enjoying faster than average growth among OECD countries in the share of telecommunications in GDP (OECD 1994a).

Telecommunications is also an increasingly important business input. Among infrastructure services the communications industry is one of the more important. Companies establishing regional headquarters in Australia report that telecommunications accounts for 30 per cent of their total expenditure, second only to wages and salaries. While such organisations are somewhat atypical, the

performance of the communications industry clearly has the potential to affect the international competitiveness of Australian industry. Moreover, telecommunications is a vital foundation for the development of new broadband services, and for Australia's participation in the industries involved in the production and distribution of broadband services equipment, networks and content.

1.3 Scope of the Report

The objectives and project scope of this report are consistent with those of the Bureau's international performance indicators monitoring program. The underlying aims are to compare Australia's performance relative to international best practice, to assess the performance of Australian telecommunications services provision since the introduction of partial competition in 1991-92, and to develop appropriate performance indicators for the period of transition to full competition in 1997, and beyond.

Reform of the telecommunications sector is aimed at achieving improved efficiencies, lowering users' costs, increasing choice and improving quality of service. The current report represents the first opportunity to see how the transformation of telecommunications in Australia since the passage of the *Telecommunications Act 1991* has affected performance in the provision of telecommunications services relative to overseas counterparts and competitors.

In comparing performance it is important to compare like with like. The world's telecommunications companies (operators) are involved in provision of a range of communication services. They differ in terms of the mixture of telecommunication services offered to their customers, and each is different in terms of the amount of traffic handled, revenue earned, and the balance between various lines of business. Large operators may be able to take advantage of economies of scale and outperform smaller operators on some indicators, and operators with different mixes of lines of business will face different scope economies and have different performance potentials. Telecommunications companies may also vary according to the physical and regulatory environment in which they operate, and environmental factors may affect their performance. All these factors must be taken into account in the interpretation of international performance comparisons.

The sample used in this report is drawn from 30 of the more developed countries from North America, Europe, and the Asia-Pacific region. Included are the 24 OECD countries; Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom and the United States, and 6 of the more developed Asian countries; Hong Kong, the Republic of Korea, Malaysia, Singapore, Thailand and Taiwan (China). Where possible the performance measures in this report are presented for all 30 countries. However, for some measures, data limitations resulted in a smaller sample being used.

Performance is considered at the country level rather than that of the individual operator to ensure that all core services and lines of business are incorporated into the comparison. Aggregated data are used for Canada, Denmark, Italy, Japan, Portugal and the United States. For the other countries

the data reflect the major supplier - the incumbent or former incumbent telecommunications carrier. Australian data used in price and quality of service comparisons relates to Telstra only.

1.4 Layout of Report

The introduction sets the study in the context of heightened interest in performance indicators in telecommunications around the world. It also sets the study in the more specifically Australian context of international benchmarking and the de-regulation of the telecommunications services sector in Australia.

Chapter 2 provides a brief overview of growth trends and the role of telecommunications as a generic business input and as a major growth industry, and explores the interrelation of technological change and competition. It also examines the trend towards de-regulation and notes major landmarks along the way, and comments on international experiences of de-regulation and competition. The next three chapters on telecommunications performance indicators examine and discuss some of the key performance indicators relating to price (Chapter 3), quality of service and innovation (Chapter 4), and operating efficiency (Chapter 5). For each of these dimensions of performance we examine what indicators to use, their strengths, weaknesses and limitations, what developments might be introduced to make these indicators better, and present international comparisons on each indicator. A number of case studies are presented during the discussion to highlight some of the major points.

Chapter 3 examines prices: simple rate comparisons include business line fixed charges, long distance call charges, international call charges, and cellular mobile fixed and call charges; and tariff basket comparisons include national business user fixed and call charges, international call charges, cellular mobile charges, packet-switched data network (PSDN) charges, leased line charges, and a composite basket. Attempts are also made in Chapter 3 to analyse the impact of discounts and to present a time series analysis for local and trunk business user charges, international call charges and cellular mobile services charges.

Chapter 4 examines quality of service and innovation. Quality of service indicators include call failure rates, IDD completion rates, fault clearance and cellular mobile drop-out rates. Indicators of innovation include the penetration of cellular mobile, digital subscriber lines and optical fibre, the availability of itemised billing and the percentage of payphones that are cardphones.

Chapter 5 examines operating efficiency. It includes an examination of some traditional partial productivity indicators (revenue per employee, revenue per line, and lines per employee); a multifactor productivity (MFP) analysis for 11 countries for 1992, and a total factor productivity (TFP) analysis for Telstra Australia covering the period 1980 to 1994.

Chapter 6 looks at some of the key issues in the development of performance indicators for the future. It serves as a review and refinement of indicators from the first report in the light of feedback and subsequent developments, and suggests what new indicators should be included in the future. The final chapter summarises some of the main findings and assesses Australia's performance in general terms on price, quality of service, innovation and efficiency.

1.5 Innovations

We have introduced a number of innovations in this update report in an effort to improve analysis. Firstly, exchange rates are used rather than purchasing power parities (PPPs). PPPs reflect prices of goods in terms of consumer purchasing power, but the focus of this study is the business user and businesses tend to base decisions, such as investment or location, on costs based on exchange rates rather than considerations of relative consumer purchasing power. PPPs may be the best unit for price comparison for residential customers, but they are not the most appropriate for business users.

Secondly, there is a greater Asian coverage in this report than the previous publication. The sample used for international comparisons includes 30 countries from North America, Europe, and the Asia-Pacific region. They include the 24 OECD countries (including Japan) and six other Asian countries: Hong Kong, Malaysia, the Republic of Korea, Singapore, Thailand and Taiwan (China).

Thirdly, mobiles are taken into account throughout the report. Traditionally, telecommunications performance indicators have used mainlines as the measure of access, but with the increasing use of mobiles this is no longer appropriate. In this

report we are making a first attempt to factor mobiles in, making telecommunications access paths or 'lines', as they are known throughout this report, equivalent to mainlines plus mobile subscribers.

Finally, we are making a first attempt to factor volume discounts into price comparisons. Internationally comparable data are as yet limited, but it is important to take account of discounts because, as discounts become increasingly common, list prices no longer accurately reflect prices paid.

Each of these innovations contributes to a report that is a more realistic reflection of the conditions facing business users of telecommunications infrastructure and services.

Chapter 2 Telecommunications

The first section of this chapter examines some of the more important global trends in telecommunications with the aim of setting the changes underway in telecommunications in Australia in that wider context. The second section narrows the focus down to Australia and examines some of the key trends and issues in the Australian telecommunications industry. The third section explores telecommunications futures. We begin with a brief description of the telecommunications network.

The telecommunications network can be divided into three parts:

- the Customer Access Network (CAN), which consists of the local loop (the twisted pair copper wires in the street) and some exchange electronics specific to an individual service (the line card);
- the exchange switching and inter-exchange network (IXN) which performs short distance carriage and basic switching and billing functions; and
- the long-haul network, including country trunks, interstate fibre cables and microwave bearers, international submarine cables and satellites (Fist 1994b, p.66).

The network employs a range of technologies including coaxial cable, microwave bearers, satellites and optical fibre, but almost all connections between local exchanges and customer premises are by copper wire pairs. The copper wire CAN was designed for the delivery of analogue voice services, which require a relatively low bandwidth (around 4 KHz).

Over the past few years optical fibre cable has been extensively installed on trunk and inter-exchange routes, and to a much lesser extent in the local loop. The information carrying capacity of optical fibre is far greater than that of twisted-pair or coaxial cable. In fact, it has the potential to carry almost any imaginable service over any distance. There are, however, some significant impediments to be overcome before optical fibre is widely used for the delivery of services to individual premises, chief amongst these are technological maturity and cost of some of the basic system components (Fist 1994b, p.66). In the meantime solutions involving digital compression techniques and hybrid coaxial and optical fibre links will allow the CAN to evolve towards true broadband capacity.

2.1 Global Trends in Telecommunications

Information and communications are increasingly seen as strategic resources at both the enterprise and national levels. For the enterprise the key driver is the increased competitiveness to be gained by responsiveness to market demand. Information and communication systems play a vital role in integrating the supply chain all the way from the individual retail customer to the commodity producer. For the nation the key driver is the need to provide an infrastructural base for industrial

and social development. The economic importance of the underlying communications infrastructure is growing as economic activity becomes, simultaneously, increasingly information intensive and increasingly globalised and globally integrated. Harnessing communication and information technology (CIT) is increasingly important to the competitiveness of enterprises, and developing leading edge communications infrastructure increasingly important to the international competitiveness of nations. Governments are also keen to develop national participation in telecommunications because it is seen as a high growth industry in its own right and appears to have a high growth future.

Telecommunications is a rapidly growing industry

Telecommunications is an important sector of the Information Technology (IT) industries. Telecommunications markets are growing rapidly, and telecommunications accounts for a rising share of national output and capital formation. The global telecommunications services market was estimated to have been worth $490 billion in 1990. It is expected to reach $820 billion by 1997, with a compound annual growth rate of 7.7 per cent over the 1990-97 period (Budde 1994, p.20). This growth is due to both network extension in developing and newly industrialised countries, and network intensification in the developed countries; with many developed countries experiencing burgeoning traffic growth in their long distance and international markets. Public Telecommunications Operator (PTO) investment in telecommunications infrastructure in OECD countries in 1992 amounted to US$ 124 per person, and customers in these countries spent a further US$ 456 per person on telecommunications services (OECD1994a).

Telecommunications significantly outperformed other industry sectors among OECD countries throughout the decade 1982-92. Between 1982 and 1987 the telecommunication services market in OECD countries grew by 7.2 per cent per annum, slowing to 3.3 per cent between 1987 and 1992. The operating income of PTOs in the OECD reached US$ 55 billion before tax in 1992 on an investment of just under US$ 103 billion, making telecommunications one of the most profitable sectors of economic activity (OECD 1994a).

In Australia the telecommunications services market was worth some $14.6 billion in 1994 (excluding equipment) and is growing at between 8 per cent and 9 per cent annually (Budde 1994, p.38-9). With a relatively high level of telephone penetration, usage increases and the introduction of new services are the main engines of growth in Australia. Minutes of international telecommunications traffic (MiTTs) from Australia increased by more than 20 per cent between 1990 and 1993, and new markets like mobile telephony are exhibiting even more rapid growth.

Telecommunications revenue accounts for a growing share of Gross Domestic Product (GDP). Australia is above the international average in terms of public telecommunications revenue as a percentage of GDP at 3.2 per cent in 1992, compared to an OECD average of 2.1 per cent and an ITU world average for 1991 of 1.8 per cent. Among OECD countries Australia's telecommunications revenue share of GDP is second only to New Zealand. Australia is also enjoying faster than OECD average *growth* in the share of telecommunications in GDP (OECD 1994a). This indicates the importance of telecommunications in the Australian economy.

Table 2.1 Public Telecommunications Revenue as a Percentage of GDP

	1982	*1992*
Australia	1.86	3.21
Austria	1.64	1.77
Belgium	1.17	1.47
Canada[a]	2.22	2.07
Denmark	1.20	1.81
Finland	1.61	1.86
France	1.31	1.75
Germany	1.81	1.93
Greece	1.71	2.03
Hong Kong	-	2.90[b]
Iceland	0.91	1.55
Ireland	2.13	2.84
Italy	1.30	1.65
Japan	1.65	1.49
Korea (Rep of)	-	2.20[b]
Luxembourg	1.07	2.19
Malaysia	-	2.30[b]
Netherlands	1.39	1.86
New Zealand	1.39	3.22
Norway	1.82	2.22
Portugal	2.02	2.45
Singapore	-	3.30[b]
Spain	1.37	2.03
Sweden	1.61	2.45
Switzerland	1.99	2.40
Taiwan, China	-	2.00[b]
Thailand	-	1.40[b]
Turkey	0.74	1.61
United Kingdom	2.29	2.53
United States	2.58	2.66
OECD Average[c]	2.05	2.12
ITU World Average[c]	-	1.80[b]

[a] Data for Canada in 1992 may not be consistent with earlier data.
[b] Data for 1991 rather than 1992.
[c] Weighted average rather than a simple average.
Sources: OECD 1994 and ITU 1994.

Telecommunications also accounts for an increasing share of Gross Fixed Capital Formation (GFCF). Public telecommunication investment in the OECD (weighted average) grew from 2.8 per cent of GFCF in 1983-85 to 3.1 per cent in 1991-92. Australia's public investment in telecommunications infrastructure, at 3.5 per cent in 1992, accounted for a higher proportion of GFCF than the OECD average (OECD1994a).

Table 2.2 Public Telecommunications Investment as a Percentage of GFCF

	1983-85	*1992*
Australia	3.07	3.52
Austria	3.41	2.92
Belgium	2.94	1.70
Canada	2.99	3.67
Denmark	2.22	2.02
Finland	2.07	2.98
France	3.35	2.15
Germany	3.72	4.71
Greece	3.82	5.06
Hong Kong	-	1.20[a]
Iceland	1.53	2.38
Ireland	4.66	3.38
Italy	3.19	4.02
Japan	1.89	1.81
Korea (Rep.of)	-	2.90[a]
Luxembourg	1.34	2.83
Malaysia	-	3.00[a]
Netherlands	1.67	2.47
New Zealand	2.00	5.88
Norway	2.61	2.69
Portugal	3.06	4.03
Singapore	-	2.00[a]
Spain	3.39	3.34
Sweden	3.07	2.82
Switzerland	2.91	3.29
Taiwan, China	-	-
Thailand	-	1.50[a]
Turkey	3.47	1.43
United Kingdom	2.70	2.35
United States	2.62	2.65
OECD Average[b]	2.82	3.09
ITU World Average[b]	-	2.60[a]

[a] Data for 1991 rather than 1992.
[b] Weighted average rather than a simple average
Sources: OECD 1994 and ITU 1994.

These figures substantially understate the significance of telecommunications investment, because they include only public sector investment and exclude the enormous investment made by the private sector and by users in network, access and terminal equipment.

Telecommunications is an important business input

All industries use telecommunication services in production either directly or indirectly. The cost of these services accrue in final products through passing on telecommunications costs in the production of the final products and services and of intermediate inputs. An examination of these costs shows that telecommunications is an increasingly important business input.

In 1993-94, the communications industry (of which telecommunications is a major part) accounted for 3.3 per cent of total Australian business inputs used, up from 2.9 per cent in 1989-90. The communications industry is highly business oriented with $10.8 billion, almost 65 per cent of its

total sales, sold as business inputs (Table 2.3). Only 35.4 per cent of the output of the communications industry is consumed as part of final demand (mainly private consumption). These statistics suggest that the communications industry, which is dominated by telecommunications, is of considerable importance to the international competitiveness of Australian industry.

Table 2.3 Importance of the Communications Industry as Business Input, 1993-94

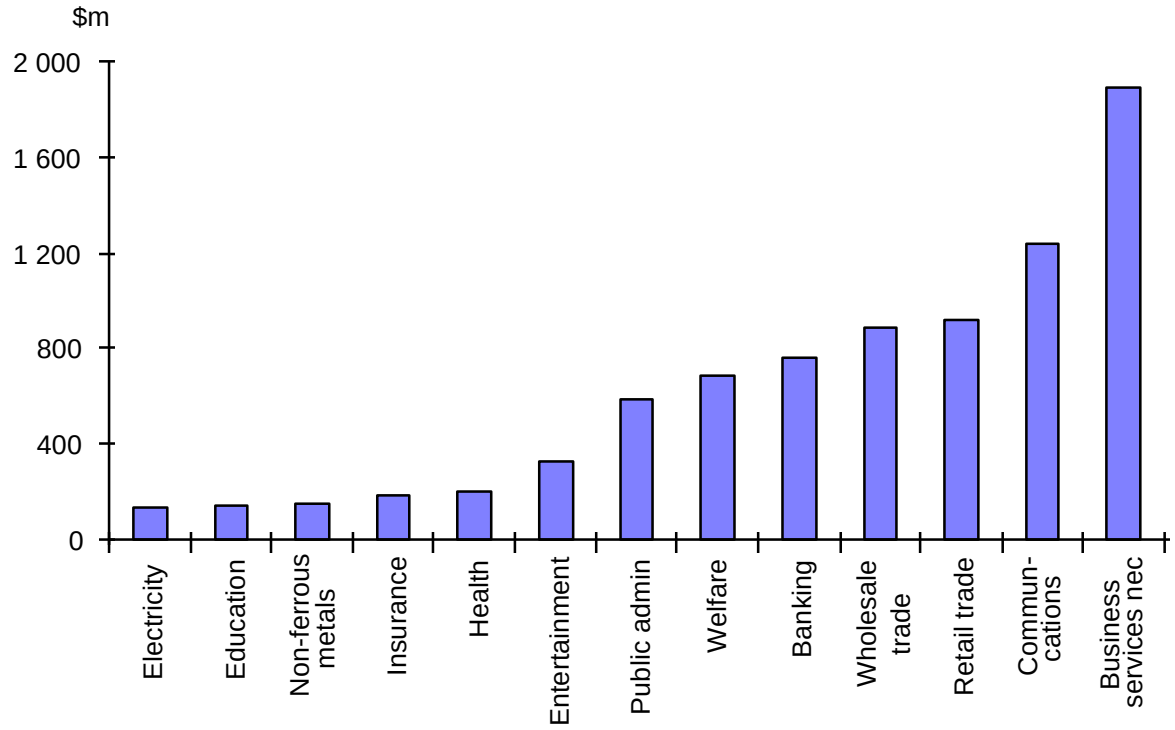
	Communications			*Australia*
		Share of total communications supply	Share in total Australia	
	$m	%	%	$m
Total intermediate usage	10 781.9	64.6	3.3	324 972.4
Final demand				
Private consumption	4 365.2	26.2	1.8	238 683.2
Exports	1 433.9	8.6	1.9	76 682.4
Government Consumption	99.6	0.6	0.1	68 905.2
Investment	0.0	0.0	0.0	106 658.3
Total final demand	*5 898.8*	*35.4*	*1.2*	*490 929.1*
Total sales	**16 680.6**	**100.0**	**2.0**	**815 901.4**

Note: Sales at basic values including margins sales.
Source:COPS 1994.

The efficiency of the communications industry is particularly important to the services sector, which is the major user of communication services. In 1993-94 the services sector accounted for 86.6 per cent of communications services demand for business purposes. Within this sector, the other business services, wholesale and retail trade and banking industries are the major users. Government services such as public administration and health services are also important users (see Figure 2.1).

While organisations such as Regional Head Quarters (RHQs) are atypical, they do demonstrate the importance of telecommunications to business enterprises operating in the global economy. A recent study of RHQs operating in Australia found that telecommunications services were their second most significant item of expenditure after staff and salary expenses, representing approximately 30 per cent of total RHQ expenditures in Australia (Allen Consulting 1994, p.25).

Figure 2.1 Major Users of Communications Services, 1993-94



Source: COPS 1994.

Usage trends

In countries with a relatively developed communications infrastructure and high levels of telephone penetration, growth comes mainly from increasing use. At 47.1 mainlines per 100 inhabitants in 1992, compared to the world average of 10.49 (ITU 1994a, p.A-3), Australia is highly developed in terms of network extension. There is growth in calls of all types, but trunk and international calls are growing faster than local. There were 9.8 billion local calls, 2 billion trunk calls and 124 million international calls made in Australia in 1992-93. Average annual growth over the decade 1982 to 1992 has been 5.7 per cent for local calls, 9.1 per cent for trunk calls and 21.1 per cent for international calls (Budde 1994, p.38).

Table 2.4 Telephone Traffic in Australia (Millions of Calls)

Year	Local	Trunk	International	Cellular	Total
1980-81	5 321.6	681.0	11.0	-	6 004.6
1981-82	5 448.4	786.2	14.8	-	6 249.4
1982-83	5 596.9	837.2	18.2	-	6 452.3
1983-84	6 191.2	932.6	22.4	-	7 146.2
1984-85	6 583.6	1 026.7	27.4	-	7 637.7
1985-86	7 078.4	1 186.8	34.6	-	8 299.8
1986-87	7 538.9	1 328.1	47.8	3.1	8 917.9
1987-88	8 074.7	1 488.4	65.9	27.9	9 656.9
1988-89	8 081.4	1 657.4	85.1	74.0	9 897.9
1989-90	8 796.8	1 794.8	104.7	156.0	10 805.1
1990-91	9 446.1	1 832.3	117.1	158.3	11 553.8
1991-92	9 364.0	1 938.0	120.0	-	11 422.0[a]
1992-93	9 767.1	1 997.9	123.7	411.3	12 300.0

[a] Excluding mobile.
Sources: Annual Reports and ITU 1994b.

Telecommunications is particularly important to trade and to the integration of Australian enterprises into the global economy. It is interesting to note that minutes of outgoing international telecommunication traffic (MiTTs) grew at a compound annual rate of almost 20 per cent in Australia between 1983 and 1992, compared to the OECD average growth over the same period of 13.6 per cent (OECD 1994a). Importantly, Australia has been transformed since the late 1970s into a net receiver of international calls. In the 1970s Australia received substantially more international call traffic than it generated. As late as 1976, when total international traffic was 41.4 million MiTTs, inbound traffic exceeded outbound by 2.8 million MiTTs. By 1981, outbound traffic exceeded inbound by 15.3 million MiTTs. Total international traffic had reached 1.1 billion MiTTs by 1991, and outbound traffic exceeded inbound by more than 90 million MiTTs (BTCE 1993, p.25).

Technology and Competition

Digitalisation and the micro-electronic revolution have played a major role in transforming telecommunications into a rapidly changing, technology-based business. Technological changes are opening new fields of opportunity and new competitive possibilities.

Among the more important areas of development in telecommunications at the moment are cellular mobile telephony, global mobile systems, the Internet, convergence, international resale, such services as country direct and telecards and callback. Mobiles and global systems are liberating the user from fixed networks with apparatus addresses. Global systems, the internet, convergence, international resale, country direct, telecards and callback are opening up possible alternatives to the existing telecommunications regime and established facilities-based carriers.

Mobiles

Cellular mobile telephony has exhibited remarkable market penetration rates. At the end of July 1994 the estimated number of cellular mobile subscribers world-wide reached 42 million, with 19

million subscribers in the United States and 11 million in Europe. Markets in Eastern Europe and the Asian-Pacific are among the most rapidly growing, while South Africa was the fastest growing national market in the world for cellular mobile during calendar year 1994. World-wide growth in mobiles between July 1993 to July 1994 was 55 per cent (*Mobile Communications* November 1994, pp.6-7). Among the OECD countries Scandinavia has led the way. For every addition to the fixed network in Sweden during 1992 there were no fewer than 14 new mobile subscribers (OECD 1994a).

In Australia the take-up of cellular mobile telephony has been rapid by international standards. Mobiles are now used by almost 7 per cent of the population. There were 1.4 million mobile phone and 400,000 pager subscribers at the end of 1994, generating a revenue of $1.4 billion over the year (Budde 1994, p.77). During 1994 there have been more than 10,000 new subscribers joining the network per week.

The deployment of mobile technologies is a crucial ingredient in the introduction of competition. Many countries are licensing new mobile operators to compete with their fixed-network carriers. It is a new field and new players can start at much the same point on the learning curve as established fixed-network players, it requires less complex interconnect regulation and it offers operators a completely different range of economies of scale.

Global Mobile Systems

A number of organisations are putting forward schemes for global mobile communications networks. Not only do such systems offer an alternative global communications infrastructure and the possibility of personal addressability and global mobility, they also offer the potential for inter-satellite switching, allowing operators to bypass existing terrestrial telephone systems and existing telephone companies. While national bypass is currently illegal in most countries of the world (Fist 1994b, p.69-79), once the potential exists for more reliable, lower cost communications pressure for regulatory reform will mount. Global mobile systems and, to a lesser extent, global roaming bypass the local fixed-network carriers for origination, and bring international competitors into the origination market.

Global Mobile Systems

Iridium - an ambitious proposal by Motorola based on a network of 66 Low Earth Orbit (LEO) satellites, which did involve space switching and terrestrial carrier bypass in its early days, but has now dropped the controversial bypass element. Iridium claims to have completed the financing of its proposed US$3.4 billion system with backers including the German utility Veba, US long distance carrier Sprint and a consortium of leading Japanese companies including DDI and Sony. Motorola expects to begin global services in 1998.

GlobalStar - a proposal to operate voice, data and positioning services using 48 Medium Earth Orbit (MEO) Satellites. GlobalStar is a limited partnership involving Loral, Qualcomm, Alcatel, Alenia, France Telecom, DACOM of Korea, Deutsche Areospace, Hyundai and Vodafone (parent company of Australia's third mobile carrier). Space segment investment is already underway, and operation of commercial call services is expected by 1999. Anticipated total project investment is of the order of US$1.8 billion.

Odyssey - a proposal underpinned by TRW and Teleglobe Canada involves a US$2 billion investment in 12 Medium Earth Orbit (MEO) Satellites offering voice, paging, data, messaging and positioning services. TRW and Teleglobe have put in US$150 million and are now seeking equity partners.

Inmarsat - Inmarsat, the international maritime satellite organisation, had a proposal known as Project 21 on the drawing board for some years, but Inmarsat's stakeholders, the carriers, have been slow to reach agreement. Inmarsat-P is a new version of Project 21, which involves floating a separate affiliate company. Inmarsat proposes to deploy a network of 10 satellites capable of space switching and linking to terrestrial networks via 12 earth stations and involving an investment of US$2.6 billion. Equity partners from the Asia-Pacific region are joining the project.

Ellipso - a proposal to use 16 to 18 satellites in highly elliptical orbits involving a hybrid LEO/MEO configuration put forward by Ellipsat. Partners include Westinghouse, InterDigital, Mantra, Harris (an Israeli defence company) and Barclays Bank. The Ellipso proposal uses relatively simple technology, but involves innovative orbit patterns as a means to optimise service potential to high density population centres in the northern hemisphere.

Teledesic - Microsoft Corp. Chair, Bill Gates, and McCaw Cellular Communications Inc. Chair, Graig McCaw, have announced a global satellite communications network that surpasses all others. The proposal involves an 840 satellite Ka-band Teledesic system that would spread low-cost, universal broadband (non-voice) services worldwide, but would require an estimated investment of almost $14 billion.

The Internet

As of December 1994 there were an estimated 2.5 million (server) computers connected to Internet (the worldwide network of computer networks) and 42,883 advertised network numbers in more

than 80 countries (Merit 1995). It is estimated that there are more than 20 million users worldwide, and their ranks are growing by some 20 per cent per *month* (BSEG 1994, p.6). In Australia the Internet links approximately 110,000 computers and an estimated 500,000 users. Traffic volumes and the number of users connected, especially commercial users, are growing rapidly.

Country-based Internet connected networks buy trunk and international links from fixed network carriers and international network capacity consortia. The Internet model of internetworked computer networks offers an alternative for communications, and a potential alternative communications future. For example, experimental software is now available to internet users which allows global voice interconnection via the internet.

The critical battle to be fought is over the pricing of the fixed network carrier links. AARNet is already the largest purchaser of trans-pacific fixed links in Australia (Cutler 1994, p.31). Analysts regularly point to an increasing divergence between the cost of providing capacity and the prices charged for its use by the carriers. Chris Maltby, technical director of a Sydney-based software consultancy, recently claimed that tariffs were 200 to 300 times higher that the actual cost of delivering the bandwidth (Young 1994, p.1), and while customers currently pay up to US$2.50 per minute for a trans-Atlantic call analysts estimate actual call costs to be of the order of 7 to 10 cents per minute (Edupage December 27, 1994). The battle over bandwidth pricing may determine the viability of this alternative communications option and many of the fledgling services enterprises that rely on it.

Convergence / Crossover

Pay-TV and related broadband services offer another possible alternative future for telecommunications. The cable networks laid by cable-TV operators in Britain are now being used for local telephone traffic, as the TV operators find that they can offer high quality, innovative services over their coaxial and/or fibre networks. And they can gain significant economies of scope by offering cable-TV and local telephony services jointly. All they need is a gateway connection into the public telecommunications network and they are in business as an alternative phone company.

UK experience suggests that such services can be a popular alternative. By April 1994 650,000 homes in the UK had cable-TV subscriptions, and 58 per cent had also taken phone services from the Cable company. The House of Commons Trade and Industry Committee reporting on Optical Fibre Networks in the United Kingdom estimated that by the end of 1994 there would be 700,000 phone subscribers using cable-TV connections, rather than those of BT and Mercury. This would represent 2.6 per cent of all phone connections. Analysts in the United Kingdom have observed that ‘every time cable goes down a street, 1 in 5 homes takes TV services and half of those also sign up for telephony services’ (Brenchley 1994, p.29). As of mid 1994, there were 49 cable companies operating local phone services in the United Kingdom.

International Resale

Another challenge to existing facilities-based carriers has arisen in the international telecommunications market, where there is an increasing divergence between the charges arising

from the international settlements regime and the cost of international carriage. Global carriers, such as BT and AT&T, offer a competitive alternative to Australian carriers in the global network services business. This is a business that is becoming increasingly important to multinational enterprises, who are asking their carriers to manage their global telecommunications networks.

Such one-stop-shop or outsourced services are provided by most of the leading carriers, and offer customers such things as a single global point of contact for service ordering, international installation, support and maintenance for circuits and equipment, integrated billing and the management of international data communications networks. Carriers providing such end-to-end services to their clients world-wide bypass the local carriers in international bearer and settlement arrangements, and offer a competitive alternative to those carriers.

Country-Direct and Telecards

Innovative new services that are available to a wider range of customers include country-direct and telecards. These also provide a competitive alternative to local carriers by bypassing their services. Country-direct began as a service offered by AT&T to its North American customers, whereby they could get dial access to their US network while travelling overseas. This gave them access to an English speaking operator and itemised billing to their US account. Phone-card, calling-card and credit card versions of this type of service, giving users the option of 'originating' calls on the network of any lower priced foreign carrier that will honour their card, have enjoyed considerable success and are spreading internationally (BTCE1993, p.86-7).

Callback

US companies have also led the way in offering international callback services. These are another way to bypass local carriers and offer users a competitive alternative. Customers from anywhere in the world dial the callback service provider's access number, often based in the USA, and hang up once it rings. The switch automatically calls back with a US dialtone. The call is then made from there, and billed as a US originated call. This can form the basis of resale of United States carriers' international 800 services or international switched voice or private line services operated from outside the United States.

The callback service providers offering international services make their margin from de facto origination in a cheaper country and from the arbitrage of tariff differences between international calls in different directions. For example, a peak rate 3 minute call from Turkey to the USA cost US$7.33 in January, compared to US$5.27 in the opposite direction. The biggest margins for callback operators are into high rate destinations, such as Spain, Israel, South Africa, Japan, Thailand and Latin American countries, where savings can be up to 50 per cent. Callback operators in Australia believe that they could win as much as 25 per cent of the total international call market over the next 3 to 4 years, making their business worth some $350 to $400 million a year.

Callback is shaking the formerly cosy international settlements regime to its foundations. No one is sure how much business is being lost to callback operators or what impact it is having on the international balance of trade in telecommunications services. Prior to the advent of callback, pricing an international end above cost was a possible revenue raising exercise for national

governments, but now almost all revenue derived from originating the end could be lost to the lowest cost carriers. National users are no longer captives of the local facilities-based carrier(s).

All of these developments are opening up new competitive alternatives to the traditional structure of national public telecommunications operators (PTOs), and challenging the customers of those operators with a new range of choices.

Regulatory Trends

Prior to the 1980s the telecommunications carriage and services industry in most countries was structured on the basis of a state-owned monopoly. The rationale for such a market structure relied on the natural monopoly characteristics exhibited by the telecommunications industry (network) and public welfare considerations, which viewed basic telecommunication services as a public service requiring universal service provisions. Beginning in the 1980s and continuing through to the 1990s there has been a general trend in many countries towards liberalising entry into telecommunication services markets and infrastructure provision. Common developments have been a move towards removing monopoly restrictions on the provision of telecommunications services and regulatory reform. The method and speed of liberalisation has varied between countries, but the general trend has been towards de-regulation of markets and the introduction of competition.

The United States was the first country to make a move towards liberalising telecommunications when, in 1982, a legal process began which led to the breakup of AT&T into regional operating companies. This ‘divestiture’ led to the creation of two separate markets: a competitive long distance market and local access or district monopolies. Local telephone services in the United States are currently provided by around 1,325 local exchange companies (LECs). Long distance services are provided by a number of operators, however, the three main players (AT&T, MCI and US Sprint) hold 85.7 per cent of the market (Budde 1994, p.190).

The United Kingdom was quick to follow the United States when, in 1983, Mercury Communications was granted a licence to compete with the long standing monopoly facilities carrier, British Telecom (BT). The facilities network duopoly was ended in 1991 and the market opened up to full competition. The privatisation of BT was completed in 1993 when the UK government sold its remaining 22 per cent share. By May 1993, twenty licences had been granted for the provision of telecommunication services over fixed links. Cable television operators in the UK can also offer telecommunications services.

Japan liberalised its telecommunications market in 1985. The reforms to telecommunications in Japan included the partial privatisation of Nippon Telegraph and Telephone Corporation (NTT) and the provision for multiple carriers to enter the market. Japanese telecommunication carriers are diided into two types: Type 1 carriers provide telecommunication services by establishing telecommunications circuit facilities; and Type 2 carriers provide value added services. By the end of 1993, there were 84 Type 1 carriers and 1,581 Type 2 carriers (Budde 1994, p.149-150).

In April 1989, New Zealand opened its telecommunications market to competition. Reforms in New Zealand mean that there are no restrictions on the number of entrants allowed into the

telecommunications market, no restrictions on the telecommunications services that could be offered, and there is no telecommunications regulatory authority. The Telecom Corporation of New Zealand (TCNZ) was fully privatised in June 1990. Clear Communications, which began operation in competition with TCNZ in 1991, gained more than 18 per cent of the market in the first two years.

In Canada, a new Telecommunications Act came into effect in 1993, marking the end of the long distance service monopoly. This allowed Unitel to enter the market in competition with the Stentor consortium of companies.

A number of the European countries have continued with monopoly provision of basic telecommunications services and infrastructure. However, in recent years many of the European countries have made moves towards partial privatisation of their telecommunications carriers. In Denmark, privatisation of Tele Denmark is currently underway; in the Netherlands, partial privatisation began in 1994; in Belgium the government is to consider privatising up to 49 per cent of Belgacom; the constitutional and legislative process to begin privatisation of Germany's Deutsche Bundespost Telekom is currently underway; and Greece has embarked on the partial privatisation of its telecommunications operator OTE.

Table 2.5 Current Market Structures

COUNTRY	*FIXED NETWORK MARKET STRUCTURE*	*OPERATOR*	*STATUS*
Australia	Duopoly	Telstra Optus Communications	State Private
Austria	Monopoly	Post and Telegraphverwaltung (PTV) Radio Austria	State State
Belgium	Monopoly	Belgacom	State
Canada	Geographically divided concessions: some competition	Stentor Members Unitel Comm. Inc	Private Private
Denmark	Monopoly	Tele Danmark Telecom Danmark Four regional operating companies	51% State owned
Finland	Open Competition	Telecom Finland 48 local telephone companies (Association of Telephone Companies)	State Private
France	Monopoly	France Telecom	State
Germany	Monopoly	DBP Telecom	State
Greece	Monopoly	OTE	State
Hong Kong	Monopoly	Hong Kong Telephone Company Ltd Hong Kong Telecom International Ltd	Private Private
Iceland	Monopoly	P&T Administration	State
Ireland	Monopoly	Telecom Eireann	State
Italy	Geographically & functionally divided monopolies	SIP STET Italcable Telespazio ASST/IRITEL	60.4% State owned 65.0% State owned 49.3% State owned 100 % State owned 100 % State owned
Japan	Open Competition	Type I carriers - NTT - KDD - 66 others Type II carriers	Minimum: 66.2% State owned 33.3% State owned Privately owned Privately owned
Korea (South)	Monopoly (local & trunk) Duopoly	Korea Telecom DACOM	98% State owned Private

Cont'd.

Table 2.5 Current Market Structures (Cont'd)

Luxembourg	Monopoly	P& T Administration	State
Malaysia	Monopoly	Telekom Malaysia Berhad	75% State owned
Netherlands	Duopoly	PTT Telecom Netherlands Kninklijke PTT Netherlands	State
New Zealand	Open Competition	Telecom Corporation New Zealand Clear Communications	Private Private
Norway	Monopoly	Norwegian Telecom	State
Portugal	Geographically divided monopolies	Telecom Portugal TLP CPRM	State State 57% State owned
Singapore	Monopoly	Singapore Telecom	89% State owned
Spain	Monopoly	Telefonica	33.6% State owned
Sweden	Open Competition	Swedish Telecom Tele2 and others	State Private
Switzerland	Monopoly	Swiss PTT	State
Thailand	Monopoly	Communications Authority of Thailand	State
Turkey	Monopoly	General Directorate of PTT	State
United Kingdom	Open Competition	BT Mercury Kingston Telecom + others	Private Private Private
United States - Local exchange carriers	Geographically divided monopolies with competition in some States.	RBOCs: Ameritech, Bell Atlantic, Bell South, NYNEX, Pacific Telesis, South Western Bell, US West.	Private
- Long Distance and International Exchange Carriers	Open Competition	AT & T, MCI, US Sprint, GTE/Cantel - Others	 Private

Sources: OECD 1994, Budde 1994 and APEC 1993, 1994.

The European Union agreement to liberalise the provision of public voice telephony by 1998 (an additional five years were granted to Member states with less developed networks, including Spain, Ireland, Greece and Portugal) should see fundamental changes to the telecommunications industries in these countries over the next few years. The European Union's framework is likely to include trans-border simple resale, which will be necessary for the development of trans-European networks, and is likely to play an important role in integrating manufacturing and service industry markets within Europe(OECD 1994a).

In Asia, liberalisation has generally taken the form of competition through the licensing of additional operators for mobile communications and competition in data communication and satellite services. In the area of infrastructure competition, the Republic of Korea has recently introduced a duopoly policy. In November 1993, the Telecommunication Authority in Hong Kong announced plans to licence additional local fixed telecommunication networks in competition with the network operated by the Hong Kong Telephone Company (HTC). A number of countries within the region are also either implementing or planning partial privatisation of telecommunications carriers. In 1990, the Malaysian government sold 25 per cent of Telekom Malaysia Berhad; 11 per cent of Singapore Telecom was sold on the Stock Exchange in 1993; and 2 per cent of Korea Telecom's shares were sold in 1993 (Budde 1994, pp.118-119).

The importance attached to telecommunications policy has also increased considerably in many countries over recent years. Two of the main reasons for this are: the recognition among many governments of the importance of communications in economic and social development, and the heightened political interest in the development of broadband communication infrastructures and applications. In the last few years a number of countries, including the United States, Canada, Japan, and Australia, have begun to review their overall communications policy in the light of the convergence of broadcasting and telecommunications, and are exploring the policy requirements of integrating these sectors. The reviews are not only looking at the market structures and regulatory requirements of the merging industries, but also at the need to stimulate service development and the diffusion of new technologies. This new focus is likely to accelerate moves towards more competitive market structures.

2.2 The Telecommunications Industry in Australia

The telecommunications services industry is globalising in response to the globalisation of its major business customers, and in response to new opportunities opened up by de-regulation in the major growth markets of the world. Multinational enterprises (MNEs) tend to be among the largest users of telecommunications services. They need efficient, cost effective, seamless communication throughout their global enterprises. But international telecommunications has been operated on a fragmented, bilateral basis. The management of a global network in such an environment is highly complex, and Telcos are seeking to develop a global reach to enable them to service the needs of these highly profitable customers.

Newly deregulated markets are also opening new opportunities for Telcos and newly developing economies are providing increasing market opportunities, which the mature economies of North

America and Europe cannot match. The major players in telecommunications are also globalising and forming strategic alliances to gain entry into these new growth markets. National telecommunications markets are now more permeable than ever before.

The Australian telecommunications market is supplied by organisations operating under various licences as per the *Telecommunications Act 1991*. These include General Carrier Licences, Service Providers Class Licences (SPCL), International Service Providers Class Licences (ISPCL), Public Access Cordless Telecommunications Class Licences (PACTS), and Public Mobile Telephone Licences (PMTS). These organisations are, in essence, either facilities-based carriers or service providers.

The Facilities-Based Carriers

Telstra, operating within Australia as Telecom Australia, and Optus Communications operate as general carriers. They provide (fixed) network facilities and a range of telecommunications services. Telstra, Optus and Vodafone hold mobile carrier licences. Telstra operates both analogue (AMPS) and digital (GSM) mobile networks, Optus and Vodafone operate digital (GSM) mobile networks, and Optus operates as a reseller of Telstra's MobileNet analogue service.

Telstra is an Australian public limited liability company 100 per cent owned by the Commonwealth Government. It was incorporated in 1991 and began trading in 1992, following the merger of the former Telecom Australia and OTC Ltd - previously the monopoly domestic and international carriers, respectively. In 1993-94, Telstra employed approximately 67,000 staff, held assets valued at $21.1 billion, generate a revenue of $13.4 billion and returned an after-tax profit of $1.7 billion.

Within Australia Telecom handled 13 billion phone calls, installed over 300,000 new phone services, operated 8.8 million telephone services, more than 38,000 public payphones, some 5,344 telephone exchanges and around 4,000 microwave repeater stations (Telstra 1994, InterData 1994, p.37). By 1994, approximately 51 per cent of Telstra's lines were digital, and by the end of 1994 mobile subscribers numbered more than 1.4 million. In October 1993 Telstra launched a five year Australian network modernisation program with the aim of ensuring that Australia's domestic network capability will meet the needs of the future. Developments include full network digitalisation by 1998 (Telstra 1994, p.12 and p.28, BSEG 1994, p.37).

Telstra's overseas operations focus in large part on the Asia-Pacific region. It operates in 17 countries independently, in partnerships and joint ventures. Telstra has built strong footholds in Indochina and Central Asia, developing and managing facilities on a revenue-share basis. Measured by traffic and revenue Telstra is the largest Asia-Pacific facilities-based carrier outside Japan, with approximately 50 per cent of the traffic to and from the region. Telstra is a large shareholder and user of Intelsat satellite facilities and Pacific regional optical fibre cable installations, including TASMAN 2 linking Australia and New Zealand, PacRimEast linking New Zealand and Hawaii and PacRimWest linking Australia and Guam (InterData 1994). Telstra is currently earning some $200 million annually from its overseas investments spanning 17 countries, and it aims to boost annual revenues from offshore projects to between $1.5 and $2 billion, or about 10 per cent of total revenue, by 1998.

Optus Communications was selected as the second facilities-based carrier in November 1991 to compete with Telstra in a duopoly fixed network carrier market until June 1997. Optus bought Australia's domestic satellite operator AUSSAT and began operation in 1992.

Optus Communications is 51 per cent Australian owned with shares being held by: Mayne Nickless (25 per cent), Bell South (24.5 per cent), Cable & Wireless (24.5 per cent), AMP (10 per cent), AIDC Fund (10 per cent), and National Mutual (6 per cent). Optus employs around 2,800 people, generated $835 million in revenue in 1993-94 and reported an operating loss after-tax of $97.7 million. Despite an accumulated loss incurred during the start-up phase of some $170 million Optus expects to be profitable by 1995-96, and is planning a float on the Australian Stock Exchange during 1995 (*Asian Communications*,June 1994, p.41).

Using interconnect to Telecom's network as a base for customer access, Optus began building its own coast-to-coast optical fibre network almost immediately, and plans to be 90 per cent independent of Telstra by 1997. Optus Mobile began in May 1992 as a reseller of Telecom's MobilNet analogue mobile services, and has since begun the roll out of its own digital (GSM) mobile network. Optus's long distance services were launched in November 1992 for Sydney, Melbourne and Canberra, and the first calls over Optus cables were made in March 1993. The Brisbane switch was commissioned in July 1993 (Optus 1993). Optus's investment budget for 1992-97 is $2 billion, and it is laying 8,000 sheath kilometres of optical fibre cable.

Focused on long distance and mobile services, Optus's market share in these segments reached 8-10 per cent in long distance in 1994, and 13-15 per cent in international. Optus's overall share of the Australian communications market was around 4.5 per cent and the company's estimated value was $2 billion in mid 1994 (Budde 1994, p.57). Optus is estimated to have contributed some $12.9 million to industry export sales in 1993-94.

Vodafone won its bid to be Australia's third mobile carrier in 1993 (under the name Arena GSM). It began operation of its digital (GSM) mobile network in Sydney, Melbourne and Canberra in late September 1993, and claimed to have signed 20,000 subscribers by mid 1994, with network coverage spreading to all other Australian capitals.

Vodafone Australia has only 5 per cent Australian equity, being largely owned by Vodafone UK, which is a leading player in mobile communications around the world. Vodafone claims 56 per cent of the UK mobile market, and operates mobile networks in more than a dozen countries. Vodafone (Australia) earned a revenue of $8.5 million in the 12 months to March 1994, while incurring an operating loss of $24.7 million (Lee 1994b, p.12).

Vodafone is operating in a wholesale only mode, relying on resellers for the delivery of services to the end customer, and experience in overseas markets would suggest that Vodafone is likely to be an innovative player.

Licensed International Service Providers

Licensed international service providers operating in 1993-94 included: BT Australia, Infolink Network Services, PacRim Financial Network, MIG International Communications, AAP Telecommunications (AAPT), Equal Access, Newsnet, Saturn Global, Easycall Australia, Pacific Nexus, Teknix Communications, Fugro Survey, ABA Telecommunications, Telecell, Stanlite Electronics, International Telemanagement, Myline, Vocom West, NewComm, Cellular One Communications, Digicall, Cooee Phone, Circa Telecommunications, Access Telemanagement, Australian Wholesale Communications, Sharelink Communications, Oryal, Bamson, H&T Telecommunications, TFM Australia, Universal Dynamics, VSP Smartcall, Sprint Telecommunications, SingCom and Peter Osterman. Other international services providers continue to operate under the 'grandfather' arrangements subject to the superseded *Telecommunications Act, 1989.*

The Service Providers

Domestic and international service provider licences allow organisations to supply a range of communications services utilising the network capacity supplied by the general carriers. As an indicator of the level of activity in services provision a leading industry directory, the *InterData Telecommunications Handbook* (InterData 1994), lists 28 companies offering telecommunications services in the Australian market, Austel had 34 registered international service providers in 1993 (although this fell to 21 in 1994), and the number of domestic services providers is estimated to have grown to more than 100.

The Service Provider (SP) industry is based on the provision of what are defined under the *Telecommunications Act, 1991* as 'eligible services'. There are three main industry segments supplying: value-added services, private network services and resale services, respectively.

Value-added services (VAS) providers have entered the industry since the introduction of competition in the provision of value-added services under the *Telecommunications Act, 1989.* Value-added services include such things as: network management and facilities management services, database and computer bureau services, videotex services, security and alarm services, directory services, electronic mail services, computer, audio and video conferencing services, electronic document interchange (EDI) services, voice information and bulletin board services, electronic funds transfer, payment, settlement and point of sale services.

Private Network Services (PNS) providers primarily supply own use networks. These networks, and networks developed by organisations for their own private use, may resell excess capacity under the open resale provision of the *Telecommunications Act, 1991.* They may do this themselves or engage a capacity reseller to do it for them.

Resellers specialise in the resale of basic carrier services (BCS), typically voice services, provided by means of carrier network services acquired from a carrier by the services providers, virtual private networks and/or leased lines. There are various kinds of resellers:

- *Switchless resellers* typically purchase bulk network services from a carrier and aggregate the traffic of their customers in order to gain volume discounts that would not be available to their customers individually. Switchless resellers do not own or operate their own telecommunications networks. True switchless resellers are, however, full-service companies that provide their customers with network services and support functions, such as billing and help desk operations.
- *Aggregators* are switchless resellers who simply sign customers and pool them under a volume discount plan. An aggregator does not maintain a supplier-customer relationship with the end user. Customers receive their bills from the carrier, and pay a fee to the aggregator to gain access to their share of the volume discounts obtained.
- *Capacity resellers* are a further subgroup of resellers who specialise in trading in the disposal of excess private network capacity, offering what is known as capacity resale services.
- *Switched resellers* typically install their own independent switching system and/or network facilities, and combine these with carrier acquired leased line and switched access and egress services to provide customers with an end-to-end service and related support functions (Austel 1994c, p.11). AAPT is among the major switched resale operators.

Domestic Service Providers and Resellers

AAP Telecommunications – originally a joint venture company 51 per cent owned by AAP Information Services, and 24.5 per cent each by MCI Communications Corporation of the USA and the Todd Corporation of New Zealand, who are also the major shareholders of New Zealand's second carrier Clear Communications. MCI relinquished its share holding in late 1994.

AT&T Australia – subsidiaries of the American Telephone and Telegraph Company.

Axicorp - previously Paxus Communications now 60 per cent owned by Fujitsu Australia, Axicorp has a staff of around 40 serving some 9,000 customers.

BT Australasia – a subsidiary of BT of the UK (formerly British Telecommunications Plc) employing approximately 200 people in Australia, and with a significant activity based around the operation of the NSW Government network.

Call Australia – offering national and international resale services.

First Direct – a digital cellular services provider based on the Optus GSM mobile facilities.

Infonet - an international provider of packet-switching services owned by a consortium of carriers, including the PTTs of Germany, France, the Netherlands, Belgium, Switzerland, Sweden, Spain and Singapore.

MCI International Australia – the US-based international services provider (and 25 per cent owner of Infonet).

Network Exchange and **Netex Exchange** – both offering capacity resale services.

NSO Telecommunications – a switchless reseller of Optus long distance and international services.

Pacific Star – a joint venture company owned by Bell Atlantic International and Telecom New Zealand International, Pacific Star has won some major facilities management contracts in Australia; most notably that of the Queensland Government which is worth around $100 million per annum, Metway Bank and Cadbury Schweppes.

QNet – the privatised former Queensland government network, now a subsidiary of The Nine Network.

Saturn Global Network – a subsidiary of the UK-based financial organisation M.W.Marshall and Company.

SingCom – a subsidiary of Singapore Telecom International.

SITA – the international airlines' telecommunications and information services supplier.

Sprint International – the Australia arm of US Sprint offering global virtual private network and messaging services.

Vodac – a Vodafone subsidiary providing cellular mobile services.

In the emerging competitive context there has been rapid growth in the number of resellers in general, and of switchless resellers in particular. As things stand profit margins are low for the switched resellers. In addition to relatively high start-up costs, this has reduced the number of entrants into that market segment. More players have been attracted to the switchless market, where start-up costs are lower.

A number of the switchless resellers are already operating cooperatively to increase their aggregation and, thereby, the margins available from volume discounts. Such arrangements are leading to the emergence of a three tier switchless reseller hierarchy involving: primary service providers with direct account relationships with one or more of the general carriers; secondary resellers utilising carrier services sourced from a primary service provider; and affiliates operating separate businesses under a local distribution agreement with either a primary or secondary service provider (McDonnell 1994, p.94).

The vast majority of resale activity is directed at business users, although there are some entrants now beginning to target the residential market. In Canberra, for example, Universal Dynamics is offering households an immediate 10 per cent reduction in their telephone bill on signing up for their resale (aggregator) services (*The Chronicle* November 21, 1994, p.54). The bigger players, such as AAPT, Axicorp, Pacific Star, BT and Q-Net, rarely enter the market as switchless resellers or simple aggregators. They bring greater experience, financial backing and sophistication, and typically engage in the provision of enhanced services, such as facilities management and other value-added services (McDonnell 1994, p.95).

Few players are entering the switched reseller business. In fact, there is only one switched reseller offering national service and competing directly with the carriers, AAP Telecommunications (AAPT), and a handful of regional players (Austel 1994c, p.33).

Both the switched and switchless segments of the reseller industry are relatively concentrated, with both segments dominated by a few large players. Austel estimate that the three largest players, AAPT, Pacific Star and Axicorp, account for 75 per cent of the total resale market (Austel 1994c, p.47).

The price of services acquired from the carriers is the major determinant of service provider costs, and thereby of the possible profit margins. Payments to the carriers typically account for up to 75 per cent of the revenue of switched services providers, and up to 80 per cent of switchless providers' revenues (Austel 1994c, p.43). This gives the carriers considerable influence over the development of the reseller industry.

Industry estimates put the current value of the resale market in Australia at approximately $400 million per annum, growing to $500 million by 1994-95 (Austel 1994c, p.12). Resellers and aggregators make their margin, in large part, from volume discounts. The maximum published volume discounts available from the carriers, therefore, give a guide to the level of discounts that resellers can offer. Savings of the order of 20 to 25 per cent, and up to 50 percent in the case of some callback operations, can be achieved.

De-regulation of the telecommunications services market has placed Telstra in a new role as a wholesaler to competitive telecommunications service providers. When the fixed network duopoly was introduced special interconnect arrangements were made for Optus Communications. All other customers connecting to Telstra's network have been treated as retail customers. Service providers are treated in the same way as any large customer, and get the same range of volume discounts. Resellers can only increase the level of discounts by taking over some of the carriers' services, such as billing and customer support.

Telstra has also lodged a special switched service provider tariff with Austel called National Connect. This provides for interconnect services for switched resellers. However, the pricing of National Connect has been widely criticised, and it has attracted no more than a handful of customers since its introduction (Austel 1994c, p.30).

Interconnect arrangements are vital for competition in telecommunications. Facilitating competition relates to both the level of charges and the service provider/retail margin, and to the barrier to entry effects of the balance of fixed to variable costs in services provider tariffing. Telstra's National Connect involves a number of fixed interconnect charges and conditions as to usage which make local or regional switched services provision all but impossible.

Neither do the service providers enjoy any special conditions as to the point of interconnect. All are restricted to the line-side of an exchange, which reduces the level of network functionality available to the service providers relative to trunk-side interconnection. Importantly, it denies the service providers access to the signalling network upon which the development of the more innovative services depends (Austel 1994c, p.31).

While the service provider industry is here to stay, it is unlikely that it will realise its full competitive potential until these technical and commercial aspects of interconnection are resolved. In the meantime resellers offer small and medium sized business customers an aggregation/discount option that can bring them significant savings on their communications costs. Discounts are now an essential part of carrier strategies in meeting their price-cap regulation obligations, and are, therefore, now an integral part of telecommunications services pricing strategies.

Case Study

AAP Telecommunications (AAPT)

Service Provider

AAPT began as a joint venture company 51 per cent owned by AAP Information Services, and 24.5 per cent each by MCI Communications Corporation of the USA and the Todd Corporation of New Zealand - who are also major shareholders of New Zealand's second carrier Clear Communications. MCI relinquished its' share holding in late 1994 as a result of entering into a global joint venture with BT (UK).

AAPT became the first competitor to Telecom in 1991 when it began to provide switched long distance services. AAPT leases trunk network capacity, but uses its own switches to direct customer traffic into the network. Access for AAPT customers is automated by the installation of equipment on the customers premises which automatically generates the required access code prefix to switch calls to AAPT's network.

International calls to the United States and New Zealand are switched directly into the foreign carriers' international networks. AAPT also offers an international Virtual Private Network (VPN) service using MCI's V-net platform.

AAPT had around 15,000 customers at the end of 1994, consisting of some 300 large businesses and government departments and thousands of small businesses. Initially AAPT targeted large business users and government departments who spend up to $400,000 per month, but has since expanded its business among smaller business users with its popular Assurance product catering for users with international and long distance accounts as low as $100-$200 per month.

Recently AAPT has begun to offer services as a facilities manager, making available services such as centralised billing, monitoring and reporting of network performance, network configuration and fault rectification and detailed analysis of telecommunications expenditure. The P&O Group is among AAPT's first customers as a facilities manager. AAPT manages P&O's communications links between its offices around Australia and expects to save the company more than 10 per cent on its annual phone bill of several million dollars (*Australian Communications*, November 1994).

AAPT currently employs around 300 people; and at the end of 1994 returned an annualised revenue in excess of $130 million. AAPT's revenues grew by 120 per cent in 1992, 140 per cent in 1993 and another 140 per cent in 1994. The large increases in revenue followed the company's move away from dedicated leased access lines to switched services such as Assurance, Vista, OneGovernment and the virtual private network service, Vantage.

The Australian Market

The Australian telecommunications services market is currently estimated to be worth more than $14.5 billion per annum. In 1993-94 Telecom's telecommunications services revenue amounted to just over $10.3 billion, with a further $2.3 billion coming from equipment rental and repair services. Optus Communications earned a further $1 billion from telecommunications services in Australia, and other service providers approximately $880 million (Budde 1994, p.39).

Telstra's revenue from voice services constitutes a declining share, with rapid growth in the area of data network and value-added services. Nevertheless, while data, text and image traffic is growing more rapidly, the voice telephony business will remain the main revenue source for some time to come. The new players in the services market are, not surprisingly, showing growth in all market segments.

Table 2.6 The Australian Telecommunications Services Market, (AU$ millions)

Supplier/Services	*1992*	*1993*	*1994*
Telstra			
Voice Services			
Local Calls	2 500	2 575	2 650
Trunk Calls	3 350	3 200	3 050
International Calls	1 500	1 425	1 400
Total Voice	7 350	7 200	7 100
Other Services			
Data Nets/VAS	1 150	1 390	1 650
Wireless[a]	700	700	890
Directories	650	680	710
Total Other	2 500	2 770	3 250
Equipment rental/repair	2 200	2 250	2 310
Total Telecom	12 050	12 220	12 660
Optus Communications			
Voice Services	5	200	375
Network Services	170	200	250
Wireless Services[b]	70	72	400
Total Optus	245	472	1025
Other services			
Value-added	475	600	750
Wireless	90	88	130
Total Others	565	688	880
Total Australia	12 860	13 380	14 565

Notes: Differences between these figures and operator reported revenues relate to the treatment of internconnect payments, mobile resale and the range of services covered, and to the difference between calendar and financial years.
[a] Excluding Optus Revenue.
[b] Excluding interconnect charges.
Source: Budde 1994, p.39.

Growth in the resale market has been rapid and is likely to continue to be so over the next few years, reaching as much as $1 billion by 1997. Uncertainty over tariff arrangements during 1994 is likely to have been only a minor hiccup, with growth resuming strongly in 1994-95 (Budde 1994, p.74). The

top five companies in the resellers/services market: AAPT, Axicorp, Pacific Star, BT and Q-Net, accounted for approximately 80 per cent of that market in 1993-94.

Telecommunications Reform in Australia

The structure of the telecommunications market in Australia has been reviewed a number of times. A major review was undertaken by the *Committee of Inquiry into Telecommunications Services in Australia* in 1982 (Davidson Report 1982). This was followed by a review in 1987 that led to the Ministerial Statement on *Australian Telecommunication Services* (Evans 1988). As a result of this review a number of reforms were introduced in the *Telecommunications Act, 1989.* They included the establishment of the Australian Telecommunications Authority (AUSTEL) as an independent regulator for the telecommunications industry, and the opening up of value added services to full competition.

Following the implementation of these reforms, emerging international competition and problems with the financial viability of AUSSAT, led to a further review of the ownership and structural relationships between Telecom, OTC and AUSSAT - the then domestic, international and satellite facilities-based carriers, respectively. This review developed into a full re-examination of the telecommunications market structure.

In November 1990, the Government announced a number of policy decisions, which established the basis for the regulatory arrangements currently governing the Australian telecommunications industry (Beazely 1990). The key elements of these regulatory arrangements included:

- the establishment of a duopoly on fixed network provision until 30 June 1997;
- the merger of Telecom and OTC into the Australian and Overseas Telecommunication Corporation (AOTC) - now trading in Australia as Telecom and internationally as Telstra;
- the sale of AUSSAT to the second carrier;
- the issuing of three public mobile telephone (PMTS) licences;
- allowing full resale of domestic and international capacity; and
- extended regulatory responsibilities for AUSTEL, including jurisdiction over the interconnection arrangements between the general carriers.

These policy decisions subsequently formed the basis of the *Telecommunications Act 1991*

Table 2.7 Time Frame for Structural Change in Australian Telecommunications

1988	Review of the operation of telecommunications in the context of a wider microeconomic reform and government business enterprise corporatisation agenda.
1989	Telecommunications Act, 1989 introduces regulatory reform and competition to limited sections of the telecommunications industry's activities
November 1990	Government announces further regulatory and competitive reforms to the telecommunications industry
June 1991	Telecommunications Act 1991
July 1991	Telecom's first phone monopoly ends
November 1991	Government selects Optus as second national carrier
January 1992	Optus licensed as second national carrier
February 1992	Formal merger of Telecom Australia & OTC to form AOTC.
February 1992	Optus starts operations
June 1992	Optus starts mobile service
November 1992	Optus starts domestic long distance and international services from Sydney, Melbourne & other centres (eg Canberra)
December 1992	Third mobile licence granted to Arena Communications. The carrier will trade as Vodafone in Australia.
April 1993	Corporate identity of AOTC changed to Telstra Corporation Ltd, operating in Australia as Telecom Australia & offshore as Telstra OTC Australia.
April-May 1993	Telecom and Optus launch GSM mobile communication services.
July 1993	Staged preselection ballots began. Customers required to select either Telecom or Optus as preferred supplier of long-distance and international services.
September 1993	Vodafone, the third mobile licence holder, commenced operation with GSM in Sydney, Melbourne & Canberra.
December 1993	Telecommunications Industry Ombudsman established.
May 1994	Telecommunications Review announced.
1995	Telecommunications Review and additional mobile licences to be considered.
June 1997	End of legislated fixed network duopoly

The Australian Government recently announced a review to examine what changes in policy, legislation and regulation are required to be introduced following the expiry of the duopoly arrangements in June 1997 (Lee 1994a). Issues to be addressed in the review include: the relevance of the current carrier licensing scheme post 1997; the types of new carriers that might be licensed; interconnect and equal access arrangements; consumer and social issues including universal service, privacy and numbering policy; on-going industry development arrangements; price regulation including price caps; future development of technology-neutral service regulation and service-neutral technology regulation and the future role of AUSTEL. An essential premise of the arrangements after 1997 is that there will be greater competition. The Government is expected to consider the results of the review following the 1995-96 Budget, and aims to introduce legislative changes in late 1996.

2.3 Telecommunications Futures in Australia

De-regulation, the opening of new competitive market opportunities and the globalisation of business generally are leading to global competition between telecommunications companies (Telcos) for customers. At the same time, the gradual breakdown of the oligopoly accounting rate regime is opening competition for the control of traffic origination and participation in transit traffic carriage internationally. Telcos are seeking a global reach to maximise growth and returns by securing sufficient scale to procure efficiently and fund R&D by securing core corporate clients worldwide, gaining new sources of traffic in developing countries, and seizing opportunities in newly industrialising countries. Benefits to customers in the form of competitive tariffs and innovative services are increasingly likely to accrue from outward looking Telcos. For Australia to be in the vanguard its carriers must pursue international markets (Allen Consulting 1991, pp.11-13).

Allen Consulting (1991) identified two international strategies being pursued by Telcos into the 1990s. Namely, infrastructure control, and global customer service through global alliances. Infrastructure control strategies involve participation in building fibre and satellite links across existing and potential major traffic routes and participation in building and/or operating domestic infrastructure developments in newly industrialising countries.

As noted above, Telstra has been active in infrastructure control, especially in the Asia-Pacific region. It is a significant investor in and user of the INTELSAT satellite network as well as fibre optic links including, TASMAN 2, PacRimEast and PacRimWest. Telstra is building and managing networks in Indochina (Vietnam, Cambodia and Laos), Saudi Arabia and Kazakhstan, operating successful businesses in Hong Kong (a cordless telephone network), Thailand (nationwide satellite-based business services), the Pacific Islands and, while suffering the setback of the recent collapse of its Philippine joint venture, is likely to pursue other opportunities there. Telstra is also rolling out a mobile network in Sri Lanka, an optical fibre cable system in Pakistan, a trunk radio network in Indonesia, is participating in a joint venture to provide value-added services in Korea, a satellite systems joint venture in the PRC, and has been awarded a licence to operate a digital mobile network in New Zealand (InterData1994, p.E6-7).

Global alliances have also attracted the attention of Australia's carriers. Staying with leading edge customers is essential for Telcos to stay at the leading edge themselves, and an important part of defending local market share against overseas incursion based on using the global customer end as a beachhead into regional markets. Telstra has played a role in the creation of the 12 carrier Financial Network Association (FNA), connecting 28 of the world's major financial centres and offering leading edge international financial services. Telstra is also a member of the World Partners carrier alliance aimed at the global business customer market, and has been associated with alliances involving BT, Tymnet and Infonet involving value-added network services, and with US Sprint involving global virtual private networking. Optus Communications' shareholders, Cable & Wireless and BellSouth, link it into the global telecommunications business, and Vodafone is involved in the international marketplace through its majority owner Vodafone UK. Other services suppliers in Australia include major global Telcos like AT&T, BT, KDD, MCI, SingCom, and Sprint, which all have clear global links.

The future stretches far beyond Australia's national borders, and it is a future that involves greater accessibility and far greater bandwidth availability, multimedia and broadband services. If Australia is to become a purveyor of content and broadband services to the world, the telecommunications network and regulatory framework that is being put into place today must be the foundation.

Chapter 3 Prices

This chapter examines some key performance indicators relating to price. The first section examines and explains the unit of comparison. The second section of the chapter presents simple rate comparisons, while the third section examines price comparisons based on tariff baskets. Such international tariff comparisons allow us to assess the extent to which business users in Australia are advantaged or disadvantaged, compared to users in other countries, by the price of telecommunication services. Tariff comparisons are based on the published tariffs of the major carrier(s) in each country, as specified in the tables, and the Australian tariffs are those of Telstra. The fourth section of this chapter examines the impact of volume discounts on the prices paid for telecommunications services by business users of various sizes, and the final section presents a time series analysis which allows us to compare the price of telecommunications services over time.

The trend towards liberalisation of telecommunications in many countries has led to a heightened interest in telecommunications tariffs, because one of the expected benefits of introducing competition is a fall in the price of telecommunications services. Tariffs are, arguably, the most sensitive indicators, reflecting reforms in the telecommunications sector before other indicators. International price comparisons are, however, compromised by the use in many countries of price-cap or rate of return regulation. Overall price changes within a country are likely to closely correspond to the prevailing price cap or implied pricing based on required rate of return. It is, nevertheless, important to compare prices for various services in order to examine relative prices within the overall price changes. Rate rebalancing and price changes for specific services are important determinants of business user costs and of the competitiveness of communications infrastructures.

3.1 The Unit of Comparison

Price comparisons for telecommunications services are problematic because there is no single telecommunications charge. Rather there are a number of charges including usage charges, subscription charges and connection fees. It is possible to make direct comparisons of the prices of separate services, such as connection, rental and usage charges, but such simple price comparisons do not reflect variations between countries in the relative revenues derived from fixed and usage charges. There are also significant differences between countries in the way that charges are levied. And although the introduction of competition in many countries is leading to adjustments in the pricing structure towards more cost-based pricing, cross-subsidisation remains common.

Comparisons based on a tariff basket, such as that used by the OECD, overcome some of the problems associated with using such simple price comparisons, by including both fixed and usage charges in a ratio that reflects the average revenue patterns, and usage charges based on a basket of

calls distributed by distance, time of day/week and duration. Using a basket approach also helps to reduce bias in the comparisons due to conditions specific to a country. Nevertheless, simple price comparisons can be undertaken for a wider range of countries, including Asian countries, and in an attempt to get as wide an international coverage as possible some simple price comparisons are presented below.

In order to make comparisons between prices in different countries it is necessary to have a common unit for accounting. There are a number of alternatives ways of making price comparisons by converting prices in different countries into a common currency, including:

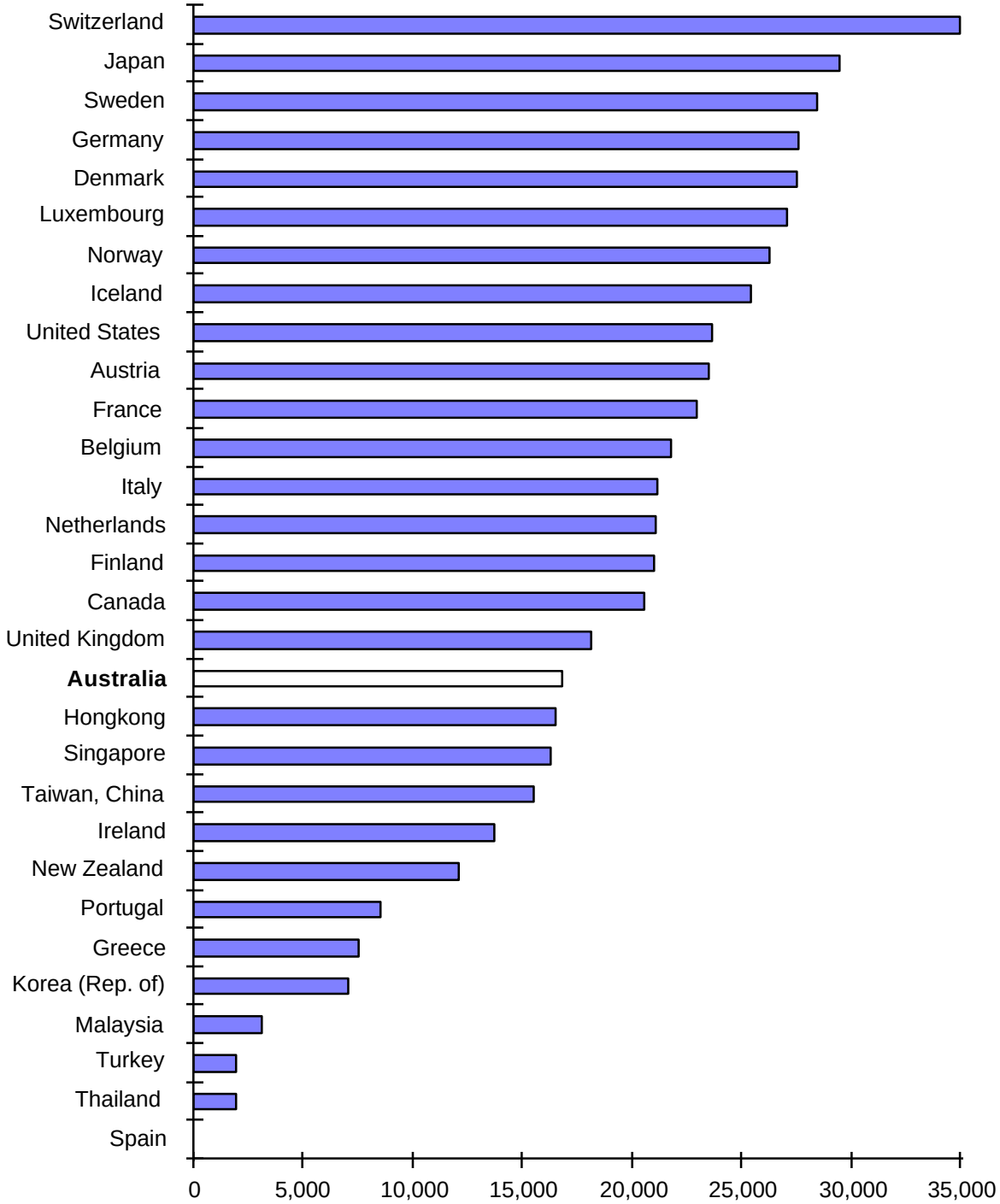
- **Purchasing Power Parities (PPPs) -** which reflect the real purchasing power of a national currency. One of the main advantages of purchasing power parities is their relative stability over time. However, PPPs reflect the ability of consumers to purchase a given good, while the focus of this study is the business user. Business users, especially multinational enterprises (MNEs), tend to base business decisions, such as investment, on costs based on exchange rates rather than considerations of consumer purchasing power. PPPs may be the best unit of comparison for residential customers, but they are not appropriate for business users.

- **Exchange Rates** - using market exchange rates to convert prices to a common currency unit (typically US dollars). The use of market exchange rates introduces an arbitrary factor into the comparison, reflecting factors such as the efficiency and level of confidence in the economy as a whole, rather than in the telecommunications sector specifically. A national currency may also fluctuate more than the tariff structure for telecommunications services (OECD 1990, p.40). Using exchange rates can, however, be useful in situations where businesses can switch their demand for telecommunications between countries. And although point of time exchange rates are volatile, it is possible to use an annual average exchange rate for comparative purposes and control for much of the short-term exchange rate volatility. Comparisons over time can also be based on constant dollar exchange rates to control for currency value fluctuations over the period of comparison.

In this study we use *average annual exchange rates* for price comparisons, and all comparisons are *excluding tax,* because business users are able to reclaim the tax paid in most countries that levy such value-added taxes, making ex-tax comparisons more representative of real business user prices.

It is useful to supplement exchange rate comparisons by some indication of affordability. Per capita Gross Domestic Product (GDP) can be used as a first approximation to such an indicator, albeit an inadequate one for the comparison of business user affordability. Per capita GDP for the countries in the sample are presented for future reference in the Figure below.

Figure 3.1 Per Capita Gross Domestic Product (US$), 1992



Sources: OECD 1994 and ITU 1994.

3.2 Simple Rate Comparisons

Simple rate comparisons examined in this section include: fixed costs (connection and rental costs) for a business mainline; the cost of a 3 minute long distance call at peak rate up to 100km; the cost of 3 minute peak rate international calls; mobile fixed costs (connection and rental costs); and the cost of a 1 minute mobile call to a distance of less than 110km. Such an approach extends the range of countries for which comparisons can be made beyond those in the previous report, especially in relation to Asia.

Business User Fixed Charges

Figure 3.2 compares fixed charges for a business mainline, including connection fees (discounted over 10 years with one tenth of the fee allocated in each year) and annual rental fees. A simple comparison of fixed charges associated with a business line reveals that, with the exception of the United States, the countries with competitive telecommunications markets, including Canada, New Zealand, Sweden, United Kingdom, Japan and Australia all have relatively high fixed charges. Australia ranks 18th of the 28 countries listed.

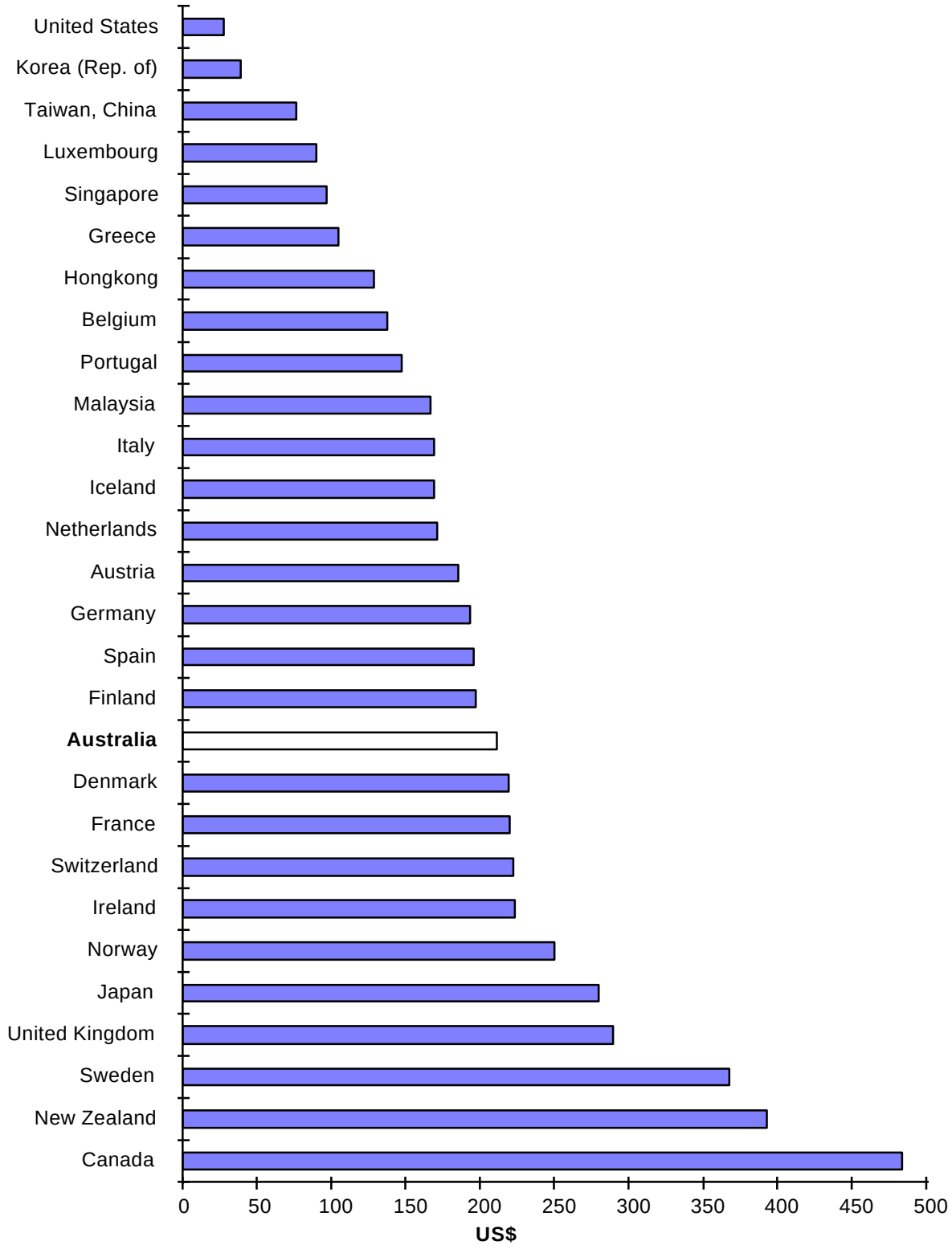
The relatively high fixed charges in Canada, New Zealand and Australia may be due to the fact that these countries have untimed or uncharged local calls and that rental charges include an element to cover the cost of these calls. Fixed charges on business lines are considerably higher in Australia than in most of the Asian countries, including Korea, Taiwan, Singapore, Hong Kong and Malaysia, but significantly less than countries where local calls are uncharged, being approximately half those of New Zealand and less than half those of Canada.

In terms of affordability, what stands out most is that the United States has low fixed charges for business users. A comparison of the ranking of these countries for business users' fixed costs with a ranking on GDP per capita suggests that affordability in Australia compares relatively favourably with most countries except the United States.

Long Distance Call Charges

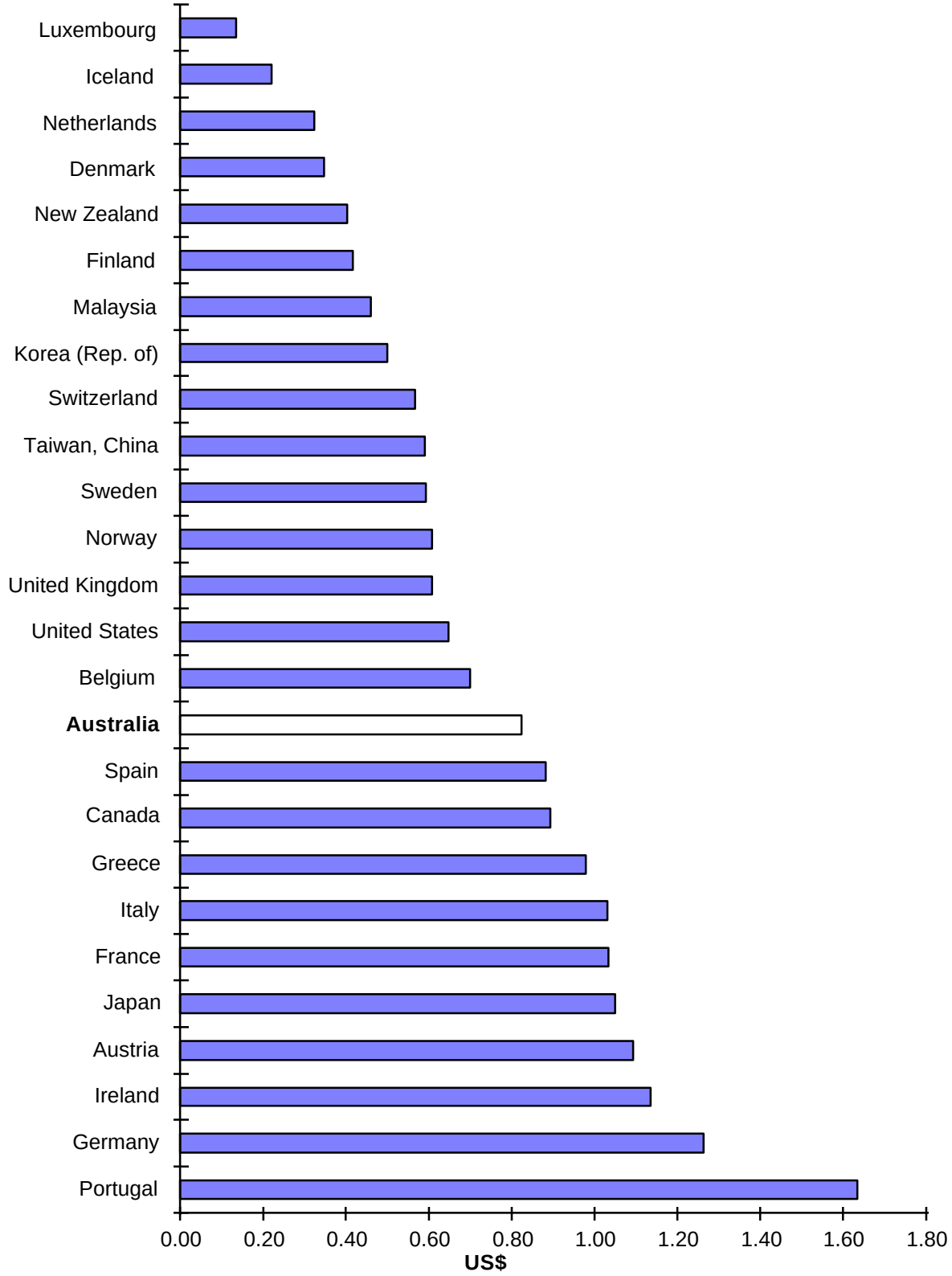
A simple price comparison for a 3 minute call at peak rate up to 100kms is presented in Figure 3.3. Australia ranks 16th of the 26 countries listed. The price of such a call in Australia is less than in Japan and Canada, but more than New Zealand, Malaysia, Korea, Taiwan, United Kingdom and the United States. In terms of affordability it would seem that a number of countries with relatively low GDP per capita have relatively high trunk call prices, with the Scandinavian countries enjoying some of the lowest trunk call prices.

Figure 3.2 Simple Price Comparison of Business Line Fixed Costs, including installation fee and rental fee, 1993 (US$)



Notes: Installation fee is discounted over 10 years. Fixed costs for Hong Kong include unlimited local calls.
Source: Siemens 1993.

Figure 3.3 Simple Price Comparison of 3 minutes long distance call up to 100kms (daytime rate), 1993 (US$)



Source: Siemens 1993.

International Call Charges

International call prices are compared in Table 3.1 and Figure 3.4. On a simple rate comparison, the most expensive calls were from Spain to Australia, New Zealand and Japan, costing US$9.21 for 3 minutes, while the cheapest calls were between the Scandinavian countries. Simple price comparisons for international calls indicate that calls from Australia to most OECD countries are cheaper than the price of making the same telephone call in the opposite direction, suggesting that Australia's international call charges are relatively low.

The price comparisons presented in Figure 3.4 are for an average of calls from each OECD country to all other countries in the OECD at peak time and for 3 minutes (weighted by the population of the country in which the call is terminated as a proxy for the likelihood of calling). We find that Australia ranks 14th of the 24 OECD countries in 1994, below the Scandinavian countries, the United Kingdom, Canada and the United States, but above New Zealand and Japan. In view of Australia's relative disadvantage of distance from the core European OECD countries this is a relatively good performance.

Cellular Mobile Fixed Charges

A simple rate comparison of cellular mobile fixed charges (Figure 3.5), including connection charges (discounted over 3 years) and rental charges, indicates that mobile fixed charges in Australia are low compared with most other countries, including Japan, Hong Kong, Canada, United Kingdom, United States and New Zealand. Malaysia had the cheapest mobile fixed charges in 1992, with Australia ranking 8th of the 29 countries listed. Again the Scandinavian countries are among the cheapest, which in combination with relatively high GDP per capita suggests that they enjoy a high level of affordability.

Cellular Mobile Call Charges

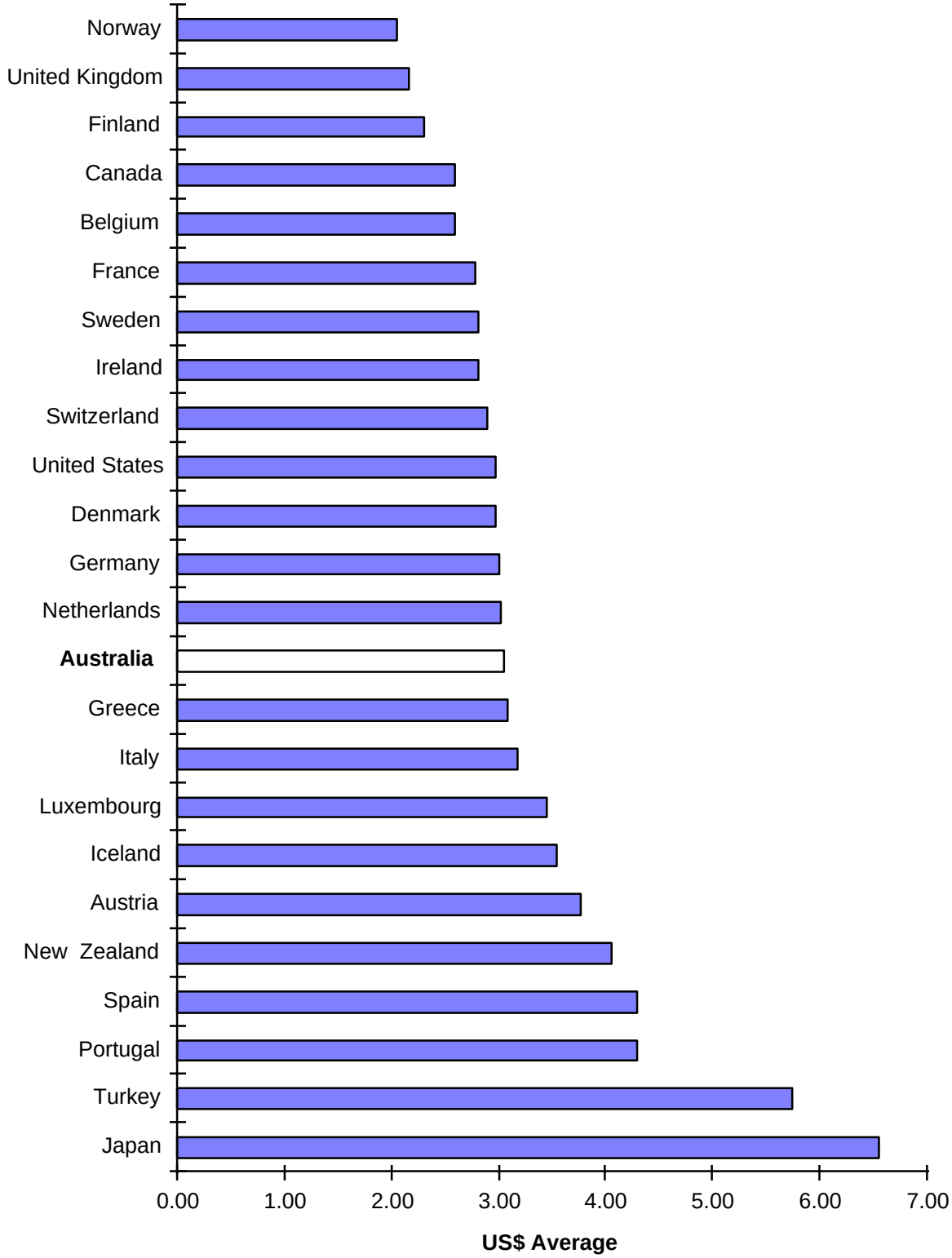
Figure 3.6 provides a comparison of cellular mobile call charges on a per minute basis at peak rates for distances up to 110km. It indicates that mobile call charges were relatively low in Australia in 1992, with only Singapore, Malaysia, Korea, Iceland, Switzerland and Hong Kong having lower cellular call charges.

Overall, in terms of simple rate comparisons, Australia performs well on cellular mobile charges and international call charges, but rather less well on business user fixed and national usage charges.

Table 3.1 Comparison of International Call Charges - Peak rate 3 minute call, 1994 (US$)

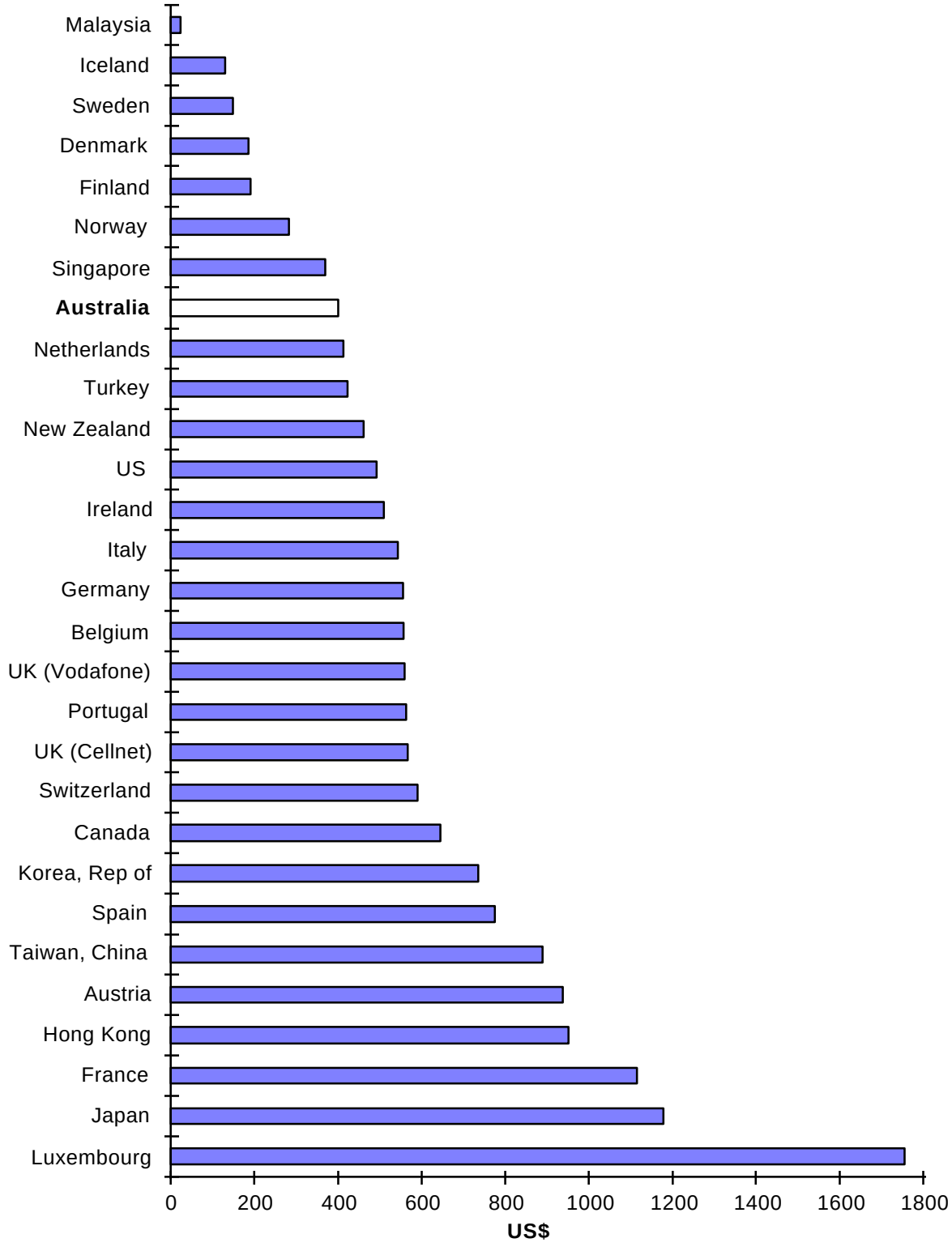
From / To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1 Australia	***	3.50	3.50	2.75	3.12	3.12	3.12	3.32	3.91	5.48	2.65	2.85	3.52	3.91	3.12	2.14	3.12	3.91	4.30	3.12	3.50	3.91	2.65	2.65
2 Austria	7.22	***	2.24	3.61	2.24	3.44	2.24	2.24	3.44	3.44	3.44	2.24	7.22	2.24	2.24	7.22	3.44	3.44	3.44	3.44	2.24	3.44	3.44	3.61
3 Belgium	4.34	1.74	***	3.06	1.74	2.17	1.45	1.45	1.86	2.89	1.74	1.74	4.34	1.30	1.45	4.34	2.17	1.86	1.86	2.17	1.74	2.60	1.45	3.06
4 Canada	2.75	2.96	3.40	***	2.56	2.56	2.23	2.93	4.34	3.03	3.03	3.53	3.74	3.48	2.02	2.75	2.56	3.92	4.97	2.02	2.02	5.16	1.83	1.23
5 Denmark	4.81	1.48	1.34	3.70	***	1.11	1.48	1.30	1.67	2.22	1.48	1.67	5.92	1.48	1.48	7.41	1.11	1.67	1.67	1.11	1.48	2.22	1.48	3.70
6 Finland	2.53	1.64	1.64	2.53	0.85	***	1.64	1.64	1.64	1.64	1.64	1.64	4.26	1.64	1.64	4.26	0.85	1.64	1.64	0.85	1.64	1.64	1.64	2.53
7 France	5.76	2.77	1.63	2.99	1.96	2.77	***	1.63	1.96	2.77	1.96	1.63	5.76	1.63	1.63	5.76	2.77	1.96	1.63	2.77	1.63	2.77	1.63	2.99
8 Germany	5.66	2.09	2.09	3.58	2.09	2.34	2.09	***	2.09	2.34	2.09	2.09	5.66	2.09	2.09	5.66	2.34	2.09	2.09	2.34	2.09	2.34	2.09	3.58
9 Greece	3.94	1.32	1.68	3.94	1.68	2.02	1.68	1.68	***	3.02	1.68	1.68	6.11	1.68	1.68	6.11	2.02	1.68	1.68	2.02	1.32	1.32	1.68	3.94
10 Iceland	5.32	3.06	3.06	3.50	2.08	2.17	2.44	2.08	3.50	***	3.06	3.50	7.14	3.06	2.17	7.14	2.08	3.06	2.44	2.08	3.06	3.50	2.44	3.06
11 Ireland	4.00	2.11	1.58	3.03	2.11	2.11	1.58	1.58	2.11	2.11	***	2.11	5.27	1.58	1.58	4.00	2.11	2.11	2.11	2.11	2.11	2.99	1.32	3.03
12Italy	5.58	1.73	1.98	4.30	1.73	1.98	1.73	1.73	1.73	2.50	1.98	***	5.58	1.73	1.98	5.58	1.98	1.98	1.98	1.73	1.73	2.50	1.73	4.30
13 Japan	6.95	8.97	8.97	6.95	8.97	8.97	8.84	8.84	8.97	8.97	8.97	8.97	***	8.97	8.97	7.01	8.97	8.97	8.97	8.97	8.97	8.97	8.84	5.67
14 Luxembourg	7.08	1.73	1.26	3.77	1.73	2.36	1.73	1.73	1.73	3.77	1.73	1.73	7.08	***	1.26	8.39	2.36	1.73	1.73	2.36	1.73	3.77	1.73	3.77
15 Netherlands	5.65	2.34	1.78	3.15	1.78	2.91	1.78	1.78	2.34	2.91	2.34	2.34	5.65	1.78	***	5.65	2.34	2.34	2.34	2.34	1.78	2.91	1.78	3.15
16 NZ	2.04	4.13	4.13	3.94	4.13	4.13	4.13	4.13	4.57	4.57	4.13	4.13	4.13	4.57	4.13	***	4.13	4.55	4.55	4.13	4.13	4.57	3.94	3.94
17 Norway	3.18	1.59	1.59	2.14	0.85	0.85	1.59	1.59	1.59	1.59	1.59	1.59	3.18	1.59	1.59	3.18	***	1.59	1.59	0.85	1.59	1.59	1.59	2.14
18 Portugal	5.21	2.92	2.92	5.21	2.92	3.53	2.92	2.92	2.92	3.53	2.92	2.92	6.66	2.92	2.92	8.56	3.53	***	2.92	3.53	2.92	3.53	2.92	5.21
19 Spain	9.21	3.08	2.53	4.60	2.53	3.08	2.53	2.53	2.53	3.08	2.53	2.53	9.21	2.53	2.53	9.21	3.08	2.53	***	3.08	3.08	3.08	2.53	4.60
20 Sweden	4.08	1.91	1.58	2.66	0.87	0.87	1.91	1.58	2.45	1.58	1.58	1.91	5.92	1.91	4.08	5.92	0.87	2.45	2.45	***	1.91	2.45	1.58	2.66
21 Switzerland	3.66	2.03	2.03	3.05	2.03	2.03	2.03	2.03	2.84	2.84	2.84	2.03	4.87	2.03	1.83	6.50	2.03	2.84	2.84	2.03	***	2.84	1.62	3.05
22 Turkey	7.33	4.88	4.88	7.33	4.88	4.88	4.88	4.88	3.26	4.88	4.88	4.88	7.33	4.88	4.88	7.33	4.88	4.88	4.88	4.88	4.88	***	4.88	7.33
23 UK	2.58	1.95	1.47	3.10	1.47	1.95	1.47	1.47	1.95	2.58	1.35	1.47	4.94	1.47	1.47	3.10	1.95	1.47	1.47	1.95	1.47	2.58	***	1.94
24 USA	5.27	3.72	4.13	1.63	3.95	4.17	3.71	3.78	5.03	4.49	3.83	4.28	5.08	4.16	3.68	6.33	3.72	4.70	4.56	3.61	4.07	5.27	3.24	***

Figure 3.4 International Call Charges Average for Peak Rate 3 min Calls to all other OECD countries (weighted), 1994 (US$)



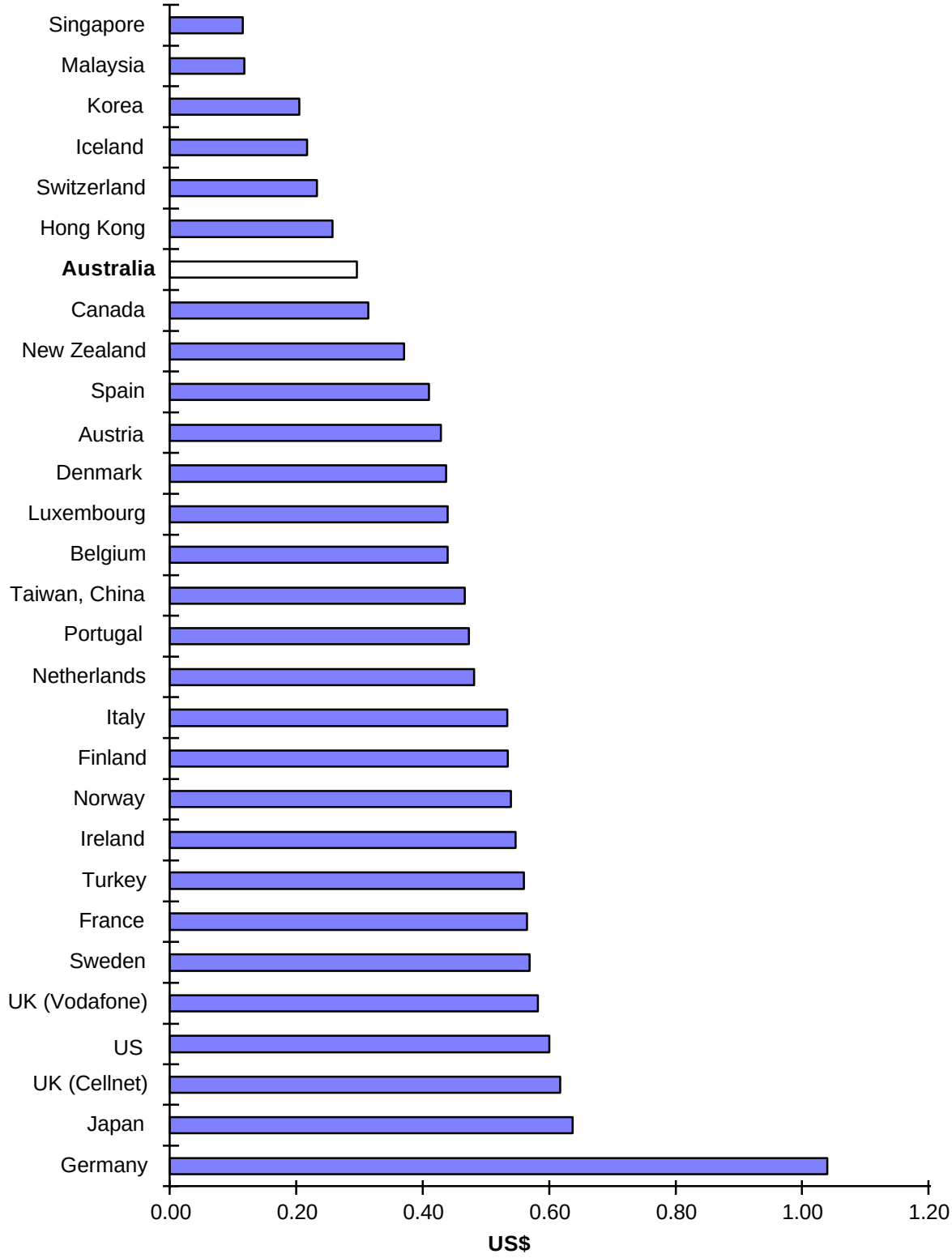
Source: OECD 1994, BIE Chart.

Figure 3.5 Comparison of Cellular Mobile Fixed Charges, including Connection Charge & Rental, 1992 (US$)



Notes: Fixed costs for Hong Kong, Korea, Singapore & Malaysia are for 1 January 1993. Rental for Hong Kong includes 100 free minutes per month.
Sources: OECD 1994 and Siemens 1993.

Figure 3.6 Comparison of Cellular Mobile Call Charges per Minute at Peak Rate up to 110km, 1992 (US$)



Notes: Tariffs for Taiwan, Hong Kong, Korea & Singapore are for 1 January 1993.
Sources: OECD 1994 and Siemens 1993.

3.3 Tariff Basket Comparisons

The OECD have developed tariff baskets for: national or intra-country fixed and call charges; international call charges; packet-switched data network (PSDN) fixed and usage charges; mobile telephone fixed and call charges; leased line charges and a composite basket comprising all of the above. These provide a basis for comparing Australia's telecommunications prices relative to OECD countries, and it is to these tariff basket comparisons that we now turn.

The construction of tariff baskets for a diverse group of countries necessarily involves a number of generalisations and simplifying assumptions (See Appendix I for an outline of the guiding principles and assumptions made). The methodology does not take into account the geographic size, location or regulatory environment of the countries. Nor are the effects of population size and/or characteristic business enterprise size on national calling patterns accounted for. The net effects of the averaging and assumptions are to produce a bias against larger countries, countries with lower than average population densities and countries with uncharged and/or untimed local calls (including Australia in these cases), while favouring countries that are at a distance from the majority of OECD countries (including Australia) in international call charge comparisons. In this way Australia is to some extent penalised in national charge comparisons and its static relative performance somewhat understated, while being favoured in international charge comparisons and its static relative performance somewhat overstated.

Inter-country differences in fixed and usage charges and the impact of rate rebalancing over time on the ratio of fixed and usage charges are also ignored in the construction of these tariff baskets. Averaged international calling pattern assumptions with respect to time of day, distance distribution and call duration also impact on the relative performance of the sample countries to some extent. These are residual variables in the OECD tariff models, and it is important that they be taken into account when interpreting the results (OECD 1990a, p.57).

International price comparisons, be they simple rate or basket comparisons, must also be seen in the light of the impact of the regulation of telecommunications. Telecommunications operations are variously required to return a dividend to shareholders and/or governments, and their performance is often regulated by means of either rate of return or price cap requirements. Hence price movements tend to be relatively tightly constrained by the regulatory environment of the countries in which the enterprises operate.

It is also important to note that while these problems afflict the interpretation of tariff basket comparisons for any given year, and rankings for any given year should be treated as at best only broadly indicative of relative position, the comparisons presented below include both 1992 and 1994 results. This allows a comparative static analysis of the change in Australia's position relative to its OECD counterparts that is substantially independent of the effects of the modelling assumptions. An alternative and more rigorous time series analysis for national, international and mobile charges is also presented in section 3.4 below.

The National Business User Basket

The OECD methodology for the comparison of national business user prices involves a basket of fixed charges and usage charges, including fixed phone/line charges, local and trunk call charges, set at certain ratios. The average business user's telecommunications bill is assumed to be made up of 20 per cent fixed charges and 80 per cent usage charges for national (local and long distance) calls. The fixed charges include both installation and rental charges, while the usage charges are based on a call distribution matrix, with a representative number of calls reflecting the OECD average distributed according to duration, time of day/week and distance based on international research on telephone usage patterns.

A comparison of national business user basket charges, expressed in US$ exchange rates for both 1994 and 1992 indicates that, despite the introduction of competition, Australia's ranking on national charges has remained unchanged at 14th among the 23 OECD member countries included in the basket (See Table 3.2 and Figure 3.7). In 1994, Australia's national call charges were higher than the OECD average, and higher than those in most of the Scandinavian countries, the United Kingdom, New Zealand, Canada and the United States, but compared favourably with those of Japan.

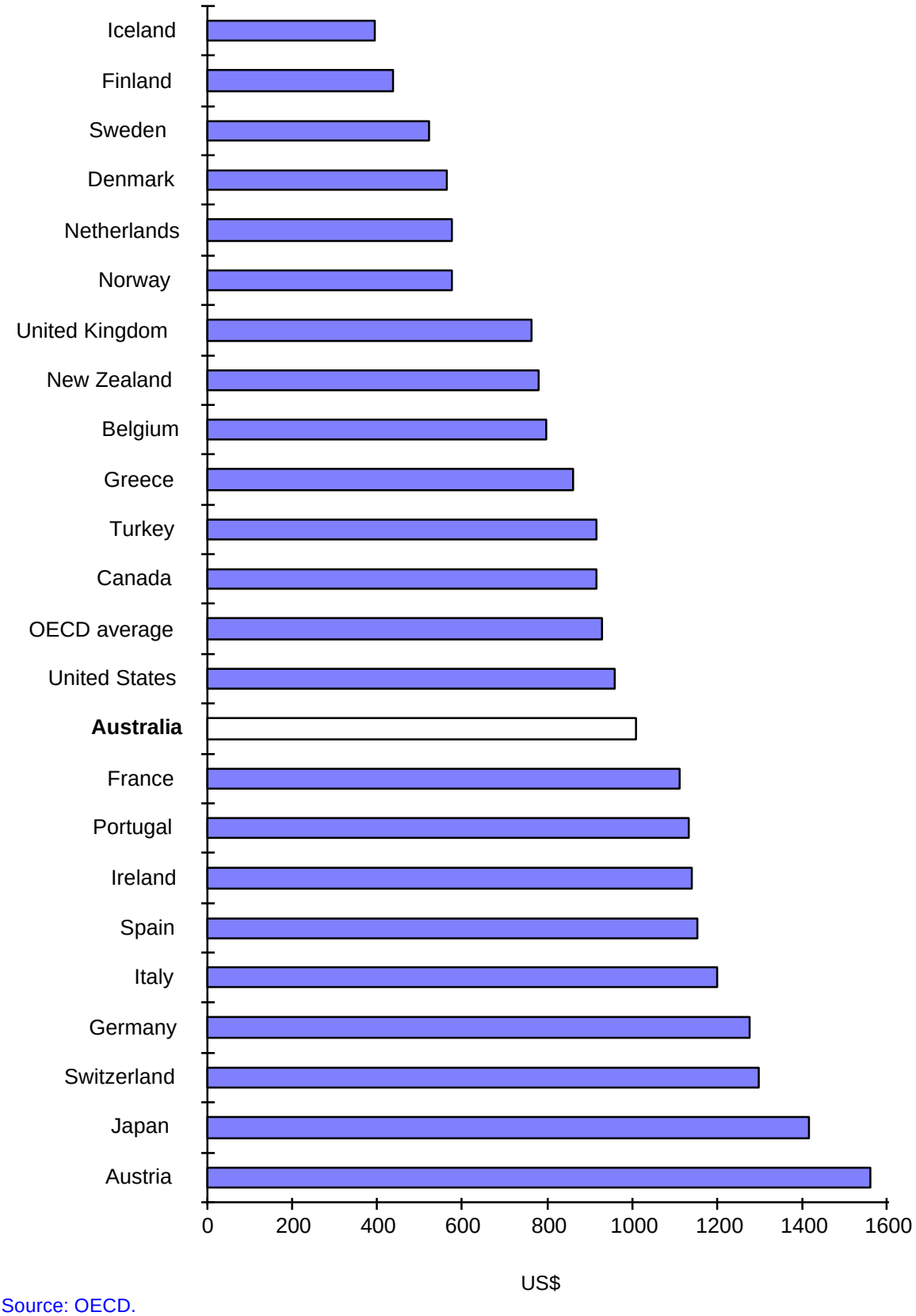
Table 3.2 National Business User Basket Charges (US$)

	1992	*Rank*	*1994*	*Rank*
Australia (Telstra)	1156.20	14	1012.19	14
Austria	1735.28	22	1561.95	23
Belgium	868.56	9	799.41	9
Canada (Bell Canada)	978.09	12	917.57	12
Denmark (KTAS)	485.08	2	562.43	4
Finland (HTC)	664.84	7	435.18	2
France	1297.37	16	1114.00	15
Germany	1404.47	20	1277.51	20
Greece	689.21	8	861.30	10
Iceland	407.84	1	393.79	1
Ireland	1337.50	18	1140.99	17
Italy	1327.82	17	1200.55	19
Japan (NTT)	1828.25	23	1418.76	22
Netherlands	583.23	4	577.25	5
New Zealand (TCNZ)	934.47	11	778.79	8
Norway	655.29	6	578.67	6
Portugal (TP/TLP)	1073.89	13	1135.22	16
Spain	1170.74	15	1152.93	18
Sweden (Telia)	640.98	5	520.99	3
Switzerland	1404.08	19	1298.24	21
Turkey	555.26	3	917.23	11
United Kingdom (BT)	925.77	10	763.48	7
US (AT&T/Nynex)	1450.47	21	960.19	13
OECD Average	1024.99	-	929.51	-

Notes: US$ is constant 1993 annual average US$ exchange rates. Direct price comparison should not be undertaken using this data as the 1992 basket includes 3002 calls while the 1994 basket includes 2694 calls.
Source: OECD.

Duration of call assumptions in the national call model disadvantages countries with free and/or untimed local calls (Australia, Canada and New Zealand) to the extent that local calls are an element of the call basket. Australia is also disadvantaged by having large trunk distances and among the largest 'local' call zones in the world. For example, in the United Kingdom the maximum trunk step distance is 56 miles and in Sweden it is 50 kilometres, while in Australia Telstra's maximum distance step is 745 kilometres. These factors place Australia at a relative disadvantage, making the basket charges appear somewhat higher than may otherwise be the case. However, work by the OECD on testing the resilience of the model suggests that these factors do not produce significant differences in the ranking (OECD 1990, p.57). Hence we must conclude that Australia falls some way behind international best practice on this indicator, being below the OECD average. Notwithstanding a small change in the number of calls included in the basket, we might, in view of Australia's unchanged ranking, also conclude that Australia has not gained ground relative to its OECD counterparts over the period 1992 to 1994.

Figure 3.7 National Business User Basket Charges (1994)



Source: OECD.

The International Call Basket

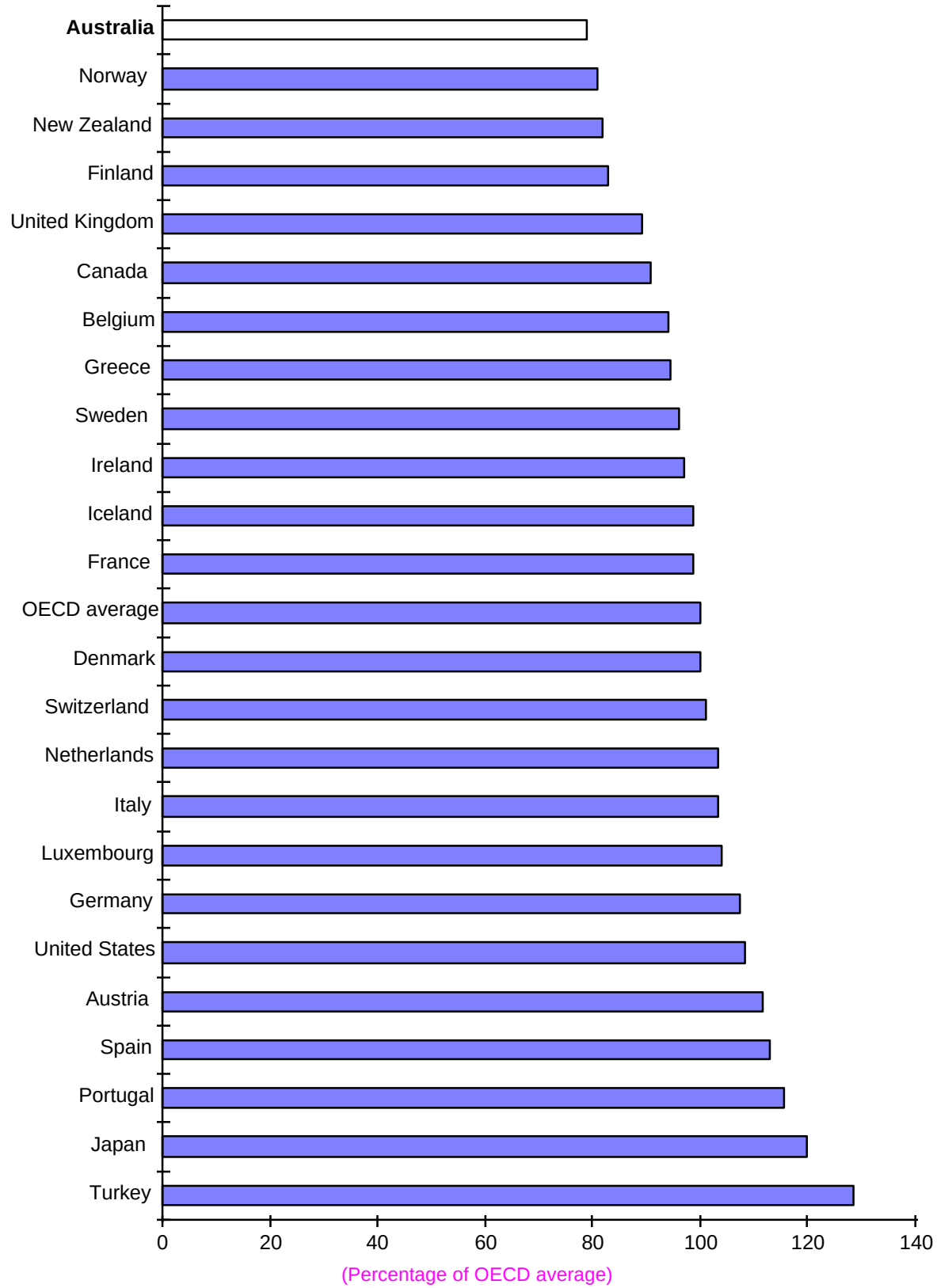
The international call charges basket is based on country pairs, which represent the relative price of making a call from one country to another, expressed as a percentage of the price of the same call in the opposite direction. The call pairs are weighted by the population size of the terminating country as a proxy for the likelihood of calling. The country average is then expressed as a percentage of the OECD average.

The advantage of this methodology is that it compensates for differences in the relative population size and location of countries. There are, however, a number of disadvantages. Firstly, fixed charges are not taken into account in the international call basket, so countries with low fixed charges and high usage charges may be somewhat disadvantaged by this approach. Secondly, the call pair methodology can change a country's relative ranking if a number of countries reverse the tariff balance between themselves and a particular destination. For example, the United States' ranking on international call charges for business users (expressed in US$) slipped from 2nd place in 1992 to 19th in 1994, a slip in ranking due largely to the fact that the number of countries with higher charges than the US decreased. In 1990, it was more expensive to call the US from 11 OECD countries than to make the same call in the opposite direction. By 1994 it was more expensive to call into the United States from only 5 OECD countries. Similarly, in 1992 it was more expensive to call Japan from 10 OECD countries than to make the same call in the opposite direction, but by 1994 this remained true for only two countries. The slip in Japan's ranking from 3rd place in 1992 to 23rd in 1994 reflects this change. It is important to realise, therefore, that the international basket measures relative prices, and is not indicative of price trends within a country.

The comparison of international call basket charges presented in Table 3.3 and Figure 3.8 indicates that in both 1992 and 1994 Australia had the lowest international call basket charges for business users among OECD countries, with charges equivalent to approximately 79 per cent of the OECD average. New Zealand, the United Kingdom and Canada also perform well on this indicator, while the United States and Japan fall somewhat below the OECD average. In comparative static terms Australia's position relative to the OECD average was unchanged over the period 1992 to 1994.

It is notable that a comparison based on the international call basket and a simple rate comparison of international call charges (see above) produce quite different results. The international call basket expresses, as a percentage of the OECD average, the price of reciprocal calling among the 24 OECD countries independent of distance and weighted by the population size of the terminating country. The assumptions made in the construction of the international basket, especially that relating to distance, are to the advantage of countries at the greatest distance from other OECD members. It is, for example, evident from a comparison of Figures 3.4 and 3.8 that Australia and New Zealand gain considerably.

Figure 3.8 International Call Basket for Business Users (1994)



Source: OECD

Table 3.3 International Call Basket for Business Users (Percentage of OECD average)

	1992	*Rank*	*1994*	*Rank*
Australia (Telstra)	79.68	1	78.83	1
Austria	105.29	15	111.66	20
Belgium	98.26	14	94.18	7
Canada (Teleglobe/Bell)	83.38	3	90.83	6
Denmark	85.50	4	100.20	13
Finland	90.53	8	82.87	4
France	95.73	10	98.83	12
Germany	109.07	19	107.39	18
Greece	108.69	17	94.41	8
Iceland	96.03	11	98.68	11
Ireland	122.92	24	97.15	10
Italy	119.48	21	103.22	16
Japan (KDD)	89.79	7	119.94	23
Luxembourg	112.69	20	103.98	17
Netherlands	98.26	13	103.19	15
New Zealand (TCNZ)	85.94	5	82.01	3
Norway	88.62	6	80.92	2
Portugal	108.95	18	115.55	22
Spain	121.13	23	112.81	21
Sweden (Telia)	96.63	12	96.18	9
Switzerland	107.48	16	101.13	14
Turkey	120.86	22	128.48	24
United Kingdom (BT)	92.16	9	89.16	5
United States (AT&T)	82.92	2	108.38	19
OECD average	100.00	-	100.00	-

Note: The basket is presented in indices, with the OECD average set at 100, such that the numbers represent a percentage of the OECD average.
Source: OECD.

The Cellular Mobile Services Basket

The cellular mobile services basket, used to compare mobile service charges, is based on the national basket methodology, including both fixed and usage charges, but with some adaptations to take into account the distinct characteristics of mobile phones. Because fixed charges for mobile communications are relatively high, the fixed/usage ratio is set at 33 per cent for fixed charges and 67 per cent for usage charges, compared to a 20:80 ratio for fixed line telephone services. Because of the relative unimportance of distance to national mobile tariffs no attempt to compensate for the relative size of countries is made, and only three distance zones are employed.

The cellular mobile charges of a sample of 24 mobile carriers in OECD countries are shown in Table 3.4 and Figure 3.9. This comparison, expressed in US$ exchange rates, indicates that cellular mobile charges in Australia (Telstra) are relatively low by international standards. In light of the likely disadvantage of distance for larger countries this is a good performance. Australia ranked fourth among 24 major mobile carriers in both 1992 and 1994. In 1994, the only countries to perform better than Australia were Iceland, Finland (HTC), and Denmark (KTAS). Australia

performs significantly better on mobile charges than Japan (NTT), the United States (Nynex), New Zealand (TCNZ), and the United Kingdom (Vodafone and Cellnet).

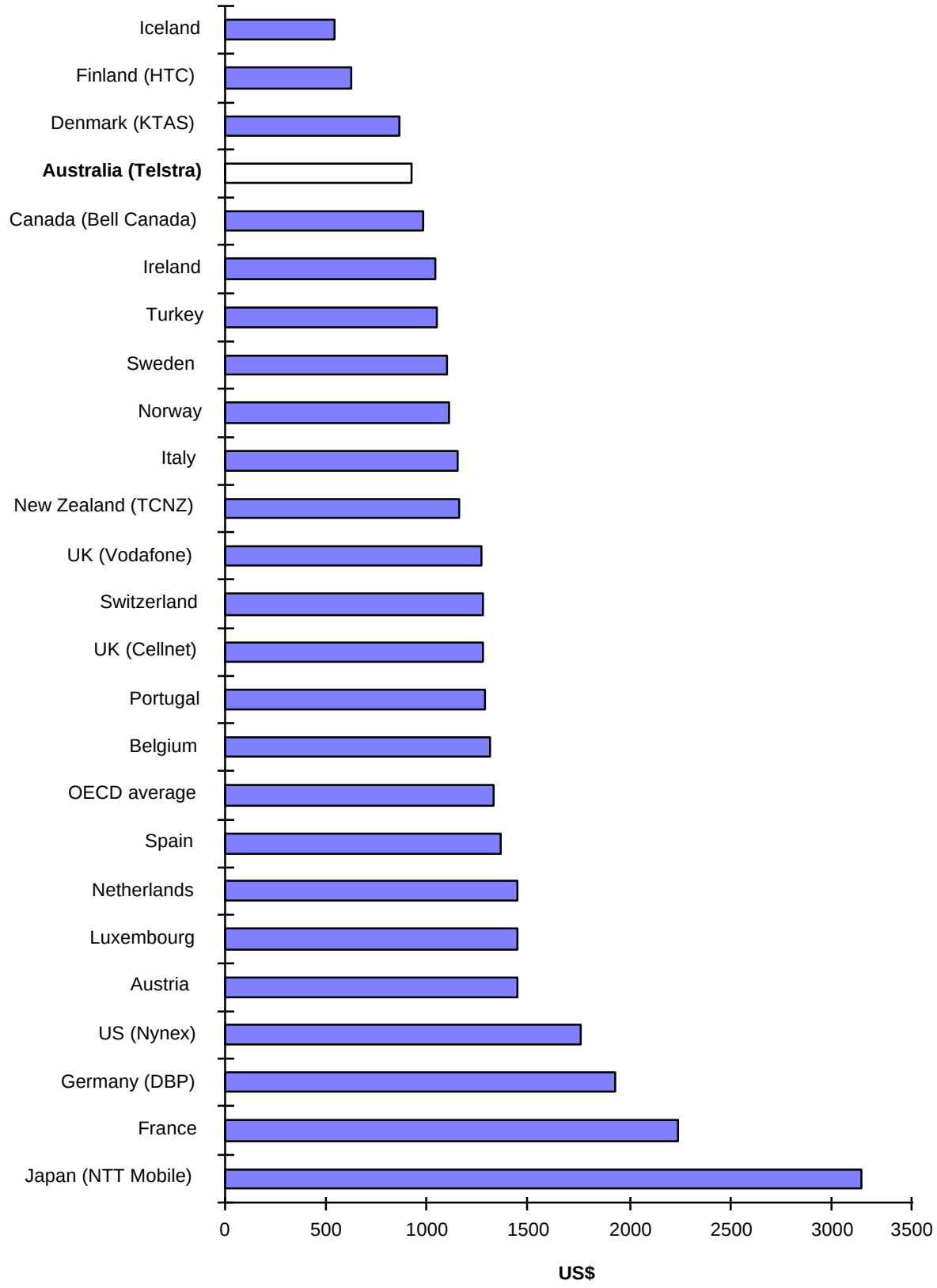
Table 3.4 Cellular Mobile Basket (US$)

	1992	*Rank*	*1994*	*Rank*
Australia (Telstra)	1035.21	4	919.78	4
Austria	1901.92	20	1447.20	20
Belgium	1595.85	15	1306.19	16
Canada (Bell Canada)	1043.78	5	976.47	5
Denmark (KTAS)	1005.69	3	861.39	3
Finland (HTC)	1045.03	6	622.73	2
France	2476.18	21	2238.25	23
Germany (DBP)	3034.85	23	1927.52	22
Greece	-	-	-	-
Iceland	606.33	1	543.94	1
Ireland	1693.92	16	1037.83	6
Italy	1293.45	11	1148.33	10
Japan (NTT Mobile)	3352.01	24	3142.82	24
Luxembourg	2860.93	22	1442.71	19
Netherlands	1764.68	18	1442.03	18
New Zealand (TCNZ)	1295.82	12	1162.05	11
Norway	1281.24	10	1104.92	9
Portugal	1438.86	13	1288.69	15
Spain	1511.34	14	1363.09	17
Sweden (Telverket/Telia)	1207.71	9	1101.03	8
Switzerland	1176.53	8	1277.32	13
Turkey	712.28	2	1051.01	7
UK (Cellnet)	1833.24	19	1279.29	14
UK (Vodafone)	1747.90	17	1267.20	12
US (Nynex)	1075.03	7	1759.74	21
OECD average	1575.73	-	1323.67	-

Notes: US$ is constant 1993 annual average US$ exchange rates. A direct price comparison cannot be made using this data as the 1994 basket uses 741 calls whereas the 1992 basket includes 892 calls.
UK(Vodafone) is excluded from the OECD average.
Source: OECD.

Australia's relatively good performance on mobile charges is probably a reflection of the level of competition in this market (currently three mobile operators), rapidly changing technology and a relatively high level of take-up leading to economies of scale. A comparison of the 1992 and 1994 rankings suggests that mobile charges in Australia are moving in line with those of OECD counterparts. Price falls in other countries being comparable to those in Australia. However, a small variation in the number of calls included in the basket affects the reliability of this conclusion.

Figure 3.9 Cellular Mobile Basket (1994)



Source: OECD.

Case Study

SITA

Global Airline Communications Services

SITA (Société Internationale de Télécommunications Aéronautiques) was established in 1949 as a non-profit international airline cooperative. The Belgian-based organisation now owns and operates one of the most globalised private data networks, providing services to over 500 members, made up of airline and transport related organisations in 220 countries and 1500 cities. Many of SITA's members could support their own network, but outsourcing provides a more convenient and cheaper service. SITA's main advantage comes from its global presence, which allows it to offer a high quality service in most countries.

SITA purchases bandwidth from telecommunication carriers world-wide and uses its multiplexing, switching equipment and management tools to provide value added international data services. SITA provides five major products: messaging, including EDI; transactional services, such as reservations; air-to-ground services, whether through VHS or satellite; software services, provided out of data processing centres in Atlanta and London; and airport information services. While SITA concentrates on data transfer services, it is expanding into voice services so that it can address all its client's communication requirements.

SITA aims to achieve between 25 and 30 per cent traffic growth annually, to enable cost reductions of between 9 and 10 per cent. For voice services SITA has found that Australian prices are competitive with other Asia-Pacific locations, but Australia's data service prices are very high. SITA currently spends 46 per cent of its total budget of about $32 million on domestic and international telecommunications services in Australia. On average, SITA spends only 19 per cent of its budget on telecommunication services in other regions. This disparity reflects Australia's high data service prices, and SITA believes the disparity will widen as other countries, such as Hong Kong and Singapore, reduce data service prices further.

For services from Hong Kong to the United States, SITA pays up to US$31,000 per month, but discounts often reduce this to US$23,000 per month. From Singapore to the United States, SITA pays US$28,000 per month after discounts. From Sydney to the United States, SITA was paying around US$58,000 per month, but after protracted negotiations with Telstra SITA now pays US$43,845 per month. The same service is available from Optus for US$41,440. SITA contends that such price differences have damaged their growth in Australia vis-a-vis other regions, and make hubbing in Australia an uneconomic proposition for data services. SITA also says that, as far as they are concerned, no real benefits of competition are apparent, because Optus prices are barely discernible from Telstra's.

The Packet-Switched Data Network (PSDN) Basket

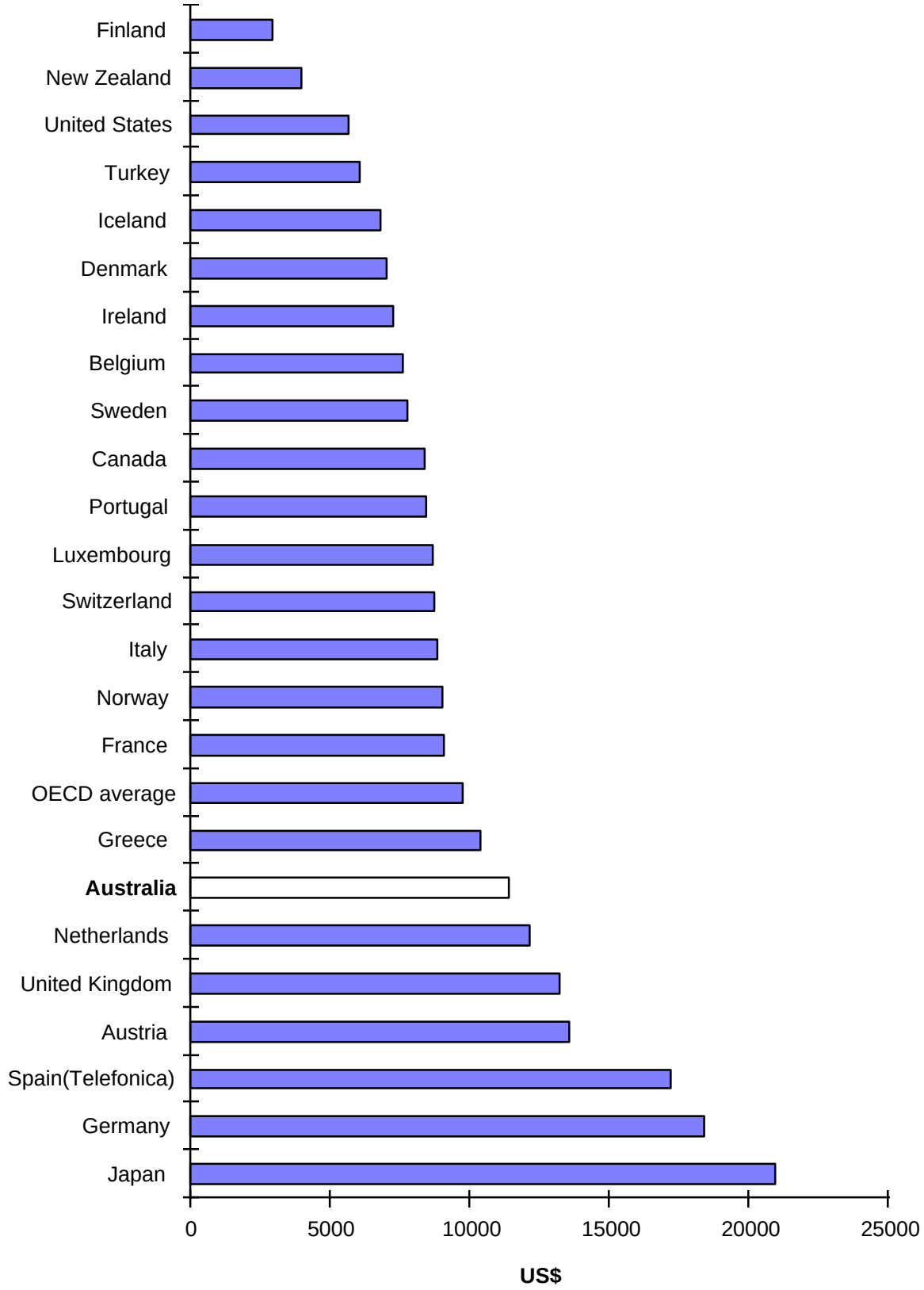
Data communications accounts for an increasing proportion of communications costs for many businesses. This is particularly the case for businesses operating in international markets. There are a number of options for transmitting data, including dial up access, public telex, private networks, inter-personal messaging services (such as electronic mail), circuit switched data networks, packet-switched data networks and integrated services digital networks (ISDN). The packet-switched data network (PSDN) communications using the CCITT X.25 protocol has been used as a proxy for a range of data communications services for OECD tariff comparisons because PSDN has been widely implemented and adopted, is less country specific than circuit-switched networks and has more widely available published tariffs (OECD 1990, p.74). To gain a more representative view of data communications tariffs comparison of PSDN prices should, because of their substitutability, be considered in combination with comparisons of leased line prices.

The PSDN tariff basket is weighted so that fixed charges, covering rental for the X.25 connection but excluding installation, equipment rental and network user identification charges if any apply, are one third of total charges. Certain assumptions are made about the average length of messages, the number of calls, the duration of calls and the time of day the calls are made in the distribution of usage charges (OECD 1994, pp.74-75).

The comparison of PSDN charges presented in Table 3.5 and Figure 3.10, expressed in US$ exchange rates, suggests that this basket of PSDN services in Australia is relatively more expensive than in New Zealand, the United States and Canada, but less expensive than in Japan and the United Kingdom. Australia's ranking in terms of the price of this basket of PSDN services deteriorated from 7th among the OECD countries in 1992 to 18th in 1994. However, prices for this basket of PSDN services appear to be volatile over time, suggesting that extreme caution should be exercised in interpreting these findings.

It is also necessary to examine price trends among data transmission substitutes to get a more accurate picture of data transmission prices. Operators may be shifting the relative prices of these substitutes in order to shape demand - to move users from PSDN to ISDN or leased lines, for example. Unfortunately sufficient tariff data are not available to allow us to pursue such an analysis in any detail. Nevertheless, consideration of the comparison of Australia's performance in relation to leased line charges (refer to next section) helps to develop a general indication.

Figure 3.10 Packet-Switched Data Network Basket (1994)



Source: OECD.

Table 3.5 Packet-Switched Data Network Basket (US$)

	1992	*Rank*	*1994*	*Rank*
Australia	6603.41	7	11400.69	18
Austria	14792.81	22	13604.62	21
Belgium	7862.31	11	7611.24	8
Canada	6554.62	6	8388.09	10
Denmark	5730.39	4	7053.25	6
Finland	5127.72	3	2958.81	1
France	9509.02	14	9062.78	16
Germany	19257.68	23	18413.73	23
Greece	10858.68	17	10373.19	17
Iceland	6975.60	8	6829.81	5
Ireland	7511.46	9	7286.64	7
Italy	11712.29	19	8863.51	14
Japan	7682.47	10	20967.01	24
Luxembourg	10369.79	16	8705.82	12
Netherlands	13205.62	20	12143.76	19
New Zealand	4732.09	2	3974.24	2
Norway	9856.46	15	9034.37	15
Portugal	8908.20	13	8459.27	11
Spain (Telefonica)	22452.60	24	17204.74	22
Sweden	8059.66	12	7805.61	9
Switzerland	10926.33	18	8778.34	13
Turkey	1457.76	1	6074.15	4
United Kingdom	14056.10	21	13245.21	20
United States	5835.28	5	5707.29	3
OECD average	9584.93	-	9747.76	-

Note: US$ is constant 1993 annual average exchange rates. Source: OECD.

The Leased Line Basket

Leased lines are important to business users because they allow greater control of telecommunications facilities and traffic, and charges are predictable and independent of usage volume and time of day. Leased lines also provide greater security. Leased lines vary with transmission technology, quality and speed or bandwidth. For the purpose of comparing leased line charges, three of the most commonly offered leased lines, 9.6 kbit/s analogue lines for voice, fax or data; 64 kbit/s digital lines used mainly for data; and 2 Mbit/s (or 1.5 Mbit/s in the United States and Japan) digital lines are included in the basket. A tariff basket consisting of rental charges for a bundle of 100 lines is calculated for each of the three leased line categories at five distances ranging up to 200km.

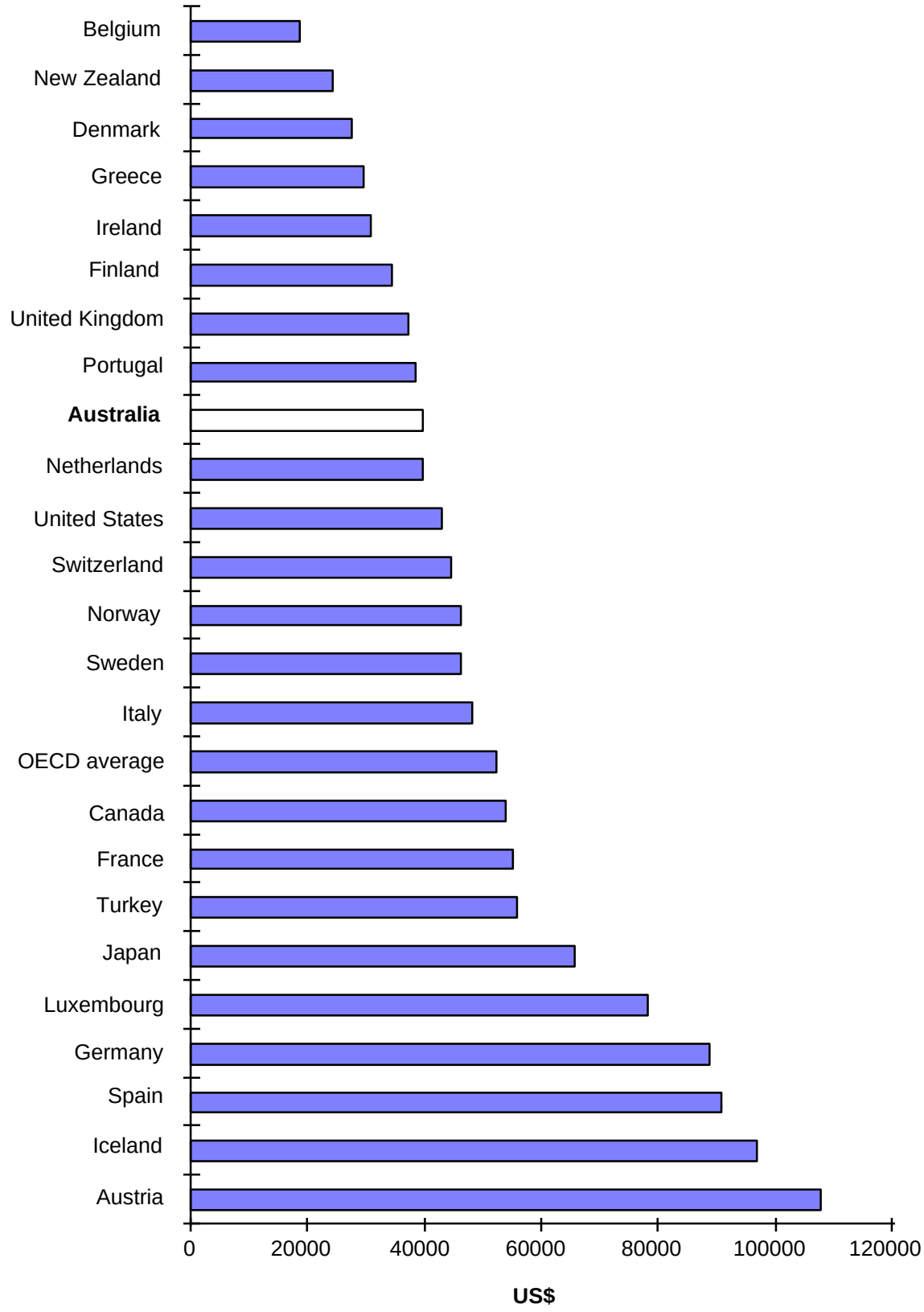
A comparison of charges for the three leased line sizes is provided in Table 3.6 and related figures. For 9.6kbit/s lines Australia ranked 9th among the 24 OECD countries in 1994, a significant improvement on 1992 when it ranked 18th; Australia was the least expensive for 56/64kbit/s lines, an improvement on 1992 when it ranked second; and for 1.5/2Mbit/s lines Australia retained its ranking at 5th among the 22 OECD countries for which 1994 data are available. These results suggest that Australia is performing relatively well in terms of charges for this basket of leased lines. In comparative static terms Australia has been improving its position over the period 1992 to 1994 relative to OECD counterparts.

Table 3.6 Leased Line Basket (US$)

	9.6 Kbit/s				56/64 Kbit/s				1.5/2 Mbit/s			
	1992	Rank	1994	Rank	1992	Rank	1994	Rank	1992	Rank	1994	Rank
Australia (Telstra)	47824	18	39742	9	33340	2	32783	1	297284	5	310706	5
Austria	46926	16	107997	24	155073	19	107997	17	854686	17	854686	18
Belgium	18481	4	18481	1	157500	20	157500	22	572674	15	572674	16
Canada (Bell)	36159	12	53756	16	95903	14	84636	13	558473	14	440837	10
Denmark (KTAS)	18173	3	27567	3	88545	13	48018	6	278363	4	362465	7
Finland (Telecom)	23884	7	34463	6	31131	1	45474	5	-	-	-	-
France	58071	20	55007	17	163347	21	82824	12	556307	13	502791	11
Germany	111494	23	88787	21	230853	22	101077	16	2308530	21	536419	13
Greece	29756	10	29756	4	75631	10	75631	9	300646	6	300646	4
Iceland	25491	8	96990	23	51745	7	129337	20	500376	11	533767	12
Ireland	30805	11	30805	5	44341	6	44341	4	269026	3	269026	3
Italy	48250	19	48250	15	108064	15	108064	18	943003	19	943003	19
Japan (NTT)	65567	21	65782	19	119523	17	119649	19	940243	18	943840	20
Luxembourg	9549	1	78236	20	37847	3	136880	21	378472	7	1368803	22
Netherlands	67677	22	39806	10	126279	18	75798	10	604470	16	397367	8
New Zealand (TCNZ)	20948	6	24298	2	86521	12	86521	14	430443	10	333198	6
Norway	43869	15	46017	13	72631	9	90292	15	418190	9	536986	14
Portugal (TP/TLP)	38450	13	38450	8	66729	8	40935	3	414659	8	255288	2
Spain (Telefonica)	113337	24	90616	22	287779	24	183056	24	-	-	1202024	21
Sweden	13739	2	46229	14	40238	5	62476	8	-	-	-	-
Switzerland	47468	17	44482	12	109851	16	55518	7	529418	12	538595	15
Turkey	25846	9	55910	18	234463	23	167730	23	1042056	20	838147	17
United Kingdom (BT)	19685	5	37259	7	40173	4	40762	2	205098	2	199181	1
U.S. (Nynex)	42987	14	42987	11	77608	11	77608	11	186793	1	423435	9
OECD average	41852	-	52117	-	105630	-	90317	-	599486	-	532193	-

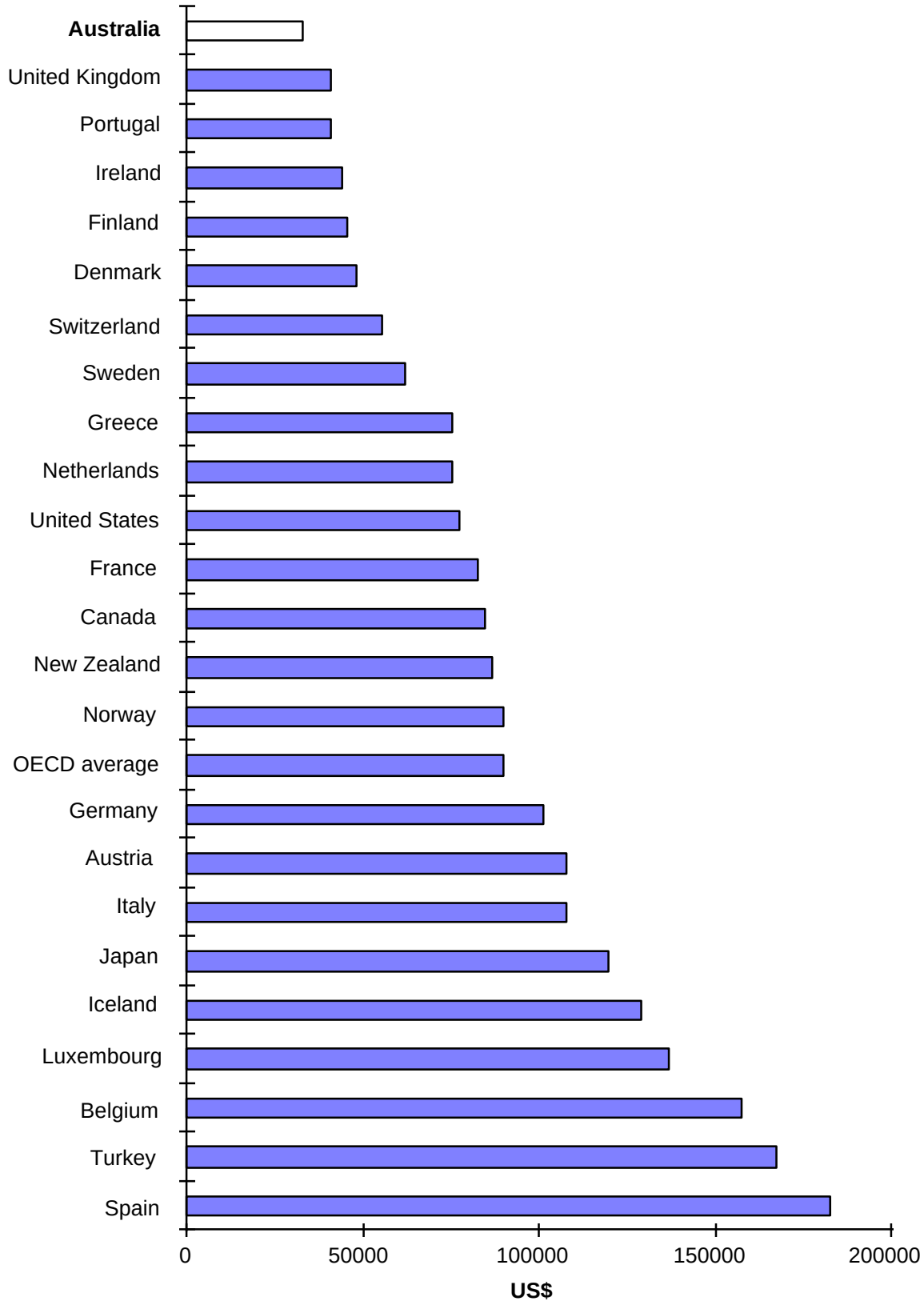
Note: US$ is constant 1993 annual average exchange rates.
Source: OECD.

Figure 3.11 Leased Line Basket - 9.6kbit/s (1994)



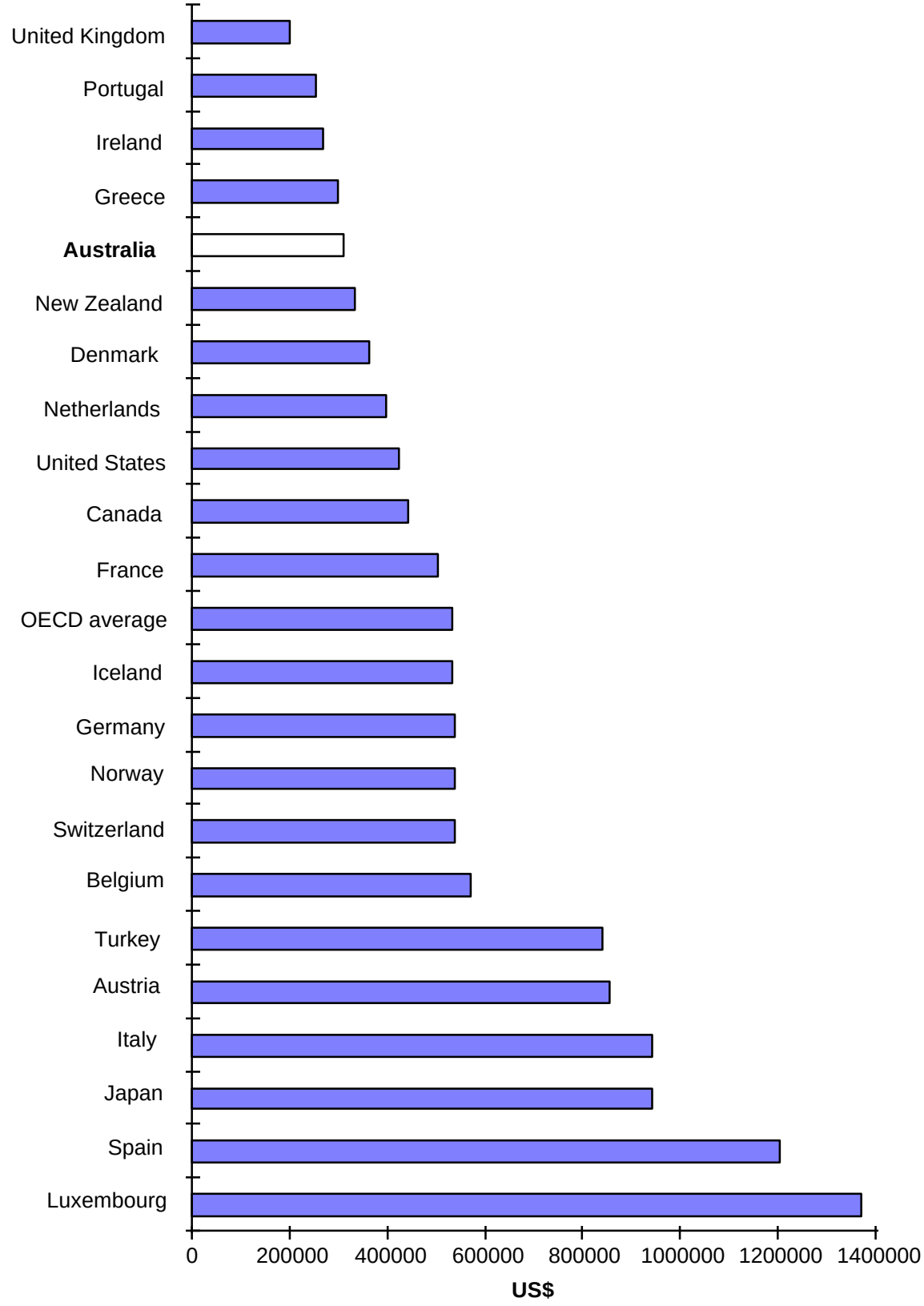
Source: OECD.

Figure 3.12 Leased Line Basket - 64kbit/s (1994)



Source: OECD.

Figure 3.13 Leased Line Basket - 1.5/2 Mbit/s (1994)



Source: OECD.

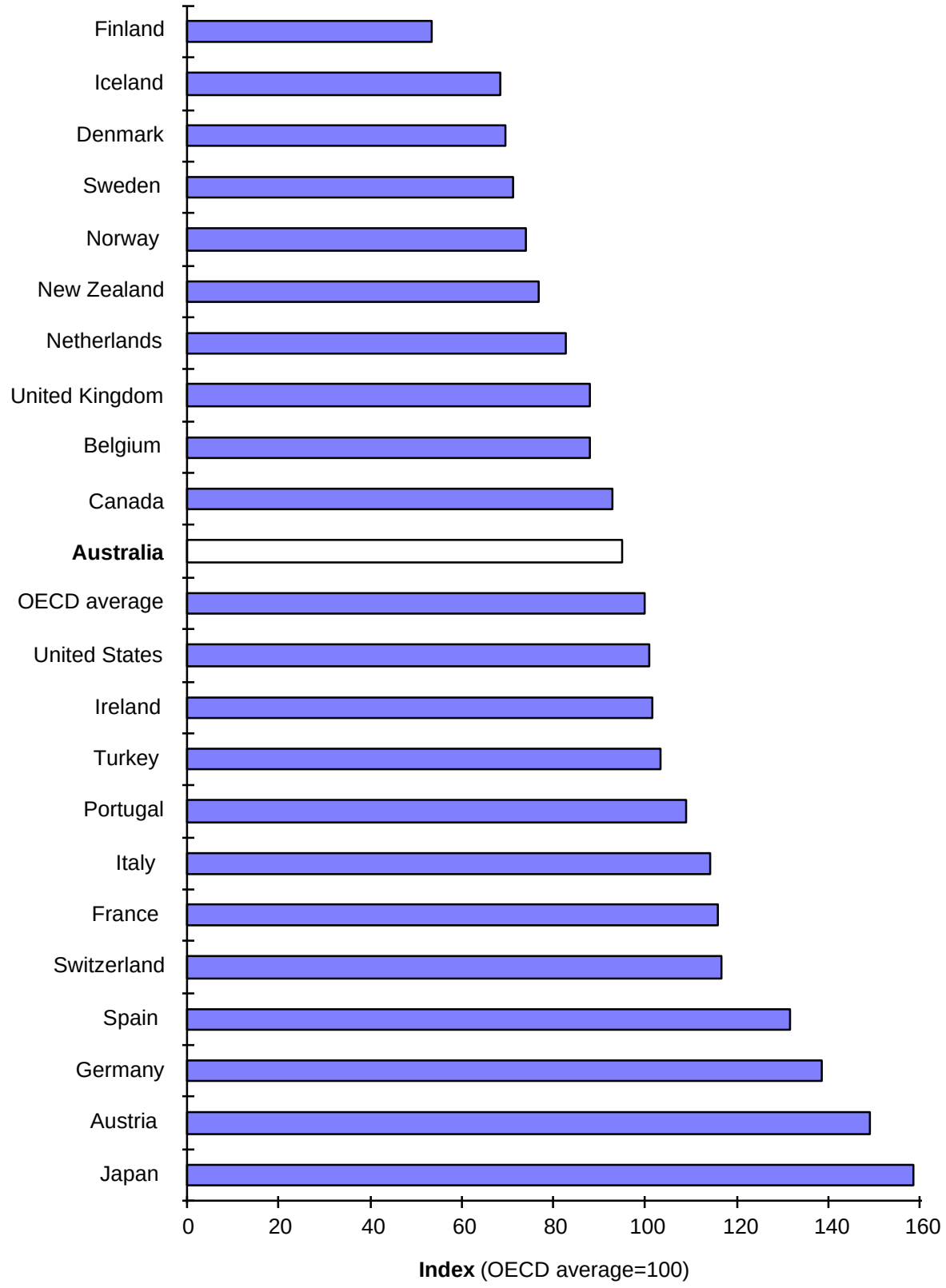
The Composite Business Basket

The composite business basket is constructed by incorporating each of the above baskets. It provides a more comprehensive overview of Australian telecommunications charges relative to those in other countries. The composite basket is weighted in the following way: the national business user basket 50 per cent - of which 10 per cent is for fixed charges and 40 per cent usage charges; international calls 20 per cent; the mobile basket 10 per cent - of which 3.3 per cent is for fixed charges and 6.7 per cent usage charges; leased line charges 10 per cent - of which 6 per cent is for 9.6kbit/s lines, 3 per cent 64kbit/s, 1 per cent 2Mbit/s with users assumed to downsize their capacity if a particular service is unavailable; and packet switched data communication charges 10 per cent - of which 3.3 per cent is for fixed charges and 6.7 per cent usage charges. The composite basket is indexed, with the OECD average set to 100.

Comparisons for this composite business basket for 1992 and 1994 are provided in Table 3.7 and Figure 3.14, with charges expressed as a percentage of the OECD average. In both 1992 and 1994, Australia ranked above the OECD average, at 11th position. This relative position is unchanged since 1989 (OECD 1990, p.78). Australia performed better than Japan and the United States in terms of the composite basket charges in 1994, but ranked lower than New Zealand, Canada and the United Kingdom. That Australia's ranking is unchanged over the period 1989 to 1994 suggests that charges for this composite basket of services are moving in line with OECD counterparts, but not ahead.

In relative terms, and in terms of affordability (relative to GDP per capita), the Scandinavian countries perform the best. New Zealand, the United Kingdom, Canada and Australia are also above the OECD average. Perhaps surprisingly, the United States does not perform so well, while the relatively less deregulated central European countries appear to fall below the OECD average.

Figure 3.14 Composite Business Basket (1994)



Source: OECD.

Table 3.7 Composite Business Basket (Indexed OECD average = 100)

	1992	*Rank*	*1994*	*Rank*
Australia (Telstra)	93.99	11	95.10	11
Austria	145.80	19	149.27	21
Belgium	88.43	10	88.04	9
Canada (Bell)	86.55	8	92.91	10
Denmark (KTAS)	58.77	2	69.38	3
Finland (HTC)	67.78	3	53.52	1
France	121.89	18	115.94	17
Germany	156.42	22	138.58	20
Greece	-	-	-	-
Iceland	56.14	1	68.41	2
Ireland	114.58	15	101.71	13
Italy	120.76	17	114.15	16
Japan (NTT)	150.71	21	158.70	22
Luxembourg	-	-	-	-
Netherlands	87.39	9	82.73	7
New Zealand (TCNZ)	82.05	7	76.79	6
Norway	77.25	6	74.14	5
Portugal (TP/TLP)	100.74	13	109.16	15
Spain	147.04	20	131.53	19
Sweden (Telia)	70.97	5	71.39	4
Switzerland	119.64	16	116.74	18
Turkey	69.48	4	103.33	14
United Kingdom (BT)	94.14	12	87.97	8
US (AT&T/Nynex)	108.69	14	100.79	12
OECD average	100.00	-	100.00	-

Note: Calculations based on US$, constant 1993 average annual exchange rates. Index OECD average = 100.
Source: OECD.

A comparative static analysis over the period 1992 to 1994 gives a picture of Australia's position relative to its OECD counterparts that is substantially independent of the effects of the tariff basket modelling assumptions. In comparative static terms Australia's position has remained unchanged in respect to the national business basket, the international call basket and the mobile basket, improved in respect to the leased line baskets, while falling behind in respect to the packet-switched data network services basket. Australia's position in terms of the composite business basket has remained unchanged since 1989.

The overall picture from price comparisons based on tariff baskets is one of having to run to keep pace with international counterparts, and barely managing to keep up. It is notable that Australia's performance seems better in the more highly contested markets of mobile and international than in markets where there is less competition.

Case Study

Softek Services Pty. Ltd.

Innovative Melbourne-based company Softek Services rely on communications to run their business. Softek Services is a small computer software and services company specialising in software modules for electronic pre-press systems and related services for clients in newspaper and magazine publishing. Most of Softek's business is done with clients overseas, making communications an essential platform. Softek serves clients in the United Kingdom (including News International and The Independent), the United States (including the New York Times, and others in California, Boston, Washington and New York), Canada, Japan, Denmark, Norway, Spain, and Malaysia.

Softek's client contact and operations revolve around phone, facsimile, answering machine, data/fax modem, cellular mobile phone, an Integrated Services Digital Network (ISDN) connection and electronic mail services. The answering machine allows much needed remote checking of messages while out in the field, and the mobile phone provides the essential point of immediate personal contact. Electronic mail services provide a much used source of time independent client contact, and the ISDN line a specialist connection for remote software and services delivery on-line. Not surprisingly communications costs are an important cost factor in the operation of Softek's business, accounting for more than 5 per cent of total business costs.

Chief executive, Rob Cook, sees the mobile phone and electronic mail as essential tools-of-trade. Closing a major deal with an international client while cruising the Murray River on a houseboat during recent Christmas holidays convinced Rob that cellular mobile coverage in Australia is excellent. Softek are also increasingly turning to electronic mail as a major means of client contact, because it is distance and time-zone independent. Softek are able to respond to client queries, provide technical support and pre and post sales information to clients world-wide on a maximum 24 hour turnaround basis regardless of time-zone.

Although unusual for a small business, Softek also use an ISDN connection. Working on systems software development for overseas clients Softek use a Sun SPARC work station and ISDN connection. Data transfers, fixes, remote program testing and systems implementation from Melbourne to News International in London is a common current, and fairly typical use of the ISDN link. Usage costs amount to around $3 per minute.

Softek executive, Lauri Clarkson, looks forward to a better modem, greater take-up of electronic mail in South East Asia making access to clients in that region easier, and to greater scope for international roaming for the mobile phone. She sees the current limitations for international roaming as an important barrier to the continuing success of Softek's export business.

3.4 Volume Discounts

One of the main problems with simple rate and tariff basket comparisons is that they are based on list prices. In reality discounts are commonly offered to large customers. List prices are likely to reflect maximum charges, rather than the actual price paid by businesses users. To get a more accurate picture international price comparisons should incorporate discounts.

Discount schemes tend to be transitory and highly volatile. There is no way to accurately estimate the level of subscriber take-up of discount options, hence no way to estimate the average price actually paid by any category of user. Volume discounts apply at various levels, including: the value of the total account, the value of specific accounts (bills), the usage component only of either of the above; and discounts may or may not be service category specific (applying differentially to fixed versus mobile, for example).

In the absence of reliable, internationally comparable discount data it is only possible to develop what is at best an indicative comparison of real user costs. For each of the categories of communications services described above we have attempted to develop tariff comparisons based on the volume discounts available to business users through published schemes during the second half of 1994 for small, medium and large business users.

We have constructed representative business user baskets by taking the OECD national business basket values and multiplying up by the weightings from the OECD composite basket. The dollar value implied by the national business basket is multiplied up to represent a total business account in proportion to the weightings of the composite basket (national 50 per cent, international 20 per cent, mobile 10 per cent, leased lines 10 per cent and packet-switched data network 10 per cent). While these proportions are essentially arbitrary, they are a reasonably accurate proxy of category shares in business use as reflected in the PTO revenue shares. These proportions accord well with Telstra's revenue shares by service category (See Table 2.5 above).

The basket so derived is taken to be representative of the small business user. The medium business user is represented by this basket x50, and the large business user by this basket x500. This gives account estimates based on list prices for small, medium and large enterprises. Volume discounts are applied to the small, medium and large user baskets on a services category-by-category basis using the best discounts available for that category in the country concerned.

There are two important embedded assumptions in the construction of these baskets. Firstly, call patterns are held constant while multiplying up for the medium and large business user baskets. Secondly, the composite basket services proportions are held constant for the small, medium and large users. At this stage there are insufficient data available to conduct a thorough sensitivity analysis in relation to these assumptions. However, in view of the importance of national and international charges in both proportional terms and in terms of the discounts schemes available these assumptions are unlikely to cause more than minor distortion in respect to the relative use of data communications in small and large businesses.

International discount data are limited, and a number of assumptions have also been made in regard to data. It is assumed that volume discounts are not as significant in countries that do not have market competition in the provision of communications services. While preliminary research suggests that volume discounts are commonly available throughout the OECD on an *ad hoc* basis, discounts in most non-competitive environments are open to only the largest users and the discount deals are typically confidential. In order to make the best of this situation we use all available volume discount data and best estimates of confidential discounts where possible. Where the range of discounts (per cent) available in a country other than Australia is known, but the details of the tariff steps are not known, the steps are assumed to be the same as the steps in the best available discount option in Australia, proportional to the range (per cent) of that discount option, and non-tiered regardless of whether the best available discount option in Australia is tiered or non-tiered.

Table 3.8 provides a summary of the range of published discounts available in Australia by service categories. The larger proportional discounts are available in the area of voice telephony, with trunk and international discounts being greatest. The business baskets examined below combine various types of services such that the discounts per cent are a weighted average of the discounts available for the various elements within the basket. Thus, in the case of trunk and international calls, the baskets understate the extent of discounts available.

Table 3.8: Range of published volume discounts available in Australia by service category (1994)

	Published discount range (Per cent)
Local calls	up to 16.5
Long distance calls	up to 25
International calls	up to 25
Mobiles	-
PSDN - access	1 to 20
- usage	5 to 50
Leased lines	-

Sources: Optus and Telecom.

Discounts form an increasingly important element of telecommunications pricing in Australia. Indeed, it is only through discount schemes that Telstra has met its price cap targets during 1993-94. Austel report that reductions in standard (list) prices during 1993-94 accounted for just -0.24 per cent, while reductions due to discounts accounted for -3.45 per cent (Austel 1994d, p.38).

Representative small business user baskets, based on list prices and the best available discount plans, are compared in Table 3.9. Incorporating the best discount plans available to the small business user in Australia results in an annual account $US130 or 6.4 per cent less than the same basket based on list prices. Of the countries for which published volume discount data are available Australia has the largest discounts, followed by New Zealand and the United Kingdom. However, this is not sufficient to substantially improve Australia's ranking for the small business user basket prices among the OECD countries.

Table 3.9 Small Business User Baskets - List Prices & Best Discount Available, 1994 (US$)

	List Prices	*Rank*	*Discounted*	*Rank*	*Discount*
Australia	2024	14	1894	13	6.4%
Austria	3124	23	3124	23	-
Belgium	1599	9	1599	9	-
Canada	1835	12	1835	12	-
Denmark	1125	4	1125	4	-
Finland	870	2	870	2	-
France	2228	15	2228	15	0.0%
Germany	2555	20	2555	20	-
Greece	1723	10	1723	10	-
Iceland	788	1	788	1	-
Ireland	2282	17	2282	17	-
Italy	2401	19	2401	19	-
Japan	2838	22	2838	22	0.0%
Netherlands	1155	5	1155	5	-
New Zealand	1558	8	1490	8	4.4%
Norway	1157	6	1157	6	-
Portugal	2270	16	2270	16	-
Spain	2306	18	2306	18	-
Sweden	1042	3	1042	3	-
Switzerland	2596	21	2596	21	-
Turkey	1834	11	1834	11	-
United Kingdom	1527	7	1486	7	2.7%
United States	1920	13	1920	14	-

Source: BIE.

A comparison of medium business user baskets using both list prices and the best discount plans available is provided in Table 3.10. The table shows that larger discounts are available to medium sized business users than to small business users. In Australia, for example, the representative medium business user basket with the best discount option available is 7.7 per cent lower than the same basket using list prices (compared with 6.4 per cent lower for the small business basket). Australia enjoys the second largest discounts among those countries for which published volume discount data are available, but as with the small business user basket this is not sufficient to substantially change Australia's price ranking among OECD countries.

Table 3.10 Medium Business User Baskets - List Prices & Best Discount Available, 1994 (US$)

	List Prices	*Rank*	*Discounted*	*Rank*	*Discount*
Australia	101219	14	93439	13	7.7%
Austria	156195	23	156195	23	-
Belgium	79941	9	79941	9	-
Canada	91757	12	91757	12	-
Denmark	56243	4	56243	4	-
Finland	43518	2	43518	2	-
France	111400	15	110779	15	0.6%
Germany	127751	20	127751	21	-
Greece	86130	10	86130	10	-
Iceland	39379	1	39379	1	-
Ireland	114099	17	114099	17	-
Italy	120055	19	120055	19	-
Japan	141876	22	122780	20	13.5%
Netherlands	57725	5	57725	5	-
New Zealand	77879	8	72989	7	6.3%
Norway	57867	6	57867	6	-
Portugal	113522	16	113522	16	-
Spain	115293	18	115293	18	-
Sweden	52099	3	52099	3	-
Switzerland	129824	21	129824	22	-
Turkey	91723	11	91723	11	-
United Kingdom	76348	7	73241	8	4.1%
United States	96019	13	96019	14	-

Source: BIE.

The comparison of large business user baskets using both list prices and best discount plans available, provided in Table 3.11, indicates that large business users enjoy the largest discounts. In Australia, the large business user basket, based on the best discount option available, is 10.1 per cent less than the same basket based on list prices. Japan has the highest discounts for large business users as defined herein at 18.6 per cent, and the incoporation of discounts improves Japan's ranking from 22nd to 19th. Again however, the incorporation of discounts does not substantially improve Australia's ranking on prices among the OECD countries.

Table 3.11 Large Business User Baskets - List Prices & Best Discount Available, 1994 (US$)

	List Prices	*Rank*	*Discounted*	*Rank*	*Discount*
Australia	1012190	14	909986	11	10.1%
Austria	1561950	23	1561950	23	-
Belgium	799410	9	799410	9	-
Canada	917570	12	917570	13	-
Denmark	562430	4	562430	4	-
Finland	435180	2	435180	2	-
France	1114000	15	1070311	15	3.9%
Germany	1277510	20	1277510	21	-
Greece	861300	10	861300	10	-
Iceland	393790	1	393790	1	-
Ireland	1140990	17	1140990	17	-
Italy	1200550	19	1200550	20	-
Japan	1418760	22	1154917	19	18.6%
Netherlands	577250	5	577250	5	-
New Zealand	778790	8	729894	8	6.3%
Norway	578670	6	578670	6	-
Portugal	1135220	16	1135220	16	-
Spain	1152930	18	1152930	18	-
Sweden	520990	3	520990	3	-
Switzerland	1298240	21	1298240	22	-
Turkey	917230	11	917230	12	-
United Kingdom	763480	7	711214	7	6.8%
United States	960190	13	960190	14	-

Source: BIE.

Overall we find that large business users have access to the largest proportional discounts. In Australia, the best discounts available to small business users for the basket of services, as constructed herein, are 6.4 per cent below list prices, for medium business users 7.7 per cent below and large business users 10.1 per cent below. However, these discounts result in only a small change to the relative basket price ranking of OECD countries. Of course, small and medium businesses can obtain greater volume discounts for specific services and/or through aggregating under an aggregator or reseller (refer to Section 2.2 above). Simple aggregators currently offer discounts of up to 25 per cent on voice communications charges, while resellers (switched and/or switchless) typically offer somewhat lower discounts in combination with other value-added features and services.

3.5 Time Series Analysis

A time series analysis of telecommunications prices provides an indication of price trends over time, and gives an overview of the impact of the introduction of new communications policies, market liberalisation, and privatisation.

In this section time series analyses are presented for national, international and mobile services. The national and mobile services comparisons are based on the OECD tariff baskets for 1990 and 1994 and examine movements in the charges for these services baskets over that period, while

international call services comparisons are based on the price movements of a peak rate 3 minute call from each country to every other country in the OECD over the period 1990 to 1994.

Time Series for the National Business Basket

For time series comparisons it is necessary to standardise the number of calls included in the basket. In this case the number of national (domestic) calls has been fixed at the 1990 basket level of 2,634. Prices in local currency are deflated by the local CPI, and then indexed with 1990 set to 100. This procedure shows the trend in national business user basket prices in OECD countries between 1990 and 1994. All the caveats relating to the construction of the national business basket, discussed above, apply and should be borne in mind in interpreting these results. Nevertheless, the results do provide an indication of the relative movements in the prices paid by business user for this basket of national (domestic) services.

Over the period 1990 to 1994, the OECD average price for this basket of national services to business users declined by 15.3 per cent, while prices for this basket of national business services in Australia fell by only 8.9 per cent. The fall in prices for this basket of national services to business users between 1990 and 1994 has been substantially greater in such countries as New Zealand, the United Kingdom and the United States than it has in Australia.

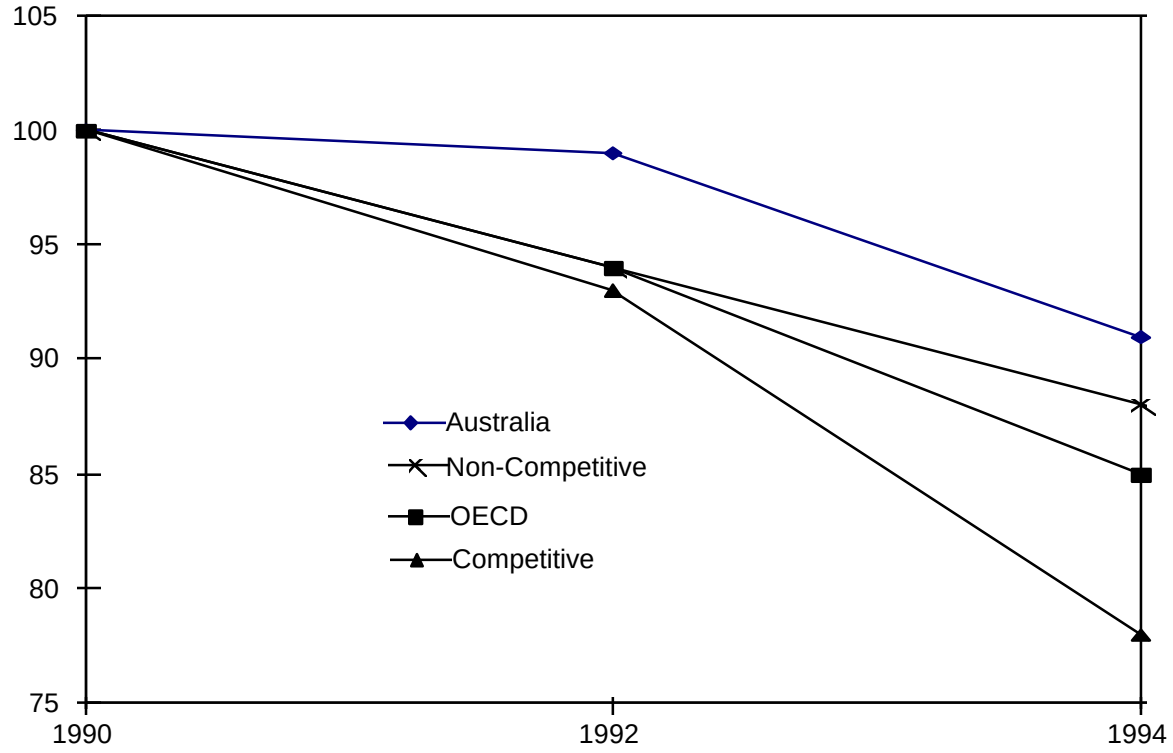
Table 3.12 Time Series for the National Business Basket (Indexed 1990 = 100)

	1990	*1992*	*1994*	*Change 1990-94*
Australia (Telstra)	100	99	91	-8.9
Austria	100	90	83	-16.8
Belgium	100	101	97	-3.2
Canada (Bell Canada)	100	83	80	-19.5
Denmark	100	80	96	-3.7
Finland (HTC)	100	116	78	-22.0
France	100	95	85	-14.6
Germany	100	78	72	-27.7
Greece	100	98	104	3.9
Iceland	100	98	97	-3.2
Ireland	100	82	74	-26.4
Italy	100	93	84	-16.0
Japan (NTT)	100	83	68	-31.8
Luxembourg	-	-	-	-
Netherlands	100	102	103	2.9
New Zealand (TCNZ)	100	90	78	-22.1
Norway	100	51	47	-52.9
Portugal (TP/TLP)	100	90	91	-9.0
Spain	100	108	105	5.3
Sweden	100	99[a]	81[a]	-19.0
Switzerland	100	110	109	8.7
Turkey	100	114	73	-27.0
United Kingdom (BT)	100	88	75	-25.2
US (AT&T/Nynex)	100	114	75	-24.6
OECD average[b]	100	94	85	-15.3
Competitive average[b]	100	93	78	-21.6
Non-competitive average[b]	100	94	88	-12.0

Notes: The countries with competitive telecommunication market structures are US (1990-94), UK (1990-94), Japan (1990-94), NZ (1990-94), Canada (1992-94), Australia (1992-94), Sweden (1994), and Finland (1994).
[a] The results reflect tariffs for Telverket in 1992 and Telia in 1994.
[b] OECD, competitive and non-competitive averages are simple averages.
Sources: OECD 1990a and 1994, ITU 1994 and BIE calculations.

While it is noticeable that some of the largest price falls for this basket of services have occurred in countries where prices were highest in the first place, such as Japan and Turkey, the impact of competition appears to be an important influence on prices. Across the group of countries with competitive market structures, prices for this basket of national services to business users fell 21.6 per cent over the period 1990 to 1994, while across the group of countries with non-competitive structures prices decreased by only 12 per cent. This suggests that competition is a key ingredient in driving down telecommunication services prices.

Figure 3.15 Time Series for the National Business Basket, 1990-94 (Indexed 1990 = 100)



Sources: OECD 1990 and 1994, ITU 1994 and BIE calculations.

Time Series for International Call Charges

In order to undertake a time series analysis for international charges, the average of the charges for calling out of each country in the OECD to all other countries in the OECD (weighted by the population of the receiving country) for 3 minutes at peak time, have been compared for the period 1990 to 1994. The average charges have been presented as an index with 1990 set to 100.

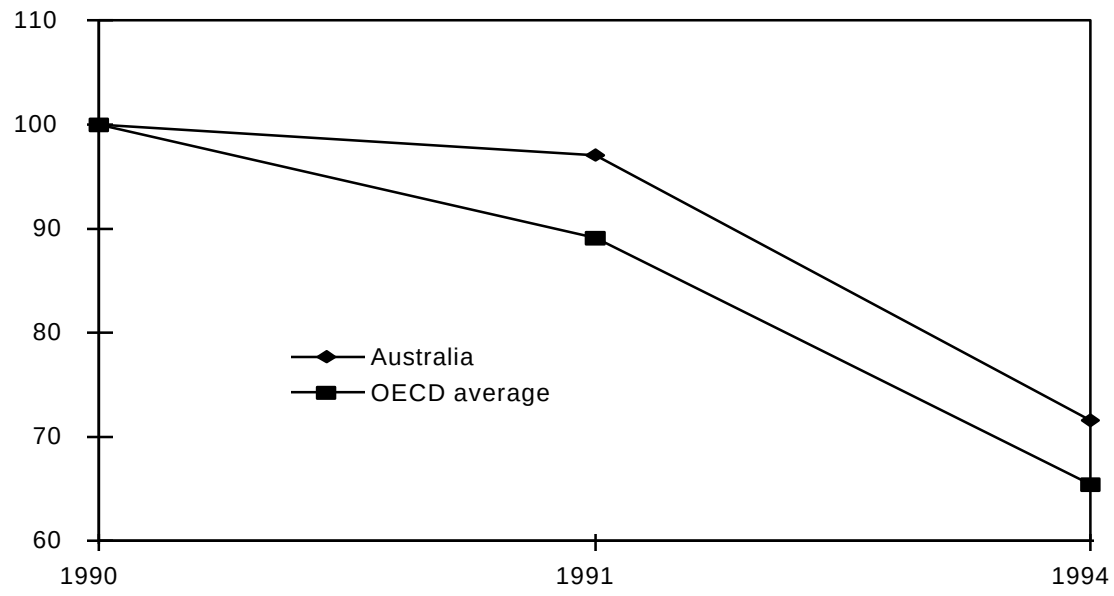
The time series for such international calls indicates that over the period 1990-94 international call prices have been declining quite rapidly. The average price of international calls in OECD countries declined by 34.6 per cent. The price of international calls from Australia to the OECD countries declined between 1990 and 1994 by 28.4 per cent. This indicates that the price of such international calls in Australia has been declining somewhat more slowly than in other OECD countries.

Table 3.13 Time Series for Peak Rate 3 min International Calls to OECD Countries (Indexed 1990 = 100)

	1990	*1991*	*1994*	*Change 1990-94*
Australia	100	97.08	71.56	-28.4
Austria	100	96.57	83.64	-16.4
Belgium	100	81.20	59.94	-40.1
Canada	100	87.70	71.03	-29.0
Denmark	100	81.55	76.00	-24.0
Finland	100	73.65	50.75	-49.3
France	100	100.36	70.37	-29.6
Germany	100	97.07	73.92	-26.1
Greece	100	87.33	40.30	-59.7
Iceland	100	97.00	63.50	-36.5
Ireland	100	78.05	45.20	-54.8
Italy	100	79.54	42.83	-57.2
Japan	100	86.85	111.18	11.2
Luxembourg	100	99.06	64.02	-36.0
Netherlands	100	111.83	91.64	-8.4
New Zealand	100	93.37	80.07	-19.9
Norway	100	64.03	45.13	-54.9
Portugal	100	84.78	62.48	-37.5
Spain	100	84.67	51.62	-48.4
Sweden	100	91.51	67.72	-32.3
Switzerland	100	94.70	70.49	-29.5
Turkey	100	95.63	19.12	-80.9
United Kingdom	100	82.21	63.30	-36.7
United States	100	92.01	94.73	-5.3
OECD average	100	89.07	65.44	-34.6

Sources: OECD 1990a and 1994, BIE calculations.

Figure 3.16 Time Series for International Call Charges, 1990-94



Source: OECD, BIE calculations.

Time Series for the Mobile Services Basket

For the purposes of comparing mobile charges over time, the OECD's mobile service basket has been used, with the number of mobile calls in the basket fixed at the 1990 level of 852. Caveats applying to the construction of the mobile services basket, discussed above, should be borne in mind in interpreting these results.

Over the period 1990-94, mobile charges in most OECD countries have been declining. The average cost of this basket of mobile services in the OECD declined by 20.6 per cent between 1990 and 1994. In Australia, the cost of the same mobile basket declined by slightly more than the OECD average, falling by 26.3 per cent over the same period. Among the OECD countries, the United Kingdom experienced some of the greatest falls in the price of this mobile basket.

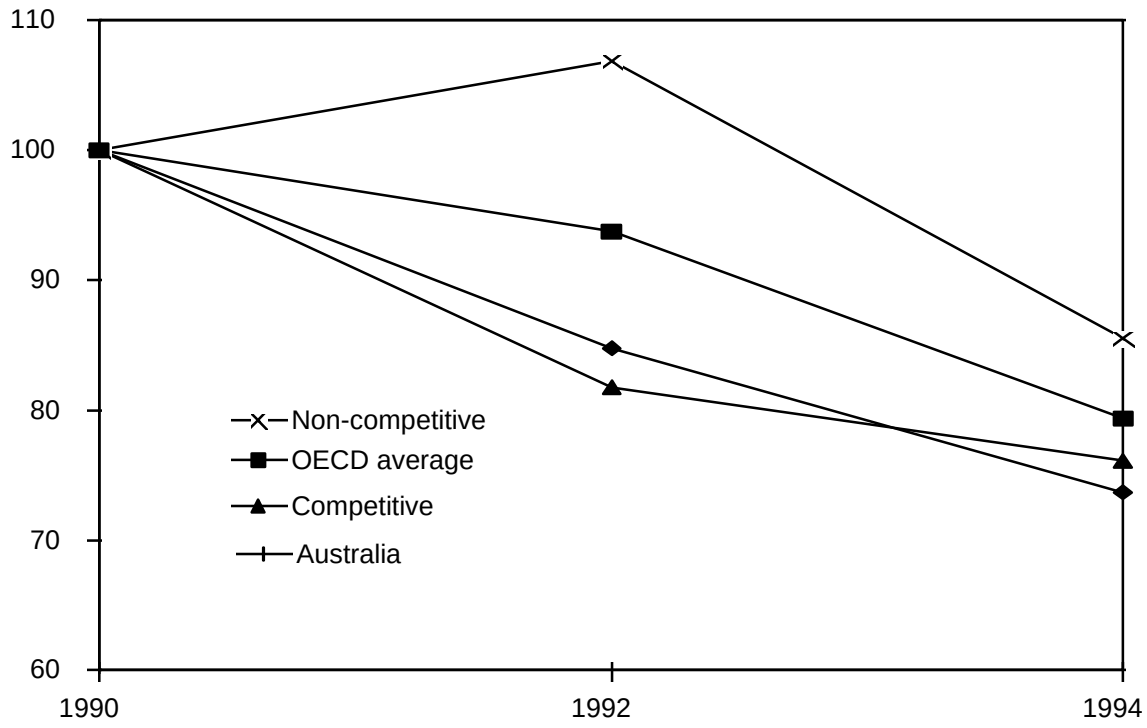
Table 3.14 Time Series for the Mobile Services Basket (Indexed 1990 = 100)

	1990	*1992*	*1994*	*Change 1990-94*
Australia (Telstra)	100	84.77	73.70	-26.3
Austria	100	99.28	72.99	-27.0
Belgium	100	120.66	96.16	-3.8
Canada (Bell Canada)	100	67.64	62.10	-37.9
Denmark (KTAS)	100	86.93	73.28	-26.7
Finland (HTC)	100	75.49	44.27	-55.7
France	100	76.47	67.63	-32.4
Germany (DBP)	100	82.02	50.14	-49.9
Greece	-	-	-	-
Iceland	100	227.37	201.16	101.2
Ireland	100	89.73	54.22	-45.8
Italy	100	65.00	55.22	-44.8
Japan (NTT Mobile)	100	89.53	82.87	-17.1
Luxembourg	100	88.40	43.07	-56.9
Netherlands	100	77.09	61.82	-38.2
New Zealand (TCNZ)	100	86.15	76.12	-23.9
Norway	100	78.18	66.10	-33.9
Portugal	100	177.77	149.78	49.8
Spain	100	86.15	74.21	-25.8
Sweden (Telverket/Telia)	100	72.68	63.53	-36.5
Switzerland	100	90.97	95.62	-4.4
Turkey	100	53.05	46.82	-53.2
UK (Cellnet)	100	81.29	55.94	-44.1
UK (Vodafone)	100	47.55	33.99	-66.0
United States (Nynex)	-	100	159.23	59.2
OECD average	100	93.77	79.39	-20.6
Competitive	100	81.76	76.12	-31.4
Non-competitive	100	106.86	85.53	-16.9

Note: The number of mobile calls in the basket has been fixed at 852. UK (Vodafone) not included in OECD average. The countries with competitive telecommunication market structures are US (1990-94), UK (1990-94), Japan (1990-94), NZ (1990-94), Canada (1990-94), France (1990-94), Sweden (1990-94), Australia (1992-94), Denmark (1992-94), Finland (1992-94), Germany (1992-94), Norway (1992-94), Finland (1992-94), Italy (1994), Netherlands (1994) and Portugal (1994). Non-competitives include other OECD countries (except Greece).
Sources: OECD 1990 and 1994, BIE calculations.

Examining the impact of competition on the price of this mobile services basket at an aggregated level, we find that the countries with competitive market structures experienced larger reductions in mobile charges than countries with non-competitive market structures. On average, countries with competitive market structures experienced a decline of 31.4 per cent for mobile charges between 1990 and 1994, compared to a decline of 16.9 per cent for non-competitive countries over the same period.

Figure 3.17 Time Series for Mobile Services Basket, 1990-94



Source: OECD, BIE calculations.

3.6 Summary

In terms of simple rate comparisons Australia performs well on cellular mobile charges, but rather less well on business user fixed charges and international and national trunk usage charges. Affordability comparisons, using the proxy of price comparisons relative to comparisons of GDP per capita, suggest that Australia performs relatively well. Scandinavian countries generally perform well across the board, and in some comparisons Asian countries perform strongly - albeit with much more mixed results between the comparisons. The Asian countries in the sample (Korea, Taiwan, Singapore Hong Kong and Malaysia), excluding Japan, have among the lowest business user fixed charges, but do not perform so well in terms of usage charges. Malaysia and Singapore

also enjoy relatively low cellular mobile charges, while Japan is probably the most expensive country for mobile overall in our sample.

Turning to tariff basket comparisons among the OECD countries, we find that Australia performs relatively poorly in the business user national services basket comparisons, with charges above the OECD average and higher than the Scandinavian countries, the United Kingdom, United States, New Zealand and Canada. National differences in geography, demography and regulation regarding local call charging make the comparison of national basket charges relatively vulnerable to external factors. Nevertheless, we must conclude that Australia falls some way behind international best practice on this indicator, being below the OECD average and, in view of Australia's unchanged ranking, that it has not gained ground relative to its OECD counterparts over the period 1992 to 1994.

In contrast, Australia performs well in terms of the international call basket charges. Australia (Telstra) also performs relatively well in comparisons of cellular mobile charges, currently ranking 4th among the 24 mobile operators listed. Only operators in Iceland, Finland, and Denmark were cheaper in 1994. In light of the likely disadvantage of distance for larger countries this is a good performance. A comparison of the 1992 and 1994 rankings suggests that mobile charges in Australia are moving in line with those of OECD counterparts.

Table 3.15 Summary of Price Comparisons

	Year	*Best Observed*	*Worst Observed*	*Australia Ranked*
Simple Rate Comparisons				
Business Fixed Charges	1993	United States	Canada	18th of 28
Long Distance Calls	1993	Luxembourg	Portugal	16th of 26
International Calls	1994	Norway	Japan	14th of 24
Mobile Fixed Charges	1992	Malaysia	Luxembourg	8th of 29
Mobile Call Charges	1992	Singapore	Germany	7th of 29
Basket Comparisons				
National basket	1994	Iceland	Austria	14th of 23
International call basket	1994	Australia	Turkey	1st of 24
Mobile basket	1994	Iceland	Japan	4th of 24
PSDN basket	1994	Finland	Japan	18th of 24
Leased line Basket, 9.6 Kbit	1994	Belgium	Austria	9th of 24
Leased line Basket, 64 Kbit	1994	Australia	Spain	1st of 24
Leased line Basket, 1.5/2 Mbit	1994	United Kingdom	Luxembourg	5th of 22
Composite basket	1994	Finland	Japan	11th of 22

Source: BIE.

Australia falls marginally below the OECD average in terms of charges for the basket of packed-switched data network (PSDN) services, ranking 18th among the OECD countries. Australia's ranking in terms of charges for this basket of PSDN services deteriorated from 7th in 1992 to 18th in 1994. However, prices for this basket of PSDN services appear to be volatile over time, suggesting that extreme caution should be exercised in interpretation. In terms of the leased line

basket Australia performs relatively well overall, ranking 9th at the slower 9.6Kbps rate lines, 1st at the mid-range 56/64Kbps line speeds, and 5th for the high speed 1.5/2Mbps lines. Australia has been improving its position over the period 1992 to 1994 relative to OECD counterparts in terms of charges for this basket of leased line services.

Putting this all together into a composite business basket we find that Australia ranks above the OECD average, but mid-field among the OECD countries, at 11th in both 1992 and 1994 - a position unchanged since 1989. Australia performs better than Japan, Germany, France and the United States in terms of the composite basket, but below the Scandinavian countries, New Zealand, the United Kingdom and Canada.

A comparative static analysis over the period 1992 to 1994 gives a picture of Australia's position relative to its OECD counterparts that is substantially independent of the effects of the tariff basket modelling assumptions. In comparative static terms Australia's position has remained unchanged in respect to the national business basket, the international call basket and the mobile basket, improved in respect to the leased line baskets, while falling behind in respect to the packet-switched data network services basket. Australia's position in terms of the composite business basket has remained unchanged since 1989.

The overall picture from price comparisons based on tariff baskets is one of having to run to keep pace with international counterparts, and barely managing to keep up. Telstra has only managed to meet its 1993-94 price cap obligations by virtue of discounts and the allowed deferral of 1 per cent until next year. Because discounts do not show in the OECD tariff baskets Telstra's price performance 1993-94 is somewhat understated. Nevertheless, prices appear to be falling more slowly in Australia than in other comparable countries. It is also notable that Australia's performance seems better in the more highly contested markets of mobile and international than in markets where there is less competition.

Tariff basket comparisons are based on list prices and do not accurately reflect prices paid by customers able to take advantage of discount schemes. Taking account of best available discounts in international price comparisons is fraught with difficulty and caveats apply. Nevertheless, our analysis suggests that, while large business users have access to the largest proportional discounts, and discounts available in Australia appear to be among the highest in OECD countries, these discounts do not result in substantial changes to the relative price ranking of the OECD countries.

In Australia, the best discounts available for small business users, as defined in the basket constructed herein, are 6.4 per cent below list prices, for medium business users 7.7 per cent below and large business users 10 per cent below. Businesses can, however, obtain greater volume discounts in specific areas of services, and overall through aggregating under aggregators or resellers, who currently offer discounts of up to 25 per cent on voice communications charges.

The time series analysis of a basket of national services charges for business users reveals that charges have fallen since the introduction of competition in 1992. However, price falls for the basket of national services in Australia, at 8.9 per cent over the period 1990 to 1994, were somewhat less than the OECD average of 15.3 per cent. The time series analysis for peak rate 3 minute international call charges indicates that although prices in Australia declined by 28.4 per

cent over the period 1990 to 1994, the OECD average decline was 34.6 per cent. Charges for the basket of cellular mobile services in most OECD countries declined over the period 1990-94, with an OECD average decline of 20.6 per cent. In Australia, the cost of the mobile basket declined by 26.3 per cent, suggesting that Australia is performing relatively well in this area.

The time series analysis also reveals that countries with competitive market structures experience larger price reductions than countries with non-competitive market structures. On average countries with competitive market structures experienced declines of 21.6 per cent for national and 31.4 per cent for mobile services baskets, compared to declines of 12 per cent and 16.9 per cent for non-competitive countries, respectively, between 1990 and 1994.

Chapter 4 Quality of Service and Innovation

As a performance indicator price alone can be misleading, because users of telecommunications services may be willing to pay a higher price for better quality or more reliable services. For this reason it is important to examine quality of service indicators as well as price. The first section of this chapter examines some of the key indicators of quality of service, such as call failure rates, fault clearance and call drop-out rates. These short-term quality and reliability indicators can be complemented by indicators of long-term quality. Investment in particular technologies, for example, suggests an ability to meet future quality and reliability demands. The second section of this chapter examines indicators of innovation that are likely to contribute to improvements in quality of service in the future. Again, comparisons for Australia are based on data for Telstra only.

Quality of service indicators are currently measured independent of price, but because of the relationship between price and quality of service performance comparisons should combine both price and quality of service indicators. At a minimum, both price and quality of service aspects should be considered when making an overall assessment of comparative performance.

All of the indicators analysed in this report are critical to business users. Some, such as call failure/completion, call drop-out, and fault clearance are of obvious direct importance to users, while others are important because of their implications for overall service and/or the nature of the evolving competitive environment. The deployment of optical fibre and network digitalisation are key technologies for the further development of the communications network and the services it supports. The other indicators examined in this chapter are either second order indicators of network (and services support) developments, such as the availability of itemised billing and the proportion of payphones that are cardphones, or indicators of the emergence of competitive communications alternatives. Itemised billing indicates the level of diffusion of digital exchanges and the implementation of such signalling systems as CCS7. The deployment of cellular mobile also indicates the level of competitive alternatives. Mobile licences are commonly granted to a wider range of service providers than are fixed network licences, and mobile networks represent an alternative to the traditional fixed network.

There are, however, difficulties in employing such indicators. The comparability of indicators may be affected by different definitions, varying size and method of sampling, and measurement in different units. For example, time for clearance of telephone faults is based on working days in some countries and on all days of the week in others. Even when indicators appear to show the same information, differences in collecting the data may be as significant as differences in performance (OECD 1990a, p.125). A further difficulty with international comparisons of quality of service indicators for telecommunications services is that carriers often offer a range of quality/price combinations to customers, whereas international comparisons are based on overall averages only. This can significantly overstate or understate quality of service performance for specific customers,

and may well tend to understate performance in respect of business users. For example, many of the volume discount agreements negotiated with larger users in Australia include quality of service targets and may also involve quality of service penalty agreements, which tend to result in higher quality of service to these customers.

4.1 Quality of Service Indicators

Quality of service indicators for telecommunications services attempt to measure network reliability, response times and availability. Key quality of service indicators for telecommunications services include: call failure rates for local and long distance calls; IDD completion rates; fault clearance; and cellular mobile drop-out rates. Both IDD completion rates and cellular mobile drop-out rates are new indicators and have been introduced in order to develop a set of indicators that are appropriate for the future.

Call Failure Rates

Calls can fail for a number of reasons including technical problems arising from network congestion, failure of local exchange equipment, failure of customer premises equipment, subscriber error in dialling and called number engaged or not answered (BTCE 1991, p.62). When measuring call failure rate, only the proportion of calls that fail because of technical problems should be included as the carrier has no control over the other sources of failure. Call failure rates vary by the time of day, with the highest rates often occurring during peak periods when the load factor is greatest. Rates of call failure also vary between types of call. Nevertheless, call failure rates are an important indicator of the general reliability of the network.

Call failure rates for local and long distance calls are compared in Table 4.1. Despite Australia's call failure rates for local calls improving from 1.5 per cent in 1990 to 0.8 per cent in 1992, they continue to be well above those for Japan, the United Kingdom and Canada. Australia's call failure rate for long distance calls in 1992 was also considerably higher than those for the United Kingdom and the United States.

Table 4.1 Call Failure Rates (per cent)

	1990			1992			1993			1994		
	Local	*Trunk**	*Overall**	*Local*	*Trunk**	*Overall**	*Local*	*Trunk*	*Overall*	*Local*	*Trunk*	*Overall*
Australia	1.5	2.2	-	0.8	1.7**	-	0.4**	1.1**	-	0.3##	1.1**	-
Austria	-	-	-	-	-	-	-	-	-	-	-	-
Belgium	-	-	2.7	2.2	-	-	-	-	-	-	-	-
Canada[1]	0.1	0.1	-	0.1	0.3	-	-	-	-	-	-	-
Denmark	2.0	-	2.0	1.9	-	1.9	1.5	-	-	-	-	-
Finland	3.3	1.5	-	3.2	0.8	-	-	-	-	-	-	-
France	0.7	-	0.7	-	-	-	-	-	-	-	-	-
Germany	-	-	-	-	-	-	-	-	-	-	-	-
Greece	6.5	48[2]	-	-	-	-	-	-	-	-	-	-
Hong Kong	69.0	-	-	53.7	-	-	-	-	-	-	-	-
Iceland	4.0	2.5	-	2.3	2.0	-	-	-	-	-	-	-
Ireland	2.0	3.0	-	1.3	1.8	-	-	-	-	-	-	-
Italy	-	-	-	-	-	-	-	-	-	-	-	-
Japan	0.0	-	-	0.0	-	-	-	-	-	-	-	-
Korea	-	-	-	-	-	-	-	-	-	-	-	-
Luxembourg	4.0	4.3	-	4.0	4.0	-	-	-	-	-	-	-
Malaysia	-	-	-	-	-	-	-	-	-	-	-	-
Netherlands	-		0.9[3]	-	-	-	-	-	-	-	-	-
New Zealand	-	-	-	-	-	-	-	-	-	-	-	-
Norway	2.0	-	2.2	1.4	2.4	-	-	-	-	-	-	-
Portugal	2.0	-	-	4.0	-	-	-	-	-	-	-	-
Singapore	-	-	-	21.8	-	-	21.5	-	-	-	-	-
Spain	1.0	9.6	-	0.5	0.4	-	-	-	-	-	-	-
Sweden	1.0	-	1.1	2.0	0.7	-	-	-	-	-	-	-
Switzerland	37.8	-	-	37.8	0.4		38.3	-	-	-	-	-
Taiwan, China	-	-	-	29.4	-	-	28.1	-	-	-	-	-
Thailand	1.8	-	-	1.1	-	-	-	-	-	-	-	-
Turkey	5.0	-	-	5.0	0.5	-	-	-	-	-	-	-
United Kingdom	0.6	0.7	-	0.2	0.2	-	-	-	-	-	-	-
United States	0.5	1.1	-	-	0.5	-	-	-	-	-	-	-

1. Data for Bell Canada only. 2. Includes unanswered calls. 3. Figure for 1988.
* OECD estimate. ** Telecom Australia estimates. # Based on Austel estimates. ## Austel estimate as at June 1994.
Sources: ITU 1994, OECD 1993 and 1994, and Austel 1994a,b.

Austel's estimates for call failure rates in Australia in 1993 and 1994 suggest that there has been some improvement in the reliability of the network since the introduction of competition, with both local and long distance call failure rates declining in those years. Austel evidence also suggests that there is a considerable divergence between the failure rates experienced by business and residential customers, and by rural and metropolitan customers (Austel 1994a, p.6-7). Rural and residential customers do not, in general, enjoy as high a level of service reliability as do metropolitan business customers. For customers in the former categories it seems likely that call failure in Australia is relatively high.

With limited data on call failure rates, and doubts as to international comparability, it is difficult to reach any firm conclusions about the reliability of Australia's network compared to networks in other countries. Nevertheless, Canada has a similar population density and similarly harsh terrain, but relatively low call failure rates. There would, therefore, appear to be considerable scope for improving the reliability of the Australian network.

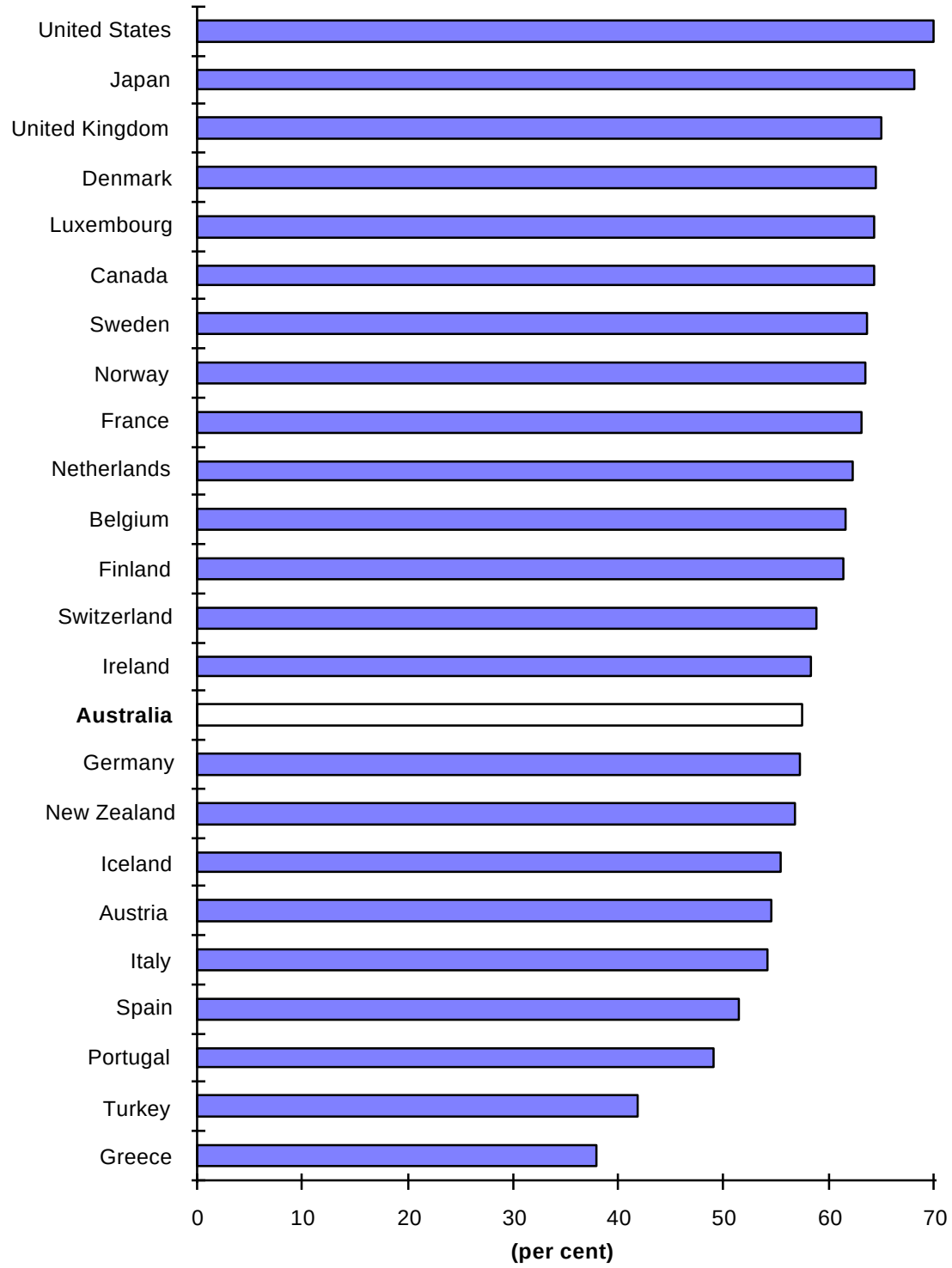
IDD Completion Rates

International Direct Dial (IDD) completion is a measure that provides some indication of the performance of the network for international services. Given the increasing importance of international communications services for trade-exposed business and for the international location decisions of businesses, IDD completion rates are an important indicator of the performance of international services and of overall network reliability. For international performance comparisons answer-seizure ratios for incoming international calls are compared.

Australia's performance in respect of IDD completion rates is disappointing (See Table 4.2 and Figure 4.1). With an IDD completion rate of 57.5 per cent in 1992, Australia ranked 15th out of the 24 countries for which data are available. The best performer on this indicator was the United States with an IDD completion rate of 70 per cent, followed by Japan (68.1 per cent), United Kingdom (65 per cent) and Canada (64.5 per cent). Australia performed marginally better than New Zealand (56.8 per cent).

IDD completion rates are not a very reliable indicator of network performance as call completion is dependent, in large part, on called party busy (engaged) and ring-no-answer conditions. A major influence on these conditions is the availability and take-up of such equipment as answering machines and facsimile machines, and such services as call forward/diversion, call waiting and voice mail. These are especially influential for IDD completion because of time zone difficulties in international calling. IDD completion should really be taken as an indicator of network reliability and of the availability of advanced equipment and services. In the latter context it remains disappointing for Australia to have been below the United States, United Kingdom, Japan and Canada in regard to IDD (answering) completion in 1992.

Figure 4.1 Mean IDD Completion Rates, 1992



Sources: OECD 1994, and ITU 1994.

Table 4.2 Mean IDD Completion Rates

	1992
Australia	57.5
Austria	54.5
Belgium	61.6
Canada	64.3
Denmark	64.5
Finland	61.5
France	63.1
Germany	57.3
Greece	38.0
Hong Kong	-
Iceland	55.5
Ireland	58.3
Italy	54.2
Japan	68.1
Korea (Rep. of)	-
Luxembourg	64.3
Malaysia	-
Netherlands	62.2
New Zealand	56.8
Norway	63.5
Portugal	49.1
Singapore	-
Spain	51.4
Sweden	63.6
Switzerland	58.9
Taiwan, China	-
Thailand	-
Turkey	41.9
United Kingdom	65.0
United States	70.0

Sources: OECD 1994, and ITU 1994.

An alternative approach to measuring the quality of service of international calls is exception reporting, ie. recording the number of times specified events exceed agreed thresholds in relation to specific destinations. The two agreed thresholds for daily international circuit congestion are the number of days on which congestion is equal to, or exceeds 1 per cent and 5 per cent, respectively.

Austel reports that between July 1992 and June 1993, for seven of the top ten destinations for international calls from Australia, congestion exceeded 1 per cent on three days or fewer during the year; and for nine of the top ten destinations congestion exceeded 5 per cent on two days or fewer during the year. Over the same period, Austel estimates that for calls coming into Australia there were 4 days when congestion exceeded 1 per cent. Telstra also provide Austel with details on busy hour congestion for incoming international calls and outgoing international calls and facsimiles reached by using the 0011 number. Telstra estimates that over the period July 1992 to June 1993, at peak time for 7 of the top ten destinations for international calls from Australia congestion exceeded 1 per cent on three days or fewer; and for seven of the top ten destinations congestion exceeded 10 per cent during the busiest hour on one day or fewer (Austel 1993, p.125-6). In terms of congestion thresholds the performance of the Australian network appears to be relatively good.

Fault Clearance

Fault clearance is defined as the time taken for faults to be repaired and the service returned to normal. It is measured as the percentage of genuine faults repaired by the carrier within a certain period of time. Again the methodology differs from country to country, with some countries measuring the percentage of faults cleared within a working day and other countries measuring faults cleared within 24 or 48 hours. Notwithstanding these differences, faults cleared is an important indicator of the quality and responsiveness of service offered by the carrier(s), and of the availability of the network.

Table 4.3 provides details on fault clearance, including faults repaired within 24 hours of notification and faults cleared by the next working day. Australia performs poorly on faults cleared within 24 hours, ranking 15th out of the 19 countries for which data are available for 1992. The 1992 estimate for Australia of 79 per cent is considerably below the estimates for Denmark (95 per cent of faults cleared within 24 hours), New Zealand and Sweden (both on 94 per cent) and Canada (91.8 per cent). However, Australia performed better than Luxembourg, Finland, Greece and Belgium on this indicator. From these figures it would appear that the Netherlands was the best performer, but their estimate of 100 per cent is for faults cleared within 48 hours. It is difficult to compare Australia's performance over time on this indicator because the Australian estimate of 91 per cent in 1990 was for faults cleared within 48 hours, whereas that for 1992 is faults cleared within 24 hours.

Australia performed better on faults cleared by the next working day in 1992, ranking 10th among the 21 countries for which data are available. However, the data for Australia is not directly comparable with that for other countries as it covers faults cleared within one working day in urban areas, but within two working days in rural areas. The 1993 and 1994 estimates for Australia suggest that there has been some decline in the percentage of faults cleared by the next working day since 1992, with clearances falling from 83 per cent in 1992 to 72 per cent as at the end of the June quarter 1994. Although the level of variation in quarterly results is such that caution should be exercised in interpreting this result.

Australia's performance on fault repair times suggests that there is considerable scope for improvement. On fault clearance, Australia would also appear to be somewhat below international best practice and in danger of falling further behind.

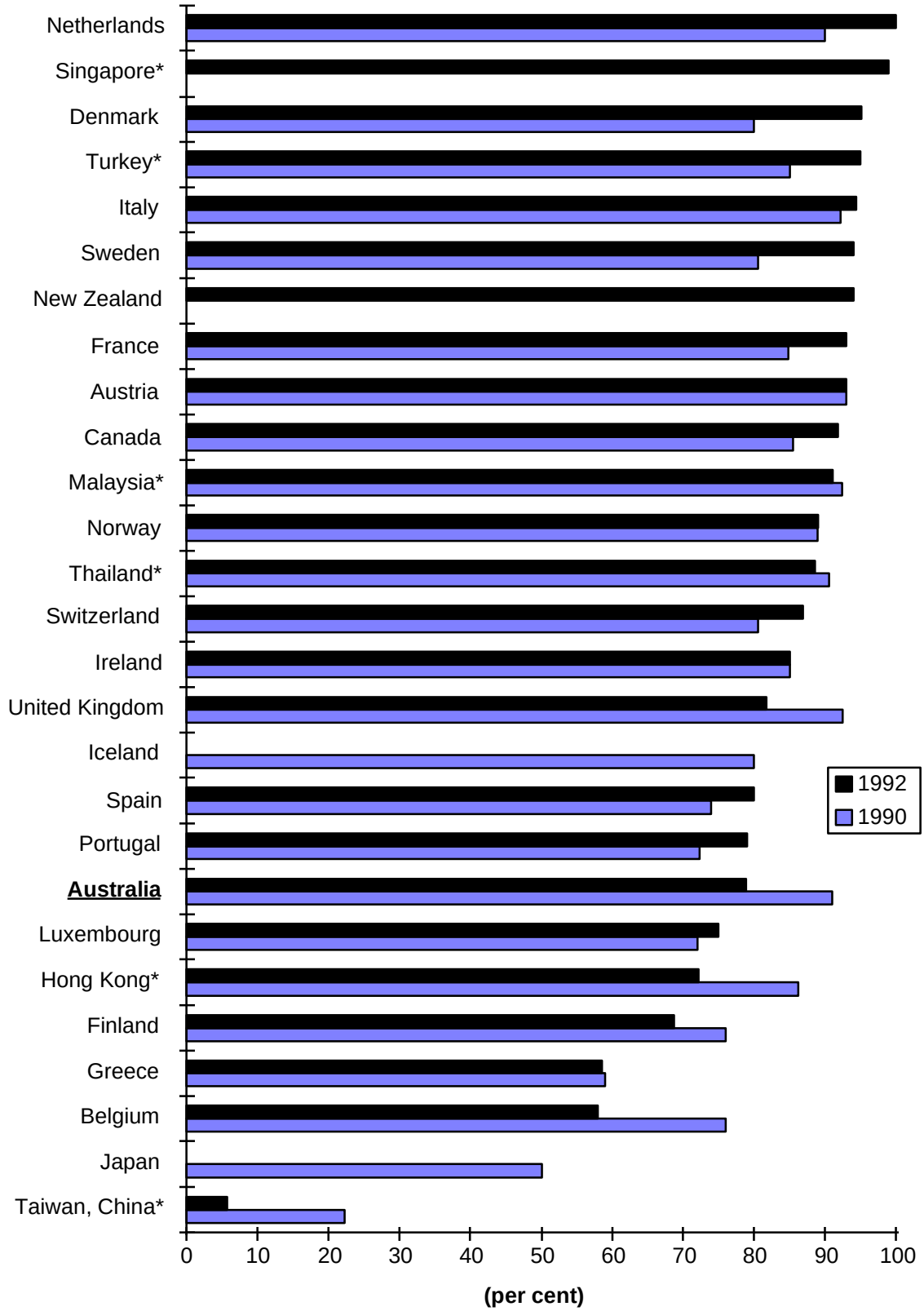
Table 4.3 Fault Clearance (percentage)

	Within 24 hrs		*By next working day*				
	1990	*1992*	*1990*	*1991*	*1992*	*1993*	*1994*
Australia	91.0[4]	78.9	-	-	83[1]	79[1]	72[2]
Austria	93.0	93.0	93.0	93.0	93.0	-	-
Belgium	76.0	58.0	78.0	76.0	77.5	-	-
Canada	85.5	91.8[3]	-	-	-	-	-
Denmark	80.0	95.1	80.0	95.1	-	-	-
Finland	76.0	68.7	67.6	62.4	68.7	73.5	-
France	84.9	93.0	84.9	86.6	-	-	-
Germany	-	-	-	-	-	22.0	-
Greece	59.0	58.6	60.3	60.9	58.6	-	-
Hong Kong	-	-	86.2	84.0	72.2	-	-
Iceland	80.0	-	-	-	80.0	-	-
Ireland	85.0	85.0[5]	85.0	82.0	85.0	-	-
Italy	92.2	94.4[6]	-	52.6	55.1	-	-
Japan	50.0	-	-	-	-	-	-
Korea (Rep. of)	-	-	-	-	-	-	-
Luxembourg	72.0	75.0	74.7	75.4	75.0	-	-
Malaysia	-	-	92.4	93.3	91.1	-	-
Netherlands	90.0	100.0[7]	90.0	-	91.0	-	-
New Zealand	-	94.0	-	-	-	-	-
Norway	89.9	89.0	88.9	90.1	89.0	-	-
Portugal	72.4	79.0	75.0	77.0	79.0	-	-
Singapore	-	-	-	99.4	98.9	96.6	-
Spain	73.9	80.0	75.0	70.0	77.1	-	-
Sweden	80.6	94.0	81.0	90.8	94.0	94.5	-
Switzerland	80.6	86.8	85.0	87.0	86.8	89.0	-
Taiwan, China	-	-	22.3	11.3	5.8	3.4	-
Thailand	-	-	90.5	88.7	88.6	-	-
Turkey	-	-	85.0	90.0	95.0	-	-
United Kingdom	92.5[8]	81.7	91.4	85.9	81.7	-	-
United States	-	-[9]	-	-	-	-	-

1. Austel estimate. Urban areas within one working day and rural areas within two working days. 1992 estimate as at June 1992.
2. Austel estimate, as at June 94.
3. Business users only.
4. In 48 hours for 1990.
5. Telecom Ireland cleared 92.5 per cent of business and 92.2 per cent of residential faults within 2 working days.
6. A figure of 73.5 has also been reported for 1992.
7. Within 2 working days.
8. 1990 data is based on 2 working days. In 1992 BT cleared 99 per cent of residential and 99.5 per cent of business faults within 2 working days.
9. PTO repair of access service averages 5 hours for access services and 6 hours for special access service.

Sources: OECD 1994, and ITU 1994.

Figure 4.2 Faults Cleared Within 24 Hours



* Faults cleared by next working day.
Sources: OECD 1994, and ITU 1994.

Case Study

Cathay Pacific

Regional Headquarters in Sydney

Cathay Pacific Airways Limited, is a major international airline in the Asia-Pacific region, operating from Hong Kong. Like most airlines, communications systems are an important part of Cathay's business and a significant factor in operating costs. Most of Cathay's communications needs are coordinated through its regional headquarters (RHQ). Cathay's recent decision to relocate its RHQ to Australia will result in a significant boost to telecommunications spending in Australia.

In a joint venture arrangement with Telstra, Cathay is currently involved in relocating its regional headquarters activities from Hong Kong to Sydney. Cathay is due to establish its Australian data centre and communications hub by the second half of 1995. The data centre will provide an aggregation point for dedicated telecommunications services that will support its computer network and act as a hub for Cathay's operations in 161 cities around the world. The data centre will process numerous functions, including all Cathay's day-to-day world-wide operations, such as passenger reservations, check-in, cargo handling, flight operations, catering, engineering and maintenance services. These functions are currently being handled by three data centres in Hong Kong.

Cathay decided to relocate because it is more efficient to run their operations from a single centre. Other factors that were important in their decision to relocate to Sydney include:

- time zone consideration for effective support;
- availability of suitable land and future growth flexibility;
- sufficient relevant skills in the local market;
- availability of advanced telecommunications facilities;
- established large computer installations; and
- availability of direct support from major vendors.

The relocation represents an investment of around $260 million. This includes expenditure on telecommunications infrastructure of $60 million. Cathay also estimate that they will spend around $20 million annually on a long-term basis on Australian telecommunications services. In addition, Cathay anticipate earning international telecommunications revenue of $5 million per annum.

Cellular Mobile Drop-out Rates

Currently there are no widely used quality of service indicators relating to cellular mobile phones. For quality of service indicators to serve as a basis for assessing quality of telecommunications services in the future they will need to cover cellular mobile services (BTCE 1991, p.48). One indicator of the reliability of cellular mobile telephony services is cellular mobile drop-out rates, and despite the absence of adequate data we have introduced it in order to begin a series and provide a basis for future comparison.

Mobile call drop-out is defined as the percentage of calls that are disconnected by the network during conversation. The internationally accepted performance standard for mobile call drop-out is 5 per cent, but with mobile telephony still relatively new there are little data available for international comparison and no widely used standard collection or measurement methods. Moreover, the use of different technical standards in different countries can make data comparability problematic. Analogue and digital systems behave differently. Certain standards react to congestion 'gracefully', such as CDMA the US hybrid standard, while others drop-out suddenly. In addition to congestion call drop-out may also relate to terrain, topography and usage patterns. Coverage of a large country like Australia presents greater difficulties than a smaller country, and international variations in city-scape and topography create significantly different operational environments. Nevertheless, call drop-out may provide a useful customer-oriented indicator of quality of service for mobile telephony.

Austel collects data on call drop-outs in Australia, and estimates that 3.9 per cent of calls were disconnected by the network during conversation in 1992, falling to 3.8 per cent in 1993. Austel also report a 3.8 per cent call drop-out at the national level in June 1994. Among capital cities, Sydney is reported to have the highest call drop-out rate, with mobile drop-out in Sydney CBD exceeding the internationally accepted performance standard of 5 per cent on a few occasions during the first half of 1994. It has, however, remained within the standard during the second half of 1994 (Austel, 1994a).

OFTEL (1994) monitors the performance of the analogue cellular networks in the United Kingdom by means of an independent drive-around survey. The results of these surveys indicate that for mobile calls made to the fixed network, 97.7 per cent of calls that were successfully set up were successfully completed (indicating a call drop-out rate of 2.3 per cent). For calls made from fixed networks to mobiles, 97.9 per cent of the calls were successfully completed (call drop-out rate of 2.1 per cent). It should be noted, however, that drive-around survey results are not comparable with switch-based data collection, and are subject to far greater variability. Telstra estimate that switch-based drop-out percentages are of the order of 3 to 4 times higher than such drive-around surveys. If this is so, mobile call drop-out rates for the United Kingdom would appear to be higher than those in Australia. However, there is insufficient evidence available to compare Australia's performance with international counterparts.

Australia's analogue system is due to be phased out over the next few years. This is likely to lead to a gradual run-down of the analogue infrastructure in favour of the continuing digital infrastructure. This in turn is likely to lead to a decline in quality of service for users of the analogue system and

may lead to a disruption of some businesses, although Telstra have been expanding analogue capacity during 1994 in order to maintain service levels. Nevertheless, restrictions relating to mandated standards and spectrum allocation restrain the ability of Australian operators to meet quality of service targets, and should be considered in making international comparisons.

Table 4.4 Mobile Call Drop-out (per cent)

	1992	*1993*	*1994*
Australia	3.9	3.8	3.8[1]
Austria	-	-	-
Belgium	-	-	-
Canada	-	-	-
Denmark	-	-	-
Finland	-	-	-
France	-	-	-
Germany	-	-	-
Greece	-	-	-
Hong Kong	-	-	-
Iceland	-	-	-
Ireland	-	-	-
Italy	-	-	-
Japan	-	-	-
Korea (Rep. of)	-	-	-
Luxembourg	-	-	-
Malaysia	-	-	-
Netherlands	-	-	-
New Zealand	-	-	-
Norway	-	-	-
Portugal	-	-	-
Singapore	-	-	-
Spain	-	-	-
Sweden	-	-	-
Switzerland	-	-	-
Taiwan, China	-	-	-
Thailand	-	-	-
Turkey	-	-	-
United Kingdom[2]	2.2	-	-
United States	-	-	-

1. As at June 1994.
2. Based on averages from Oftel 'drive-around' survey. Estimates represent an average of call drop-out rate for mobile calls to the fixed network and of calls from the fixed network to mobiles.

Sources: OFTEL 1993, Austel 1994a, and Telstra.

4.2 Indicators of Innovation

Innovation is the third leg of the service performance stool. As Sir Bryan Carsberg, Director General of Telecommunications to the Secretary of State, in Britain, observed: the benefits of competition "come from improvements in the way basic operations are carried out, from greater interest in offering innovative services, and more creative use of technology" (Oftel 1990, p.3). It is important that users get the earliest possible access to the latest communications technology and the innovative services it supports - important for both the cost and quality of service, and for the early

emergence of enterprises using communications services as the vehicle for and/or as an integral element of their business. Innovation indicates investment in long-term service quality and reliability, and broader consumer choices.

To capture these important aspects indicators of innovation one should focus on new technologies and new services that are basic to supporting new competitive possibilities - ie. underlying, enabling technologies, rather than stand-alone or one-off developments. Consequently, it is to the deployment of such generic technologies that this study looks. Key indicators of innovation or modernisation of this type explored in this report include: the penetration of cellular mobile telephony, digital mainlines, and optical fibre, the availability of itemised billing and the proportion of payphones that are cardphones.

The penetration of cellular mobile is important not only as a new technology, but also because it can represent an alternative to the fixed network and its operators. Mobile operators face completely different economies of scale from those faced by fixed network operators, barriers to entry are lower and, because mobiles are a new technology, both new entrants and incumbent operators start from much the same point on the learning curve. These factors make mobile penetration rates a particularly important indicator of new competitive possibilities. The penetration of digital mainlines and optical fibre, the availability of itemised billing and the proportion of payphones that are cardphones are all key indicators of the extent to which the existing network can support interconnection by new competitive entrants and/or the kinds of new services likely to attract new entrants into the service provider market. They are, in short, key indicators of the potential for emerging competitive alternatives.

Innovation/modernisation data are much more varied in quality than are tariff data, and there are considerable difficulties involved in collecting internationally comparable data. Such indicators as those outlined do, however, give some indication of the overall picture in respect to investment-related performance and the ability to support competitive telecommunications services provision.

The Penetration of Cellular Mobile Telephony

Mobile communications offers a new range of possibilities for users. In many countries with an already high level of fixed network telephone penetration the mobile phone has rapidly become an almost indispensable tool for business; for those whose occupations involve a high degree of travel and for the operation of small businesses. In countries that have low levels of fixed telephone penetration the mobile phone offers an alternative to the enormous fixed network investment that would be required to bring those networks up-to-date. So the availability and take-up of mobile services is an important indicator of operator performance, especially for business users, and of the potential for the entry of new competitive alternatives to the operation of the traditional fixed network.

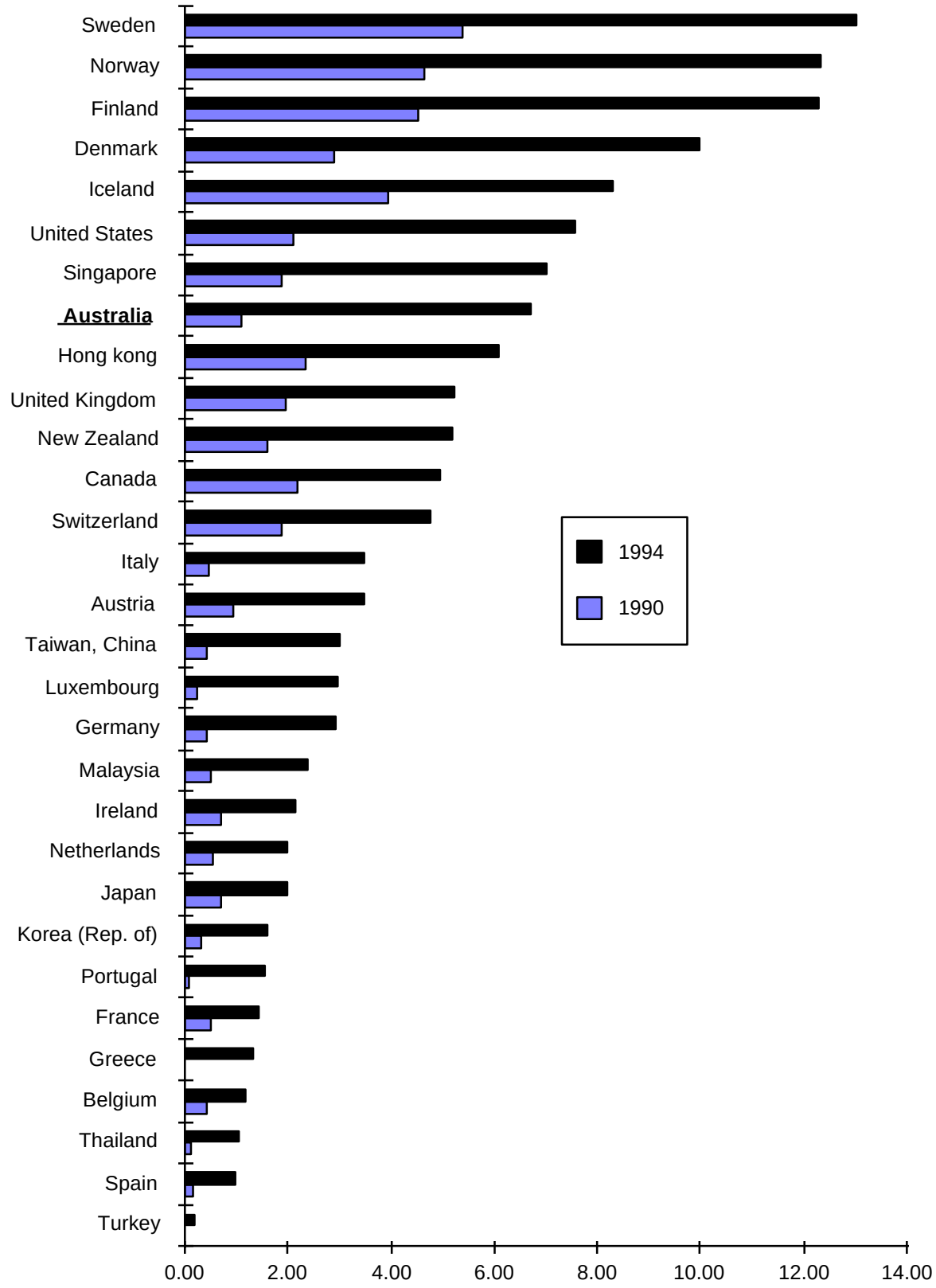
As indicated in Table 4.5 and Figure 4.3 there were 6.7 cellular mobile subscribers per 100 population in Australia in 1994. Australia ranks 8th out of 30 countries listed in terms of mobile subscribers per 100 people, up from 13th in 1990. This puts Australia some way behind the Scandinavian countries, the United States and Singapore, but marginally ahead of the United

Kingdom, New Zealand and Canada. Australia's performance on the penetration of cellular mobile is above the average of the 30 countries listed.

There is an inter-relationship between take-up and price (relating to price elasticities of demand, scale economies, etc.) and it is notable that the Scandinavian countries and Singapore have relatively low prices. Comparisons of fixed and usage charges and the price of the mobile services basket show a strong positive relationship between price and take-up, with but a few notable exceptions (See Table 3.7 and Figure 3.9 above). These comparisons highlight the fact that Australia's take-up is relatively high, even allowing for the relatively low prices. There may also be a relation between the quality and penetration of the fixed network and the take-up of mobiles (push factors), although this is more likely to show up in relatively less developed countries than among the sample of 30 comparable countries examined herein.

Were data available it would be interesting to examine the relative take-up of analogue mobile and digital mobile, as the latter might be considered a greater indicator of modernisation and/or innovation. Such a comparison might well place Australia in a rather less favourable position compared to European countries with its, as yet, rather slow take-up of digital mobile. However, as noted above, international comparisons are subject to the influence of nationally mandated standards and spectrum allocation, such that penetration/take-up indicators may reflect these as much as, or even more than carrier performance or customer acceptance.

Figure 4.3 Mobile Subscribers per 100 Population



Source: ITU 1994.

Table 4.5 Mobile Subscribers per 100 People

	1990	*1991*	*1992*	*1993*	*1994*[1]
Australia	1.09	1.69	2.84	4.25	6.69
Austria	0.95	1.48	2.19	2.85	3.46
Belgium	0.43	0.51	0.61	0.66	1.17
Canada	2.19	2.91	3.73	4.87	4.97
Denmark	2.88	3.41	4.08	6.91	10.00
Finland	4.53	6.35	7.66	9.74	12.27
France	0.51	0.66	0.76	1.02	1.43
Germany	0.43	0.83	1.50	2.21	2.92
Greece	0.00	0.00	0.00	0.17	1.31
Hong Kong	2.35	1.69	4.01	4.96	6.10
Iceland	3.93	5.00	5.84	4.25	8.31
Ireland	0.71	0.91	1.24	1.75	2.15
Italy	0.46	1.69	1.35	2.09	3.48
Japan	0.70	1.11	1.38	1.61	1.98
Korea (Rep. of)	0.30	0.38	0.62	0.87	1.60
Luxembourg	0.22	0.29	0.29	1.34	2.96
Malaysia	0.49	0.72	1.13	1.53	2.36
Netherlands	0.53	0.76	1.09	1.42	2.00
New Zealand	1.61	2.12	2.93	4.13	5.18
Norway	4.64	5.34	6.53	8.74	12.34
Portugal	0.07	0.13	0.38	0.97	1.55
Singapore	1.89	2.96	4.26	6.24	7.00
Spain	0.14	0.28	0.46	0.66	0.96
Sweden	5.39	6.59	7.56	8.96	13.03
Switzerland	1.86	2.57	3.11	3.79	4.77
Taiwan, China	0.41	0.96	1.85	2.58	3.00
Thailand	0.12	0.37	0.43	0.74	1.05
Turkey	0.06	0.08	0.10	0.14	0.21
United Kingdom	1.94	2.13	2.59	3.83	5.22
United States	2.11	2.99	4.33	6.25	7.55

(1) As at July 1st. 1994.
Sources: ITU 1994 and *Mobile Communications* November, 1994.

The Penetration of Digital Mainlines

Digitalisation has, arguably, been the technological change most fundamental to the recent rapid evolution of telecommunications networks, to the operational and commercial efficiency of telecommunications companies and the one most essential to the emergence of new operational possibilities. Many countries have recently pursued digitalisation as a matter of priority in order to meet evolving customer demand, to enable new innovative services, to increase the efficiency of the network and to enable their customers to exploit emerging service possibilities.

Network digitalisation is measured variously as the number of digital exchanges in operation and/or digital mainlines. The Bureau has adopted the percentage of digital mainlines as the indicator for this report because it best reflects the extension of digital capabilities to customers.

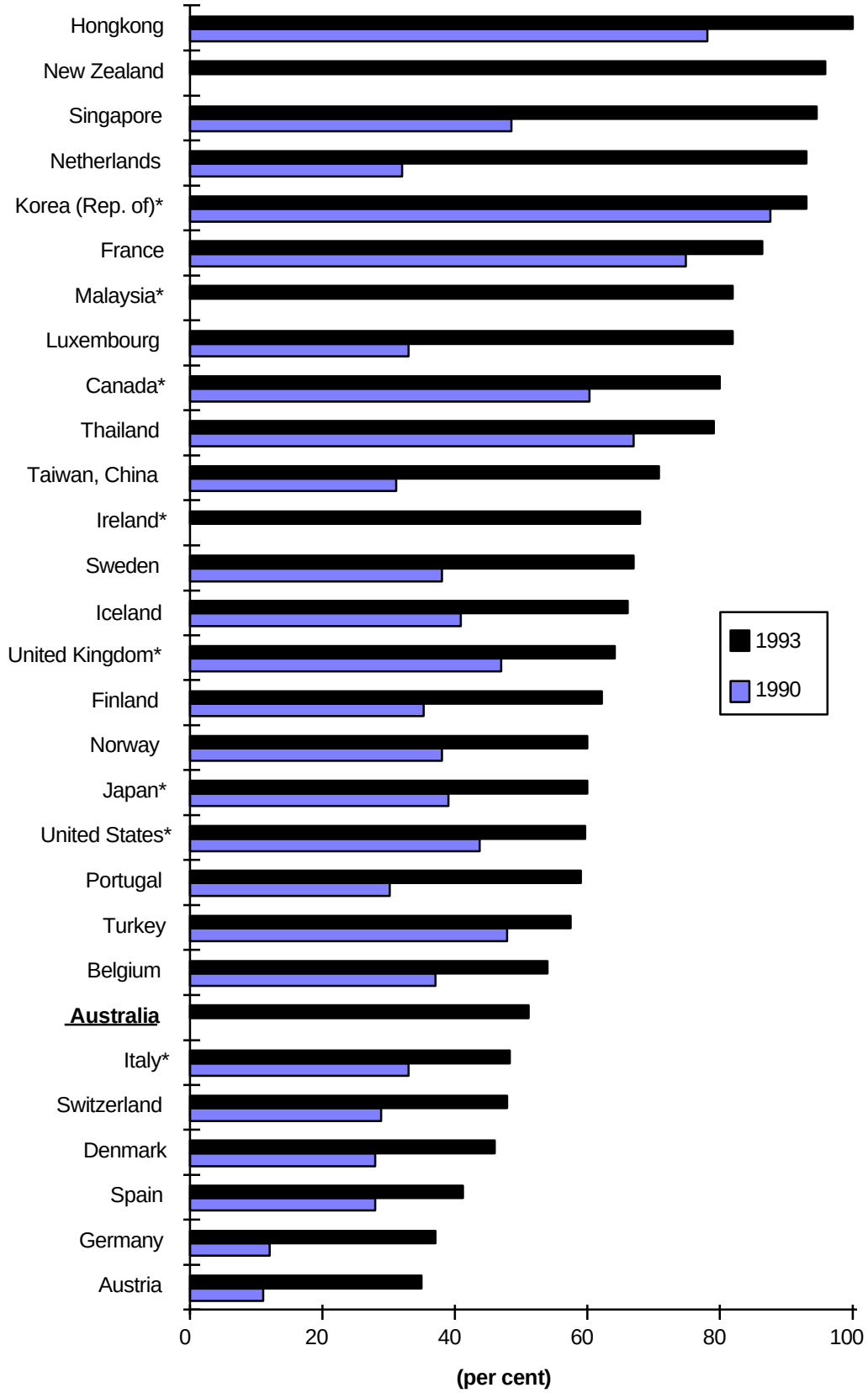
Australia ranked 23rd out of the 30 countries listed in terms of digitalisation of fixed network mainlines in 1993, below most comparable countries. There has been some concern for a number of years that Australia has been falling behind on modernisation investment in regard to digitalisation. Concern over Telstra's performance on fault clearance in relation to the COT cases, for example, pointed to insufficient attention to network modernisation. Recently announced investment plans for Telstra have set full digitalisation by 1998 as a major goal, while competitor Optus is rolling out an entirely digital network. These announcements are to be welcomed because significant investment in modernisation is required if Australia is to catch up with international best practice in respect of network digitalisation.

Table 4.6 Percentage of Digital Mainlines

	1990	*1991*	*1992*	*1993*
Australia	-	26	-	51[1]
Austria	11	18	27	35
Belgium	37	45	48	54
Canada	60	69	80	-
Denmark	28	33	39	46
Finland	35	42	51	62
France	75	79	83	86
Germany	12	16	25	37
Greece	15	-	-	-
Hong Kong	78	93	98	100
Iceland	41	42	49	66
Ireland	-	58	68	-
Italy	33	41	48	-
Japan	39	50	60	-
Korea (Rep. of)	88	92	93	-
Luxembourg	33	50	70	82
Malaysia	-	78	82	-
Netherlands	32	79	83	93
New Zealand	-	92	95	96
Norway	38	45	50	60
Portugal	30	44	54	59
Singapore	49	71	77	95
Spain	28	34	36	41
Sweden	38	47	54	67
Switzerland	29	33	42	48
Taiwan, China	31	50	58	71
Thailand	67	71	75	79
Turkey	48	51	56	58
United Kingdom	47	55	64	-
United States	44	53	60	-

1. BSEG estimate. Sources: ITU 1994, and BSEG 1994.

Figure 4.4 Percentage of Digital Mainlines



* 1992 data used for 1993.
Sources: ITU 1994, and BSEG 1994.

Case Study

Alcatel in Australia

Video Conferencing

Alcatel Australia is a member of the Alcatel group; the largest supplier of telecommunications equipment in the world. Although comprising only a small proportion of Alcatel's global business, Alcatel Australia, with an annual turnover close to $600 million, is one of the largest designers and manufacturers of telecommunications systems and equipment in Australia. The company first began operating in Australia in 1895 as a part of the Western Electric Company. Alcatel Australia currently employs more than 2,500 people and has four plants in Australia; three located in Sydney and one in Melbourne.

The company has a number of contracts with Telstra for the supply of telecommunications systems and equipment. Alcatel Australia is one of two suppliers with a contract to supply Telstra with telephones and exchanges, and has been a key supplier of Telstra's synchronous digital hierarchy (SDH) transmission systems. The company also has a contract to supply Telstra with GSM radio base stations.

Alcatel has a strong Asian development strategy, with the People's Republic of China as its main focus. Alcatel's Australian operations form part of this strategy. Alcatel Australia is securing regional export business in a number of areas, including: switching, transmission, global systems for mobile telephony, telephones and submarine fibre optic cable.

Alcatel Australia uses video conferencing as one means of communicating with other members of the Alcatel group throughout the world, and with the company's office in Melbourne. The company currently has interactive video conferencing links with France, Belgium and Melbourne. Alcatel Australia uses the video conferencing links for engineering and project management discussions. Video conferencing is an alternative to expensive travel for Alcatel Australia, and although not eliminating travel completely video conferencing has certainly reduced the amount of travel undertaken by the company and reduced associated costs.

Initially Alcatel Australia used Telstra's 2Mbit system for video conferencing, but has since purchased its own video conferencing equipment which makes use of Integrated Services Digital Network (ISDN) links. Video conferencing using ISDN currently costs Alcatel around $7 per minute.

Alcatel expects to make greater use of video conferencing in the future as the cost of video conferencing equipment falls. The company also envisages the use of video features on personal computers in the not too distant future. Innovative use of communications will continue to contribute to Alcatel's global operations.

The Penetration of Optical Fibre

A key technology in the recent rapid increase in available bandwidth and the reduction in bandwidth cost has been the introduction of optical fibre. To be able to meet the bandwidth demands of emerging and forecast services it will be necessary to continue to deploy fibre throughout the network, even into the customer access network (CAN).

Optical fibre penetration is measured variously as network route kilometres, fibre kilometres, sheath kilometres and cable kilometres. These can be significantly different where, for example, multiple cables are laid along the same trunk route or there are multiple fibres in a sheath. Moreover, none of these measures take account of the practical operational bandwidth. The geographic and demographic characteristics of countries should also be taken into account in making international comparisons. Clearly the geographic size and demographic distribution of a country influences fibre deployment. All these factors make the deployment of optical fibre a very problematic indicator. It is, nevertheless, an important indicator of network modernisation.

To allow international comparison on the basis of the limited data available, countries are compared in terms of the rate of deployment during the 1990s (compound annual growth rate (CAGR) 1990-92 in whatever measure is used in that country). This allows comparisons to be made even though the standard measures used in different countries are different. The main shortcoming of this indicator is that countries which start from a low base will appear to be deploying fibre faster than countries in which fibre deployment was already well advanced in 1990. The United States, Canada and Australia are disadvantaged in this way, while Portugal and Turkey are advantaged. Nevertheless, this indicator offers a first approximation to fibre deployment levels for international comparison.

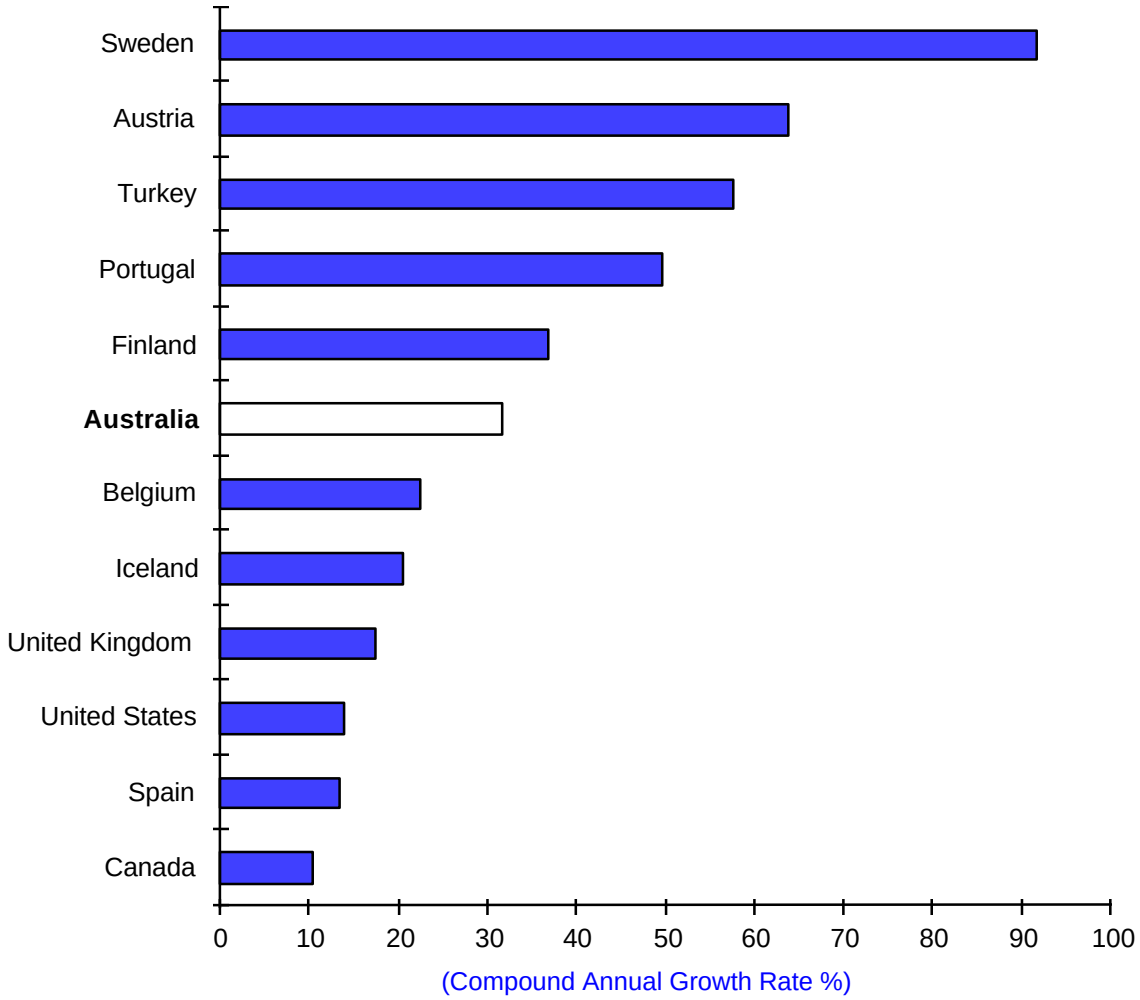
Australia performs relatively well in terms of fibre deployment with a CAGR of fibre deployed in the network of 32 per cent 1990-92, and ranked 6th among the 12 countries for which data are available.

Table 4.7 Optical Fibre Kilometres and rate of deployment

	1990	*1991*	*1992*	*1993*	*1994*	*CAGR % 1990-92*
Australia[5]	467 461	726 712	1 065 989	1 434 382	1 640 287	32
Austria	5 832	12 021	25 689	-	-	64
Belgium	14 000	24 740	25 640	-	-	22
Canada[2]	75 702	91 219	102 155	-	-	11
Denmark	-	-	-	-	-	-
Finland	47 915	76 953	122 699	-	-	37
France	-	-	-	-	-	-
Germany	-	-	-	-	-	-
Greece[3]	-	500	500	-	-	-
Hong Kong	-	-	-	-	-	-
Iceland	9 166	12 582	16 030	-	-	20
Ireland	3 500	7 000	-	-	-	-
Italy	-	-	-	-	-	-
Japan	-	-	-	-	-	-
Korea (Rep. of)	-	-	-	-	-	-
Luxembourg	-	-	-	-	-	-
Malaysia[5]	-	6 400	10 300	-	-	-
Netherlands[3]	-	-	10 000	-	-	-
New Zealand	-	-	1 000	-	-	-
Norway	-	8 500	10 000	-	-	-
Portugal	3 960	6 681	13 251	-	-	50
Singapore	-	-	-	-	-	-
Spain[3]	15 131	20 290	22 056	-	-	13
Sweden	3 835	12 500	27 000	-	-	92
Switzerland	-	100 250	136 252	-	-	-
Taiwan, China	-	-	-	-	-	-
Thailand	-	-	-	-	-	-
Turkey[3]	35 000	74 500	137 000	-	-	58
United Kingdom[3]	1 441 000	2 045 000	2 337 000	-	1 930 800[6]	17
United States[4]	5 342 699	6 736 211	7 916 470	-	-	14

(1) Cable Kilometres
(2) Route Kilometres
(3) Kilometres
(4) Fibre Miles
(5) Fibre Kilometres, Telstra only
(6) BT only
Sources: OECD 1994, and PTO Annual Reports.

Figure 4.5 Rate of Optical Fibre Deployment, 1990-92



Sources: OECD 1994, and PTO Annual Reports. BIE Chart.

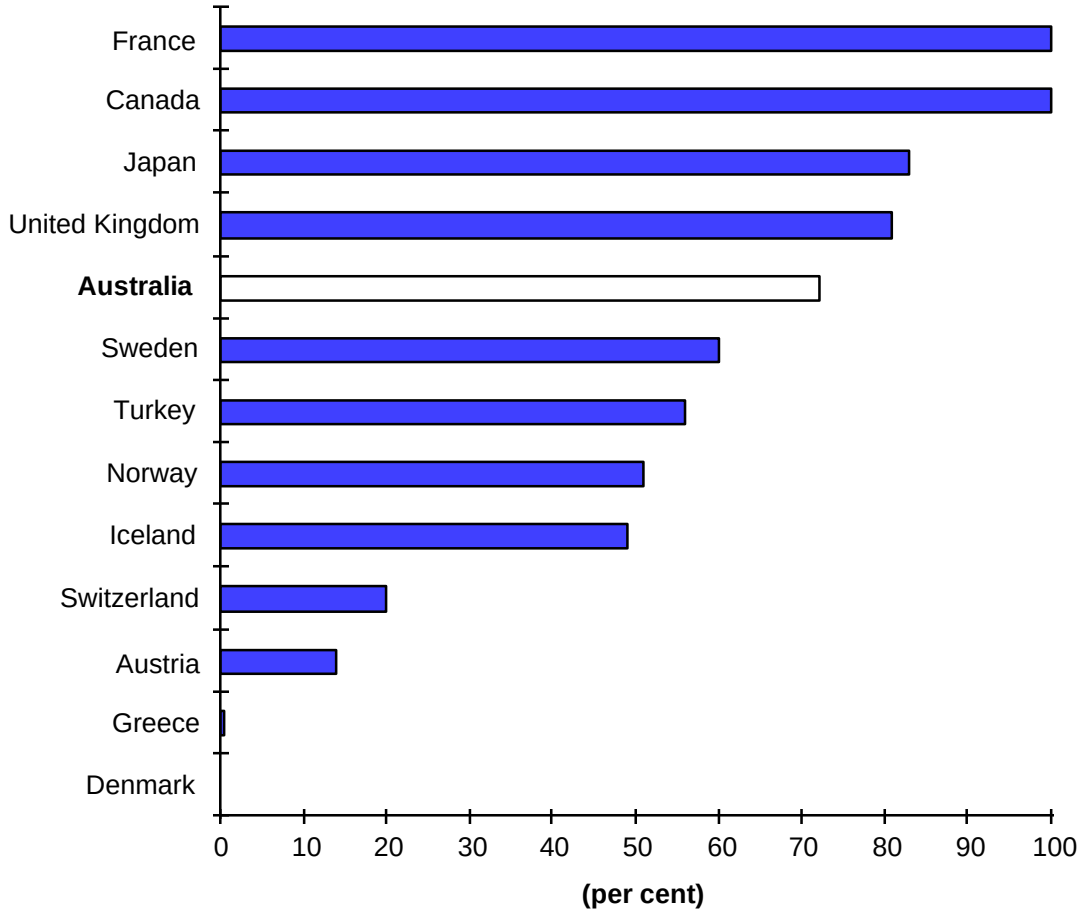
Availability of Itemised Billing

Data relating to customer complaints about telecommunications services indicates that the usual concerns are either faults or billing. Itemised billing allows customers to scrutinise accounts and businesses to manage their telecommunication requirements. The percentage of customers receiving itemised accounts, or the option of receiving such accounts, is included as an indicator because it is vital to informed telecommunications user choices and the building of user trust in the reliability of the network and in the carrier.

Details on the percentage of customers served by itemised billing, and the potential service availability of itemised billing in the countries for which data are available are provided in Table 4.8 and Figure 4.6. In December 1992, 72 per cent of Australian customers were provided with itemised accounts, increasing to 81 per cent in December 1993 and 90 per cent in December 1994. For those

countries for which data are available, Canada, with 100 per cent of customers served with itemised billing, was the only country to perform better than Australia on this indicator.

Figure 4.6 Availability of Itemised Billing, 1992



Source: OECD 1994.

When interpreting these results it is important to be aware of international differences in the definition of itemisation. In Australia, for example, itemisation is currently only available for long distance, international and some other special call types, and does not yet include local calls. There are also national differences in the implementation of itemisation whereby it is provided to customers in some countries automatically, while being supplied only on request and charged for in others. In Australia itemisation is automatically made available to all customers, such that customers served and availability are the same.

Table 4.8 Availability of Itemised Billing, (per cent)

	Customers Served			Availability		
	1992	*1993*	*1994*	*1992*	*1993*	*1994*
Australia[1]	72	81	90	72	81	90
Austria	-	-	-	14.0	-	-
Belgium	-	-	-	-	-	-
Canada	100	-	-	100	-	-
Denmark	0	-	-	0	-	-
Finland	-	-	-	-	-	-
France	13.5	-	-	100	-	-
Germany	-	-	-	-	-	-
Greece	-	-	-	0.5	-	-
Hong Kong	-	-	-	-	-	-
Iceland	1.1	-	-	49.0	-	-
Ireland	-	-	-	-	-	-
Italy	-	-	-	-	-	-
Japan	-	-	-	83.0	-	-
Korea (Rep. of)	-	-	-	-	-	-
Luxembourg	-	-	-	-	-	-
Malaysia	-	-	-	-	-	-
Netherlands	-	-	-	-	-	-
New Zealand	-	-	-	-	-	-
Norway	-	-	-	51.0	-	-
Portugal	-	-	-	-	-	-
Singapore	-	-	-	-	-	-
Spain[2]	-	-	-	-	-	-
Sweden[3]	-	-	-	60.0	-	-
Switzerland	2.6	-	-	20.0	-	-
Taiwan, China	-	-	-	-	-	-
Thailand	-	-	-	-	-	-
Turkey	6.0	-	-	56.0	-	-
United Kingdom	-	-	-	80.7	-	-
United States	-	-	-	-	-	-

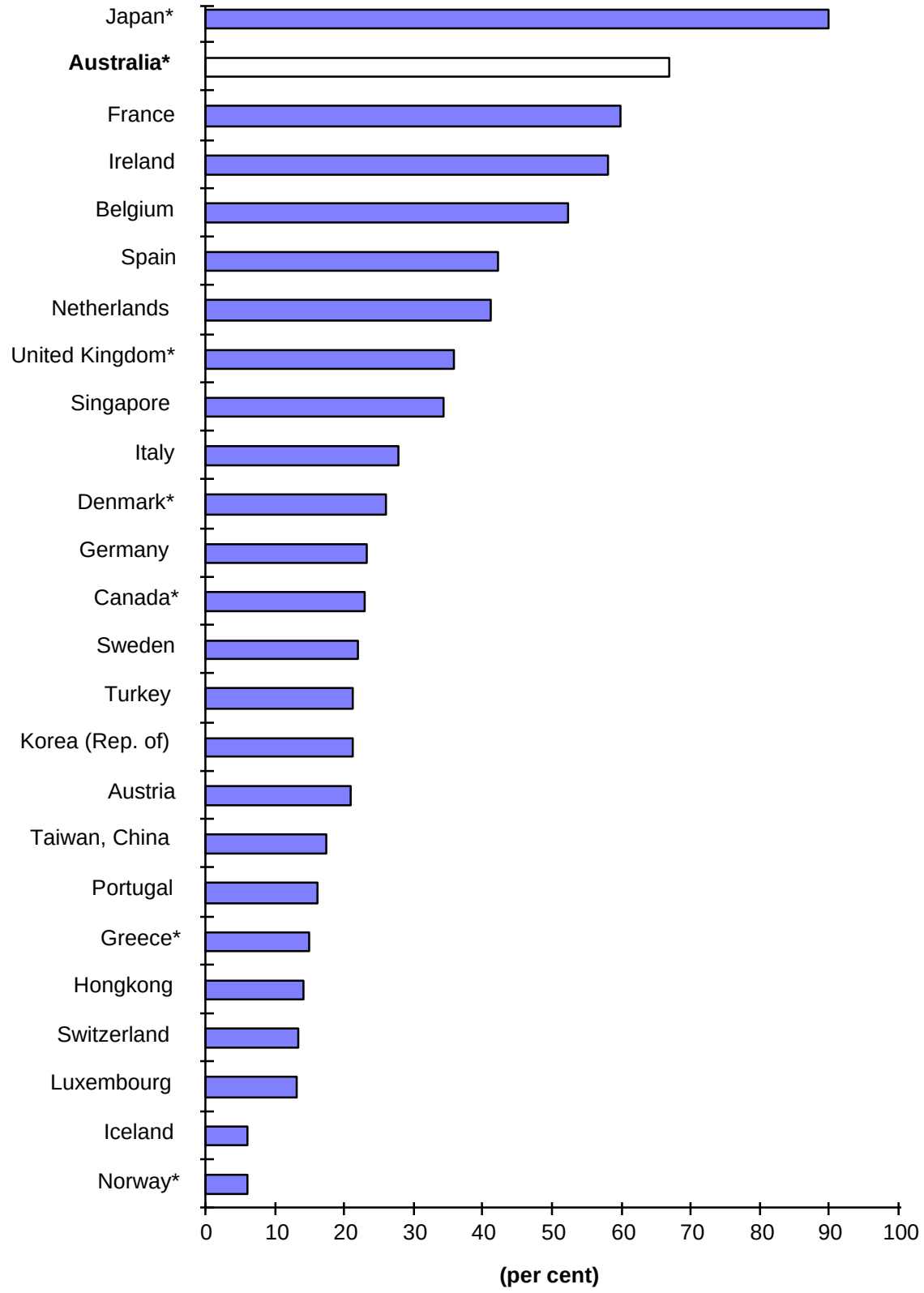
1. Telstra estimates as at December of that year.
2. Services being introduced by Telefonia in 1994 with a goal of 100 per cent coverage by 1997.
3. Service is being introduced by Telia during 1994. The figure of 60 per cent refers to Telia. Tele-2 served 100 per cent of its customers with itemised bills in 1993.

Sources: OECD 1994, and Telstra.

The Proportion of Payphones that are Cardphones

One recently emerging indicator is the proportion of payphones that are cardphones. The use of phonecards has been an important development because it brings users new service possibilities. Australia, with 67 per cent of public payphones as cardphones, performed well on this indicator, ranking second among the 25 countries for which data are available for 1992. Japan ranked first, with 90 per cent of payphones as cardphones. (See Table 4.9 and Figure 4.7).

Figure 4.7 Percentage Payphones that are Cardphones, 1992



* OECD estimate.
Sources: ITU 1994 and OECD 1994.

Table 4.9 Percentage of Payphones that are Cardphones

	1990	*1992*
Australia[1]	-	67.00
Austria	-	20.93
Belgium	40.20	52.21
Canada[1]	-	23.00
Denmark[1]	-	25.90
Finland	-	-
France	-	59.83
Germany	-	23.30
Greece[1]	-	15.00
Hong Kong	8.44	14.26
Iceland	4.82	6.18
Ireland	-	58.06
Italy	-	27.80
Japan[1]	-	90.00
Korea (Rep. of)	13.69	21.10
Luxembourg	6.80	13.09
Malaysia	-	-
Netherlands	21.96	41.24
New Zealand	-	-
Norway[1]	-	6.00
Portugal	-	16.17
Singapore	23.39	34.27
Spain	0.90	42.10
Sweden	-	21.88
Switzerland	-	13.37
Taiwan, China	4.17	17.52
Thailand	-	-
Turkey	4.21	21.13
United Kingdom[1]	-	35.90
United States	-	-

1. OECD estimates

Sources: ITU 1994 and OECD 1994.

4.3 Summary

Quality of service indicators reveal that Australia's local call failure rates continue to be above those for Japan, the United Kingdom and Canada, and long distance call failure rates are considerably higher than those for the United Kingdom and the United States. Austel estimates for call failure rates in Australia in 1993 and 1994 suggest that there has been some improvement in the reliability of the network since the introduction of competition. Australia's performance in respect of IDD completion rates is also somewhat disappointing. With a completion rate of 57.5 per cent in 1992, Australia's performance was below that of the United States, Japan, the United Kingdom and Canada, but marginally better than that of New Zealand. The evidence suggests that Australia's performance on call completion/call failure was some way below international best practice in 1992, but has improved since then. Australia also performs relatively poorly on fault clearance, ranking 15th out of the 19 countries in 1992 for which data are available. This suggests that there is scope for improvement in this area too. In terms of cellular mobile call drop-out Austel reports a declining call drop-out rate of 3.8 per cent in 1994 at the national level, and notes that mobile drop-out in

Sydney has occasionally exceeded the internationally accepted performance standard of 5 per cent during the first half of 1994.

Table 4.10 Summary of Quality of Service and Innovation Indicators

	Year	*Best Observed*	*Worst Observed*	*Australia Ranked*
IDD Completion Rates	1992	United States	Greece	15th of 24
Fault Clearance	1992	Netherlands	Taiwan, China	15th of 19
Mobile Penetration	1994	Sweden	Turkey	8th of 30
Digitalisation	1993	Hong Kong	Austria	23rd of 30
Optical Fibre Deployment	1990-92	Sweden	Canada	6th of 12
Itemised Billing	1992	Canada/France	Denmark	5th of 13
Proportion Cardphones	1992	Japan	Norway	2nd of 25

Source: BIE.

Examining indicators of innovation reveals that Australia's performance on the penetration of cellular mobile is above average. However, Australia ranked well below most comparable countries in terms of digitalisation of fixed network mainlines in 1993. It would seem that significant investment in modernisation is required if Australia is to catch up with international best practice in respect of network digitalisation.

Australia performs reasonably well in terms of optical fibre deployment, ranking 6th out of the 12 countries for which data are available in 1992. While great care must be taken in interpreting such a poor indicator, it seems apparent that Australia is among the leading countries in fibre deployment.

Australia performs relatively well in terms of the availability of itemised billing, and the proportion of public payphones that are cardphones, ranking 5th of 13 and 2nd among the 25 countries for which data are available in 1992, respectively.

The evidence suggests that Australia is performing reasonably well, but below international best practice on most quality of service indicators. Overall, Australia's performance in terms of indicators of innovation is also relatively poor. It may be that some increase in network investment is required, as well as greater attention to innovation opportunities, if Australia is to move towards international best practice on such indicators.

Chapter 5 Operational Efficiency

Improved operational efficiency in the use of capital and labour is an important goal of corporatisation, deregulation and the introduction of competition. Productivity reflects the relative efficiency with which resources are used to produce output of value in the market, and is measured as the ratio of an index of outputs to an index of inputs.

There are difficulties in choosing measures of output and input that accurately reflect the operations of any business, and a variety of measures are presented in this report as no single measure provides a complete picture. Taken together, however, these productivity indicators give an overall impression of efficiency levels and changes.

Partial productivity measures focus on output per employee input and output per unit capital input - labour and capital productivity, respectively. Revenue per employee, revenue per line and lines per employee are commonly used partial productivity indicators in telecommunications, and for the purposes of comparability with previous work on productivity the analysis begins with these indicators.

Partial productivity indicators need to be interpreted with caution because of changing input mixes. For instance a rapid improvement in observed labour productivity may simply result from substituting capital for labour. To get an accurate impression of overall productivity it is necessary to look at all outputs and all inputs, and to gain a more comprehensive impression of efficiency differences we construct a multifactor productivity model for international comparisons and then construct a total factor productivity model for Telstra Australia in sections 5.2 and 5.3, respectively. The multifactor productivity analysis examines outputs in relation to labour and capital inputs, while the total factor productivity analysis also includes other inputs.

5.1 Traditional Productivity Indicators

Revenue per employee, lines per employee and revenue per line are measures commonly used as partial productivity indicators for telecommunications operations. Previous studies have used mainlines as the measure of network access paths, but because of the increasing importance of cellular mobile telephony mobile network access paths and mainlines are used in the calculation of ‘lines’ throughout this study.

Revenue Per Employee

Revenue per employee is defined as the ratio of total revenue derived from providing telecommunications services to the number of full-time equivalent employees. While there are a

number of caveats to be borne in mind (as discussed below), revenue per employee is commonly used as an indicator of labour productivity.

In 1993 Australia ranked 19th among the 27 countries for which data are available in terms of telecommunications revenue per employee, up from 25th out of 30 in 1990. While Australia's revenue per employee has increased, it is a case of having to run to keep up. Australia's revenue per employee was below the OECD and sample averages in 1992, suggesting that labour productivity was relatively low. However, a number of caveats apply.

First, as deregulation and liberalisation proceeds the ITU/OECD statistics, which tend to capture public sector activity, cover less than the total picture. In so far as there may be different combinations of labour, capital and other inputs in the private and public sectors, such indicators as revenue per employee are becoming less representative of the overall labour productivity situation in telecommunications. Indeed it seems likely that were all private sector activity captured, labour productivity improvements would be greater than are reflected in the official statistics.

Second, there is an increasing tendency in telecommunications organisations that are restructuring, and among start-up competitor enterprises, to contract out. Telecom New Zealand, which has cut its workforce from more than 20,000 in the early 1980s to less than 9,000 today, in part through contracting out, and Optus Communications in Australia, which has outsourced much of its activity as a way of allowing it to develop more quickly than would otherwise be possible, are among the major examples. An indication of the importance of contracting out to labour productivity indicators can be gained by comparing Telstra and Optus. In the year to June 1993 Telstra reported revenue per employee of $A186,000, compared to Optus's $A610,000 (IBIS 1994). Efficiency factors notwithstanding, this difference is due in large part to differences in operational strategies which see Optus contracting out a significant proportion of its activity.

Third, revenue per employee is affected by the balance of traffic between relatively lucrative international traffic and local traffic (notable in the cases of Switzerland and Luxembourg where international traffic is high).

Given the coverage of ITU/OECD statistics, revenue per employee gives a reasonably accurate picture of the rate of change and the relative position of Australia compared to its international counterparts in the provision and operation of public telecommunications infrastructure. It is likely to understate the rate of change (efficiency gains) in countries with liberalised/competitive regimes, because of the statistical focus on public sector telecommunications operators (PTOs).

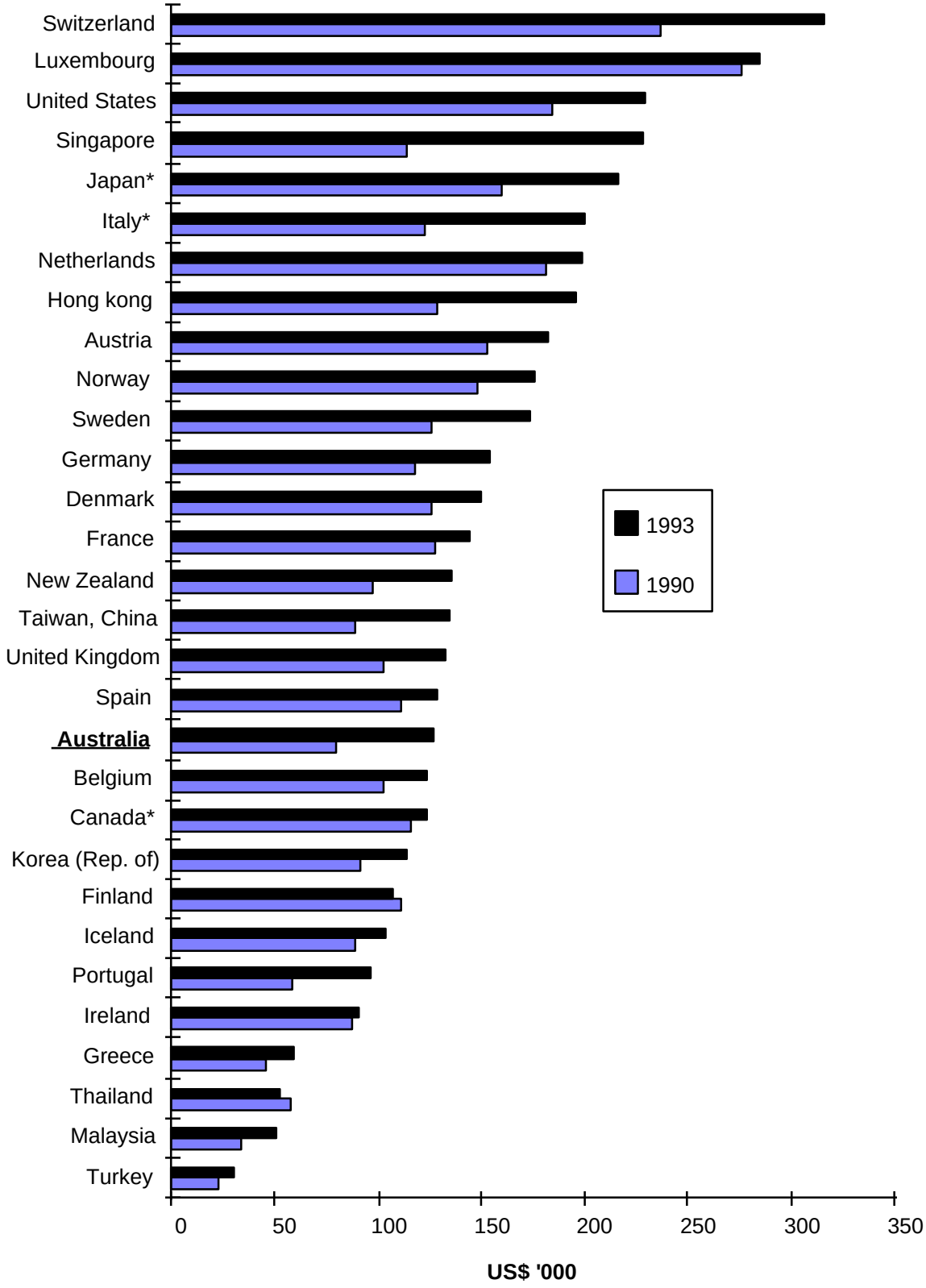
Table 5.1 Telecommunications Revenue per Employee, (US$ '000)

	1990	*1991*	*1992*	*1993*
Australia	79.78	88.57	127.00	126.50[a]
Austria	153.22	166.33	179.51	181.88
Belgium	102.45	101.80	119.84	123.89
Canada	116.14	123.09	123.34	-
Denmark	125.90	131.43	149.48	150.11
Finland	110.73	112.76	123.70	107.33
France	127.79	131.44	149.16	144.41
Germany	118.36	124.15	149.57	154.45
Greece	45.95	45.93	54.39	59.06
Hong Kong	128.27	153.02	176.00	195.69
Iceland	88.55	90.44	103.71	103.23
Ireland	88.14	88.14	99.69	90.44
Italy	123.29	178.66	200.25	-
Japan	160.23	184.28	215.99	-
Korea (Rep.of)	91.50	105.59	106.56	113.74
Luxembourg	276.35	267.40	300.12	285.11
Malaysia	33.90	37.94	45.26	50.59
Netherlands	181.08	179.50	195.65	198.89
New Zealand	97.27	109.67	107.90	135.08
Norway	148.16	145.21	164.89	175.25
Portugal	58.78	69.06	85.62	96.82
Singapore	114.08	159.47	195.01	228.40
Spain	111.00	128.49	151.52	128.97
Sweden	125.58	145.91	176.60	173.44
Switzerland	237.15	243.36	281.40	316.21
Taiwan, China	88.69	103.52	121.04	134.64
Thailand	57.04	52.32	58.69	52.54
Turkey	22.90	24.75	28.17	30.50
United Kingdom	103.52	112.14	147.98	140.54
United States	184.34	195.18	207.20	229.41
Average	149.23	162.20	181.10	-
OECD average	151.23	164.23	183.43	-

[a] Revenue was sourced from Telstra's *Annual Report* , 1993 and employment from IBIS 1994.
Sources: ITU 1994, Telstra 1993 and IBIS 1994.

The countries showing the largest proportional increase in revenue per employee between 1990 and 1993 (including Singapore, Italy, Hong Kong and Switzerland) are, caveats in mind, those with the most rapid improvement in labour productivity. Australia is among the more rapid improvers. However, this indicator is subject to price and labour-shedding effects which suggests that there is a need for caution in interpretation.

Figure 5.1 Revenue per Employee (US$ '000)



* 1992 data used for 1993

Sources: ITU 1994, Telstra 1993 and IBIS 1994. BIE chart.

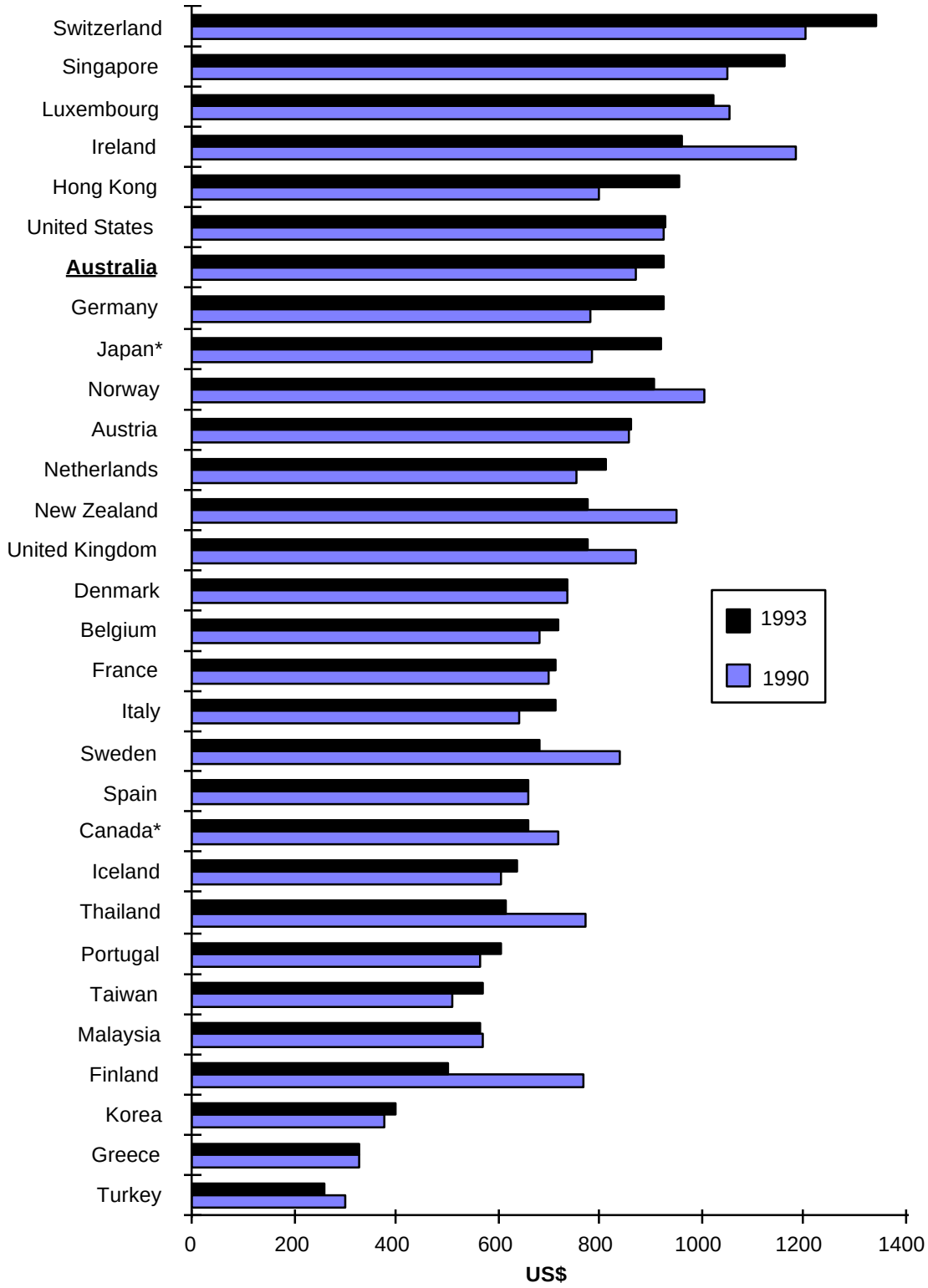
Revenue per Line

Revenue per line is one possible indicator of the efficiency of use of the capital invested in the network. As noted above, the rapid take-up of cellular mobile in recent years suggests that we must factor mobile access paths into calculations relating to the total number of telecommunications network access paths. Again lines are equivalent to fixed network mainlines plus cellular mobile telephone subscriptions.

In 1993 revenue per line was greater than US$ 1,000 in three countries: Switzerland, Singapore and Luxembourg. Australia ranked 7th out of the 28 countries for which data are available in 1993, down from 5th in the previous year, but up from 9th in 1990 among the 30 countries listed. The impact of national shares of relatively lucrative international traffic is again evident in revenue per line results, with Switzerland, Luxembourg and Singapore showing strongly. One reason for Australia's relatively good performance in terms of efficient use of the capital invested in the network (revenue per line) is a relatively high level of network utilisation. In 1992 Australia ranked 4th among OECD countries in terms of business telephone penetration, with 38 lines per 100 workers, just behind Canada at 39.8, the USA at 38.3 and Luxembourg at 38.2 (OECD 1994).

High revenue per line could also reflect high prices, and revenue per line should be considered in combination with price comparisons. The comparison of prices for a composite basket of telecommunications services shows that some of the better performing countries, such as Switzerland, Japan, Italy and Austria, in terms of revenue per line, also have some of the highest prices. Others, such as the Netherlands, Sweden and Norway, have prices below the OECD average. For these countries the results suggest that network usage, and thereby capital productivity is relatively high. In the light of this the declining revenue per line between 1990 and 1993 reflected in Figure 5.2 among Scandinavian countries, the United Kingdom and New Zealand may indicate that efficiency gains in those countries are being passed to customers through falling prices, and it is notable that Australia is *not* among those countries showing such a decline, although there is a decline from 1992 to 1993.

Figure 5.2 Revenue per Line (US$)



* 1992 data used for 1993.
Sources: ITU 1994 and Telstra 1993. BIE Chart.

Table 5.2 Telecommunications Revenue Per Line[a] (US$)

	1990	*1991*	*1992*	*1993*
Australia[b]	870.82	861.55	1027.14	925.57
Austria	855.80	880.06	902.01	862.41
Belgium	681.06	679.91	743.64	718.55
Canada	717.98	709.82	658.97	-
Denmark	735.07	760.82	802.91	734.94
Finland	767.28	709.66	637.46	500.43
France	701.72	696.15	763.45	714.58
Germany	781.03	833.93	949.30	922.71
Greece	326.84	302.44	323.17	326.86
Hong Kong	800.38	834.71	915.89	956.08
Iceland	604.36	600.10	664.54	637.95
Ireland	1184.35	1095.64	1123.00	960.05
Italy	643.20	686.39	740.25	714.52
Japan	787.48	850.64	920.41	-
Korea (Rep. of)	378.52	415.13	419.78	400.41
Luxembourg	1052.82	1053.56	1115.98	1024.25
Malaysia	569.08	561.18	581.66	565.45
Netherlands	754.91	758.86	836.49	810.70
New Zealand	953.20	950.23	814.62	777.39
Norway	1003.13	907.88	957.45	905.94
Portugal	565.90	588.53	635.13	607.12
Singapore	1048.71	1023.82	1116.28	1162.86
Spain	660.80	725.43	807.20	660.71
Sweden	841.14	878.34	914.62	680.09
Switzerland	1202.90	1211.84	1366.33	1340.97
Taiwan, China	509.54	537.28	561.49	571.10
Thailand	770.51	737.16	719.68	612.71
Turkey	299.33	274.01	262.19	259.90
United Kingdom	872.20	855.67	924.24	776.49
United States	922.89	936.04	927.21	926.91
Average	825.92	843.71	879.91	-
OECD average	836.13	854.56	891.66	-

[a] Lines are measured as mainlines plus mobile subscribers. [b] Revenue sourced from Telstra 1993.
Sources: ITU 1994 and Telstra 1993 and earlier issues.

Lines Per Employee

Lines per employee provides an indication of labour productivity relating to the construction, maintenance and operation of the network. Market liberalisation and the digitalisation of telecommunications networks are bringing reductions in employment levels in PTOs around the world, and should lead to productivity improvements in terms of lines per employee.

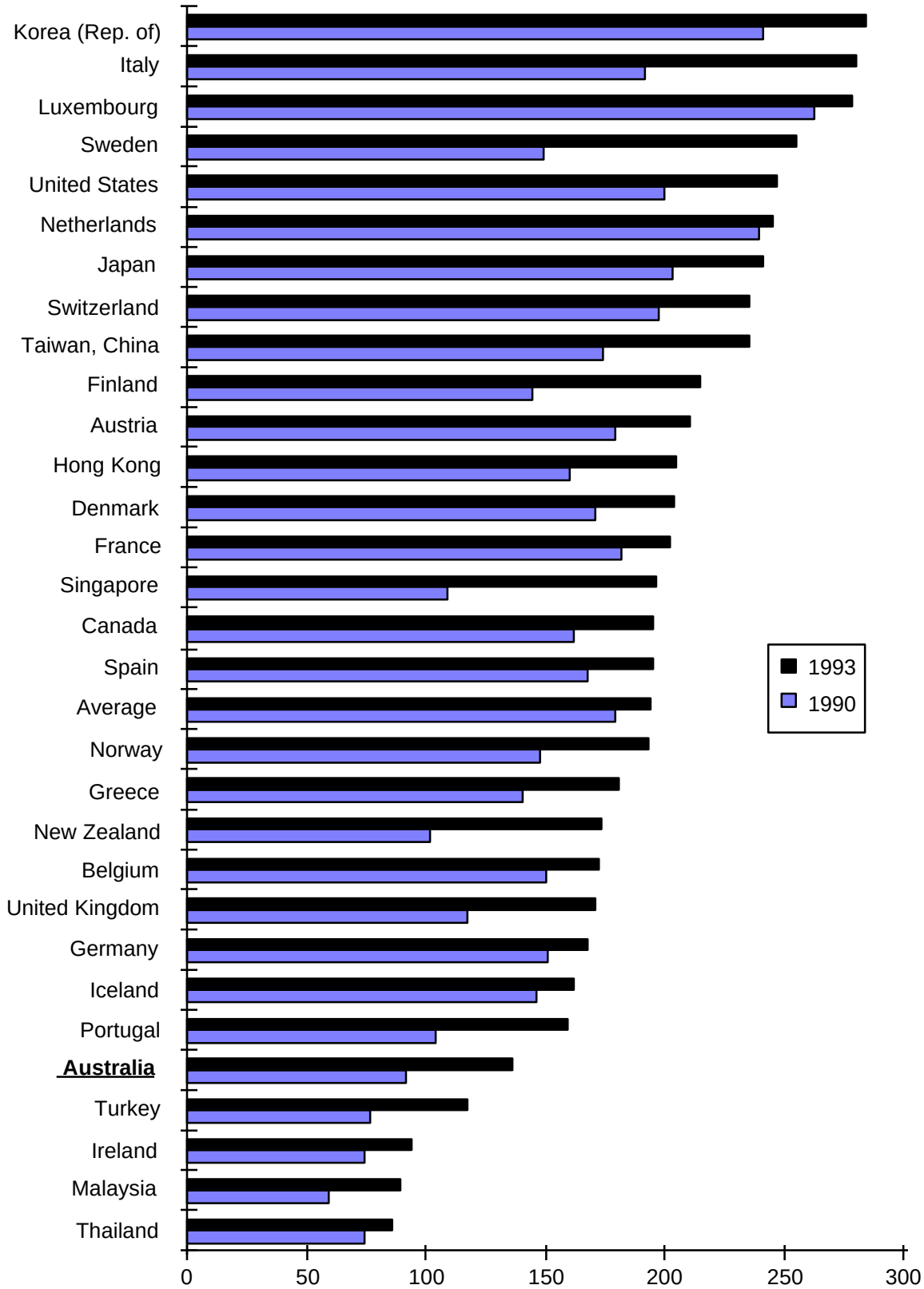
Australia ranked 26th out of the 30 countries listed in terms of lines per employee in 1993, having occupied the same position since 1990. The Republic of Korea, Italy, Luxembourg, Sweden and the United States are the best performers on this indicator. Contracting out is also an important factor in lines per employee measures, and the caveats discussed above apply. It is interesting to note that the countries that have experienced extensive PTO restructuring and job shedding in recent years, particularly the United Kingdom, New Zealand and Australia, still performed poorly on this indicator as recently as 1993, suggesting that their labour productivity was still relatively low despite these job losses.

Table 5.3 Lines per Employee[a]

	1990	*1991*	*1992*	*1993*
Australia	92	103	124	137
Austria	179	189	199	211
Average	179	191	205	194
Belgium	150	150	161	172
Canada	162	173	187	195
Denmark	171	173	186	204
Finland	144	159	194	214
France	182	189	195	202
Germany	152	149	158	167
Greece	141	152	168	181
Hong Kong	160	183	192	205
Iceland	147	151	156	162
Ireland	74	80	89	94
Italy	192	260	271	280
Japan	203	217	235	241
Korea (Rep. of)	242	254	254	284
Luxembourg	262	254	269	278
Malaysia	60	68	78	89
Netherlands	240	237	234	245
New Zealand	102	115	132	174
Norway	148	160	172	193
Portugal	104	117	135	159
Singapore	109	156	175	196
Spain	168	177	188	195
Sweden	149	166	193	255
Switzerland	197	201	206	236
Taiwan, China	174	193	216	236
Thailand	74	71	82	86
Turkey	77	90	107	117
United Kingdom	117	126	160	171
United States	200	209	223	248
OECD average	178	189	204	197

[a] Lines being mainlines plus mobile subscribers.
Source: ITU.

Figure 5.3 Lines per Employee



Source: ITU 1994.

Digitalisation of the network is commonly thought to be important for productivity improvement, and a number of the countries with relatively high levels of digitalisation perform relatively well (Korea, France, Luxembourg and others), but there are exceptions too. Allowing for a lagged effect, by comparing present lines per employee performance and levels of digitalisation in 1990, does not remove the exceptions. If time to adjust to a digital paradigm is a factor, it would appear that it takes more than three years. Digitalisation may be a necessary factor in underpinning efficiency improvements, but does not appear to be sufficient. Italy, Japan, the Netherlands and Switzerland perform relatively well using this measure, have relatively high wages compared to the sample of PTOs and are among the PTOs that employ the least staff relative to total national employment. Similarly, the US has relatively high wages and performs well using this measure. These findings suggest that it may take some considerable time to restructure and reskill the workforce to take advantage of the new technological opportunities, and some time to reap the full benefits of modernisation.

There are a raft of geographic and demographic factors affecting lines per employee levels, and there can be little doubt that a large country with a low population density would be disadvantaged in this comparison. However, comparative static performance does reveal a picture of Australia's performance relative to counterparts over the period 1990 to 1993, and it is notable that Australia is among those showing a considerable increase in lines per employee over that period.

These traditional partial productivity indicators are subject to numerous caveats and should be interpreted cautiously. Nevertheless, Australia's labour productivity would appear to have been relatively low by the standards of this sample of comparable countries, while capital productivity appears to have been considerably better.

5.2 Multifactor Productivity

Multifactor productivity analysis involves examination of performance in the efficient use of multiple factor inputs and outputs. In constructing multifactor productivity (MFP) comparisons labour and capital are taken as the two inputs, and the telecommunications network (lines) and services based on it (calls) as the outputs. The number of public telecommunications operator (full time equivalent) employees is used as the measure of labour input, and accumulated capital investment expenditure 1981-92 as an indicator of the dollar value of network capital stock as the measure of capital input. These inputs represent the bulk of telecommunication operators' costs and provide an indication of overall performance.

The number of lines (being both fixed network mainlines and cellular mobile subscribers) is used as the indicator of the production of the network (the dimension of output that represents access to the network), and the number of calls as the indicator of the production of telecommunications services. The multifactor productivity (MFP) index is constructed as the ratio of the aggregate of these outputs to the aggregate of inputs.

The MFP approach outlined in this section is the most comprehensive achievable given the limits of currently available comparable international data. In view of these limitations the results of this analysis should be interpreted with caution. The MFP approach used herein is an extension (in terms of both methodology and country coverage) of work originally carried out by McKinsey (1992). Before discussing the MFP analysis we examine the physical measures of labour and capital productivity used in subsequent analysis.

Table 5.4 Physical Productivity Indicators, 1992

	Lines per Employee	*Calls per Employee*	*Calls per US$ '000 capital stock*
Australia	124	164 213	629
Canada[a]	187	514 305	1 416
Denmark[a]	186	276 582	844
Finland	194	244 720	666
Germany	158	199 068	352
Italy	271	342 642	474
Japan	235	309 423	422
Netherlands	234	268 715	657
Switzerland	206	186 628	211
United Kingdom[b]	160	187 700	728
United States[c]	223	744 965	2 103

[a] Call data from TeleGeography estimates.
[b] Call data from Oftel 1993 for BT with Mercury calls estimated from market share.
[c] US call data adjusted to exclude calls provided by operators reporting to the FCC but not included in ITU United Sates data.
Sources: ITU 1994, Oftel 1990, TeleGeography Inc. 1993 and FCC.

Labour Productivity

Labour costs in telecommunications are relatively fixed, relating to the development and maintenance of the network much more than to the level of its use. The primary labour cost driver is the size of the network. Hence, *lines per employee* plays the most important role in labour productivity. For the relatively small proportion of labour inputs deployed in traffic-related operations, usage is the most important driver and *calls per employee* is used as the secondary indicator.

Lines Per Employee

As discussed in section 5.1 above, Australia ranked 26th out of the 30 countries listed in terms of lines per employee in 1993, suggesting that labour productivity was rather low at that time. Among the more limited sample of countries for which we have sufficient internationally comparable data relating to 1992 for multifactor productivity analysis, Australia ranks 11th out of 11.

Calls Per Employee

Calls per employee is defined as the ratio of the total number of calls (including mobile calls) to the total number of full-time equivalent employees. On this measure Australia ranks 11th among the 11 countries for which call data are available for 1992.

Calling behaviour varies significantly across countries, because of differences in telephone penetration rates (existing and historical), geography (distance, climate, population density), the amount of advertising expenditure, the reliability of the system in terms of call completion and the penetration of particular types of customer premises equipment (answering machines, facsimile machines etc.). To some extent the calls per employee measure reflects differences in consumer preferences. Nevertheless, per person Australians make about the same number of calls as do the Japanese per person, and yet Australia's performance in terms of calls per employee is well below that of Japan.

On both these measures of labour productivity, lines and calls per employee, Australia performed relatively poorly in 1992. While there are a number of factors that may contribute to this poor performance and caveats apply, it seems that Australia's labour productivity was relatively poor by international standards in 1992, and there would appear to have been considerable scope for improvement.

Capital Productivity

National (domestic) telecommunications is a capital-intensive business with high fixed costs involved in network construction and maintenance. High usage of the network is the key to economical utilisation of the invested capital. *Calls per dollar of network capital stock* can, therefore, be used as an indicator of capital productivity.

Calls per Dollar of Network Capital Stock

There are difficulties involved in estimating capital stock values. Capital stock is not consumed in the current period the way other inputs are. Capital is durable and is typically used over a number of years. Estimates of the value of capital stock must account for this gradual consumption over time. International differences in accounting practices can also affect the valuation of capital assets, and make international comparisons difficult to interpret. In view of these difficulties, and of those associated with obtaining comparable international data, much of which is considered to be commercially sensitive, we have used an accumulated capital investment series as the basis for an estimate of capital stock.

Capital stock is estimated as the accumulation of a 12 year investment series for the years 1981 to 1992, converted to US dollar exchange rates to make the figures comparable across countries. The assumed life of 12 years for telecommunications assets is based on the best approximation to known asset values for Australia, and accords with Swan (1990) and Lawrence et al (1992) estimates of the average life of telecommunications assets in Australia.

An examination of calls per dollar of network capital stock reveals that Australia ranks 7th out of the 11 countries for which data are available for 1992. There are a number of factors effecting these findings.

As noted above, calling behaviour varies significantly across countries, because of differences in telephone penetration rates (existing and historical), geography (distance, climate, population

density), the amount of advertising expenditure, the reliability of the system in terms of call completion and the penetration of particular types of customer premises equipment (answering machines, facsimile machines etc.). And to some extent the calls per employee measure reflects differences in consumer preferences.

A number of studies have addressed population density as a factor influencing performance. The OECD (1990a, p.168) tested the thesis that it was easier to serve a clustered, urbanised population in a flat country, than a dispersed rural population in a mountainous country. Population density per square kilometre (which ranges from 2 in both Australia and Iceland to 393 in the Netherlands) was tested as a variable, and resulted in a weak correlation (R squared=0.010) between low prices and a high population density. This correlation improved (R squared=0.238) when an index of urbanisation was used for smaller countries.

A study by Ergas, Ralph and Sivakumar (1990) found that there was little relationship between subscriber density and labour productivity, with the correlation between the two not statistically significant. They also found that even if there was a relationship between the two, the population density in the inhabited parts of Australia was not significantly lower than the inhabited parts of Canada and the United States. An examination of the extent to which cost disparities may be influenced by Australia's relatively low overall population density suggested that capital requirements may be greater in low density networks because the average subscriber loop would typically be longer and exchanges smaller. Operating and maintenance costs may also be higher with higher break-down rates, and operating economies of scale more difficult to achieve. The study analysed detailed cost data for 50 of the United States and found a statistically significant relationship, with costs per access line decreasing by about 1 per cent for every 10 per cent increase in the number of lines per square mile. A regression analysis undertaken by the BTCE (1989) on data from a sample of 60 exchanges found that both customer density and distance from the exchange were significant variables influencing the average customer access network installation cost per line. It would appear, therefore, that there may be some relationship between the cost per access line and subscriber density, and Australia may be disadvantaged because of its low average population density.

On the other hand, analysis by McKinsey (1992), using data from 50 Local Exchange Carriers in the United States and applying a simple regression between density and productivity, found that density is not important when it comes to labour productivity. McKinsey also found that when productivity is measured in terms of the ratio of access lines to operating costs, network topography is an influential factor, but the importance of network topography to labour productivity is unclear.

What these analyses show is that the impacts of geographic and demographic factors are more complex and varied than may at first seem to be the case, and that evidence for any particular significant influence is difficult to substantiate. Hence, caveats notwithstanding, Australia's labour productivity in 1992 would appear to have been relatively low, while capital productivity was somewhat higher.

Multifactor Productivity

The telecommunications industry produces both the network (lines) and services (calls) outputs by combining labour (full time equivalent employees) and capital (estimated dollar value of network capital stock) inputs. Since it is not meaningful to simply add these quantities directly the Bureau has used the multilateral indexing procedure to calculate an MFP index. The multilateral index method in a means of estimating a weighted sum of the rates of change of the component output or input quantities.

It is defined in log-change form as:

$$\ln\left(\frac{MFP_m}{MFP_n}\right) = \sum_i \frac{1}{2}\left(R_{im} + R_i^*\right)\ln\left(\frac{Y_{im}}{Y_i^*}\right) - \sum_i \frac{1}{2}\left(R_{in} + R_i^*\right)\ln\left(\frac{Y_{in}}{Y_i^*}\right) - \sum_j \frac{1}{2}\left(S_{jm} + S_j^*\right)\ln\left(\frac{X_{jm}}{X_j^*}\right) + \sum_j \frac{1}{2}\left(S_{jn} + S_j^*\right)\ln\left(\frac{X_{jn}}{X_j^*}\right)$$

Where: m and n are adjacent observations, there are i outputs (Y), j inputs (X), the Rs are output revenue shares, and the Ss are input cost shares.

Refer to Appendix II for a description of the methodology.

While it is usual to use revenue shares to weight output quantities when calculating multifactor productivity, telecommunications charges do not accurately reflect the cost of providing the network and related services. Had the process of rate rebalancing been completed, and the ratio of fixed and usage charges come to reflect full attributable costs, it would be possible to weight according to the ratio of fixed to variable costs. Clearly, however, these conditions do not apply, and it would not be accurate to weight according to the ratio of fixed to usage revenue. In the light of this the output index in the analysis presented herein is constructed by combining *lines* and *calls* weighted according to the division of labour costs between fixed labour costs (relating to the construction and maintenance of the network) and variable labour costs (relating to traffic levels).

McKinsey (1992, p.4) report that an analysis of FCC data for US carriers shows that in the late 1980s approximately 85 per cent of employees were engaged in the construction and maintenance of the access network and in maintaining the customer relationship, while 15 per cent were engaged in traffic-related functions, such as maintaining and operating the switches and providing directory services. Their analysis suggests an 85:15 weighting. There have, however, been considerable

changes in telecommunications since the late 1980s, and there are considerable differences between the US and other countries.

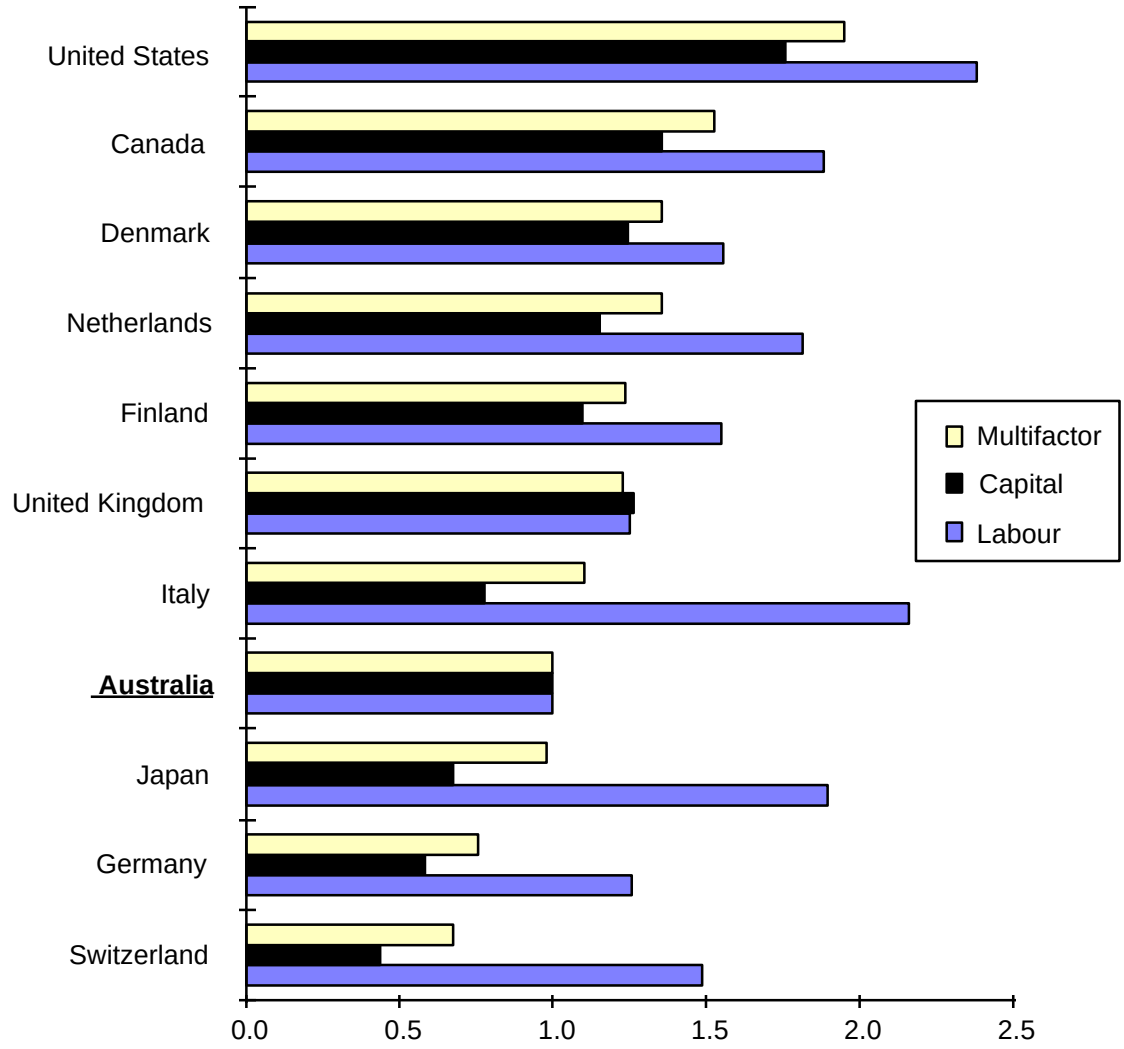
The rate of change, national differences in the rate of labour restructuring, differences between competitive and non-competitive environments and national differences in categorisation make generalisation difficult, and sufficient data do not exist to allow accurate estimates of fixed and variable labour proportions. Available data on the distribution of PTO employment in OECD countries show some marked variation. Australia is a case in point. Telstra reported 57 per cent of staff in network construction and maintenance and only 2 per cent in sales and marketing in 1992, while Optus reported 33 per cent in network construction and maintenance and 57 per cent in sales and marketing in 1993 (OECD 1994). These proportions reflect the inclination of Optus to contract out, functional and life-cycle differences between the organisations.

Notwithstanding these variations, and the fact that employment distribution data are available for only 9 countries, it is possible to use employment data to derive weightings. Taking network construction and maintenance as fixed labour, and distributing administrative employees in proportion to the balance of network construction and maintenance to non-network construction and maintenance, shows that there is an average distribution across the 9 countries of 55 per cent fixed and 45 per cent variable. This procedure understates the extent to which non-network construction and maintenance employees are engaged in network-related functions and support functions. An average of the two methods, taking these caveats into account, would suggest a 70:30 weighting.

Sensitivity analysis shows that there is no significant variation in results produced by adjusting the weighting ratio between the 85:15 and 55:45 limits suggested by these approximations. Hence an average of the two methods, a 70:30 weighting is the ratio used herein to calculate the output index.

The input index has been constructed as the sum of labour and capital, weighted by the ratio of 1992 labour costs to the value of the annual user cost of capital (derived as a proportion of the nominal capital stock allowing for depreciation, financing charges and capital gains (see Appendix II). The results of this multifactor productivity analysis are summarised in Table 5.5 and Figure 5.4, which shows output and input indexes, labour and capital productivity indexes and a multifactor productivity index for the 11 countries for which data are available for 1992.

Figure 5.4 Multifactor Productivity, 1992



Source: BIE Chart.

Table 5.5 Partial and Multifactor Productivity Indexes, 1992

	Output Index	*Input Index*	*Labour Index*	*Capital Index*	*Multifactor Index*
Australia	1.00	1.00	1.00	1.00	1.00
Canada	2.45	1.61	1.88	1.35	1.52
Denmark	0.38	0.28	1.56	1.24	1.35
Finland	0.35	0.28	1.55	1.10	1.24
Germany	4.10	5.43	1.26	0.58	0.75
Italy	2.76	2.50	2.16	0.78	1.10
Japan	6.77	6.93	1.89	0.67	0.98
Netherlands	0.83	0.61	1.81	1.16	1.35
Switzerland	0.45	0.67	1.49	0.44	0.67
United Kingdom	3.18	2.59	1.25	1.26	1.23
United States	23.35	11.96	2.38	1.76	1.95

Source: BIE.

Labour Productivity

Table 5.5 and Figure 5.4 show that Australia has the lowest labour productivity of the 11 countries listed. There are a number of factors that may explain relative performance in respect to labour productivity.

First, economies of scale. It is widely believed that telecommunications exhibits considerable economies of scale. Such economies would favour the United States and Japan, as the countries with the largest networks in this sample, and they rank 1st and 3rd respectively in terms of labour productivity, while Australia, with a relatively small network, ranks last. However, Germany and the United Kingdom also have relatively large networks, and yet they rank 9th and 10th respectively.

Secondly, population density is also thought to effect labour productivity potential, with a dispersed population in rural and remote areas costing more to service than an urban population. Such factors would disadvantage Australia, the United States and Canada among the countries in this sample, but we find that the United States ranks 1st and Canada 4th on labour productivity, while Australia ranks last.

Thirdly, the level of digitalisation. While digitalisation is seen as a key to increasing productivity there is no apparent correlation between the percentage of digital mainlines in 1993, or 1990 allowing for a lagged effect, in the available data (See Tables 4.7, 5.3 and 5.5). If there are productivity gains to be made from digitalisation it seems that the lead time may be substantial. It is interesting to note that a regression analysis of 50 United States Local Exchange Carriers (LECs) found a strong positive relationship between electrical analogue switching and labour productivity, and a negative relation between labour productivity and both electro-mechanical and digital switching (McKinsey 1992, p.10). This suggests that the primary existing technological base holds a major advantage over both older and emerging technological bases.

Fourth, economies of scope. Innovation in the mix and range of services creates new output mixes and productivity frontiers, and the strong productivity performance of the United States may be related to the greater range of services available. However, neither the strong performance of Italy, nor the relatively poor performance of the United Kingdom would appear to fit such an explanation.

Fifth, a quality of service-productivity trade-off. While it may be possible to ‘buy’ higher labour productivity with lower quality of service, the evidence relating to this sample of countries suggests that this is not an important factor. Indeed the United States, Japan and Canada, all near the top of the list in terms of labour productivity, are strong performers on quality of service indicators for the same period (refer to Chapter 4).

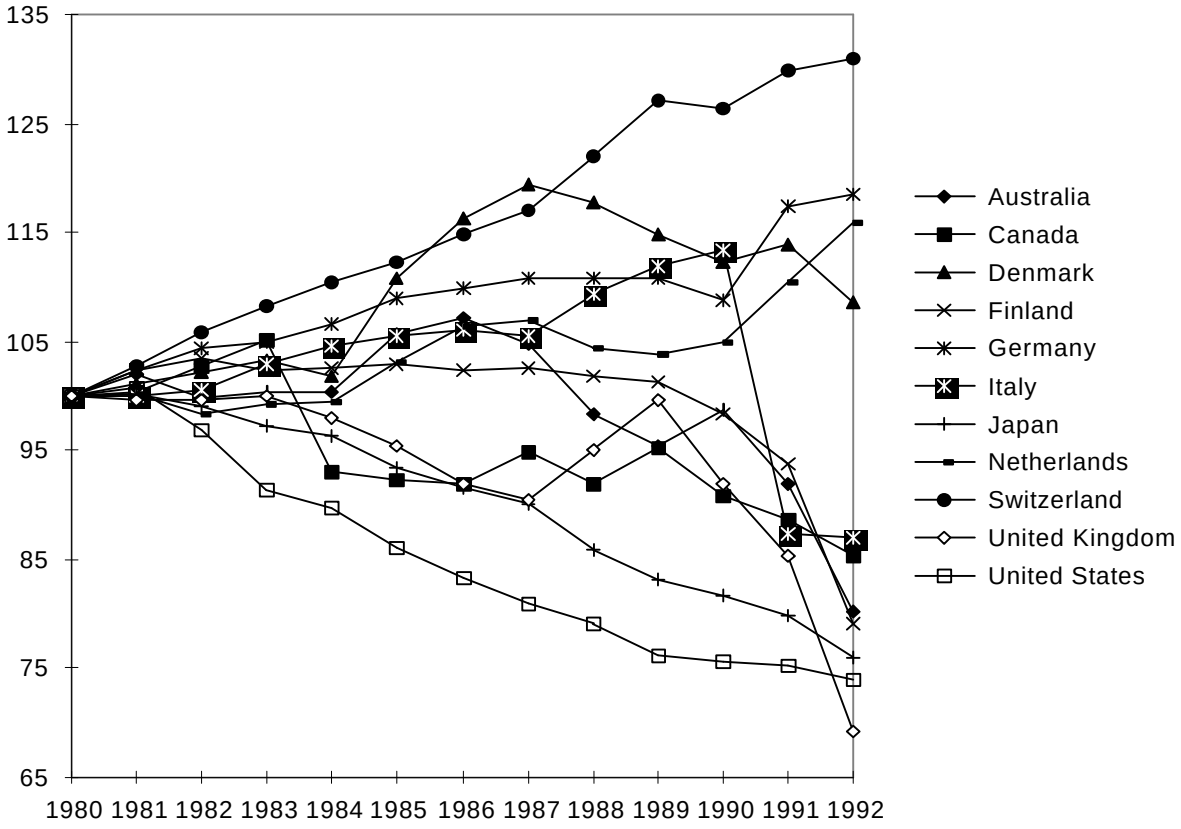
Finally, the organisation and management of labour may be related to productivity. While all the caveats relating to contracting out noted above apply, an analysis of labour trends in telecommunications in these countries is interesting. Examining telecommunications employment in the 11 countries over the period 1980 to 1992 (indexed with 1980 set to 100) shows that the countries with the steadiest and fastest falls in telecommunications employment levels are the United States, Japan and Canada, which ranked 1st, 3rd and 4th, respectively, in terms of labour

productivity in 1992 (Figure 5.5). This suggests that long-term labour restructuring may be a major factor contributing to labour productivity.

Moreover, Italy, which ranks second, has witnessed a precipitous fall in employment levels since 1990, although employment levels had been growing until then. There may be a lagged effect at work in the labour productivity result for Italy, whereby past labour inputs into the network are reaping delayed outputs. It is notable that in the analysis of revenue and lines per employee (Tables 5.1 and 5.3 above) Italy is amongst those countries making the greatest gains over the period 1990 to 1993. However, employment levels in the United Kingdom, Finland and Australia have also been falling quite rapidly since the late 1980s without such a noticeable effect on labour productivity. Moreover, Germany, the Netherlands, Switzerland and Denmark have experienced increasing employment levels, but are 'middle of the pack' performers in terms of labour productivity.

While changes in the organisation of labour are clearly important, the starting point is also influential. The relative performance of Japan and the United Kingdom in terms of labour productivity, for example, seems inescapably linked to the basic relation between employment levels and network size. In 1992 NTT in Japan operated a network twice the size of that of BT in the United Kingdom with only 20 per cent more staff (McKinsey 1992, p.11). Caveats notwithstanding, the relatively low labour productivity in Australia, the United Kingdom and Germany appear to be due in part to historically high staffing levels. Problems associated with reunification in Germany are also likely to adversely effect operational performance in Germany for some years to come.

Figure 5.5 Telecommunications Employment, 1980-92 (Indexed 1980=100)



Source: ITU 1994. BIE Chart.

Capital Productivity

Australia ranked 7th among the 11 sample countries in terms of capital productivity in 1992 (See Table 5.5, above). As already outlined, the main factors driving capital productivity as defined herein are capital investment (input) and calls (output) produced.

The capital productivity index is dependent, in part, upon the efficiency of the capital allocation and the phase of the investment life-cycle at the time of measurement. Investment decisions that see a temporary or long-term imbalance of investment between the access, switching and transmission elements of the network, or a push for infrastructure investment ahead of market demand for services, will have an adverse effect on capital productivity (McKinsey 1992, p.12).

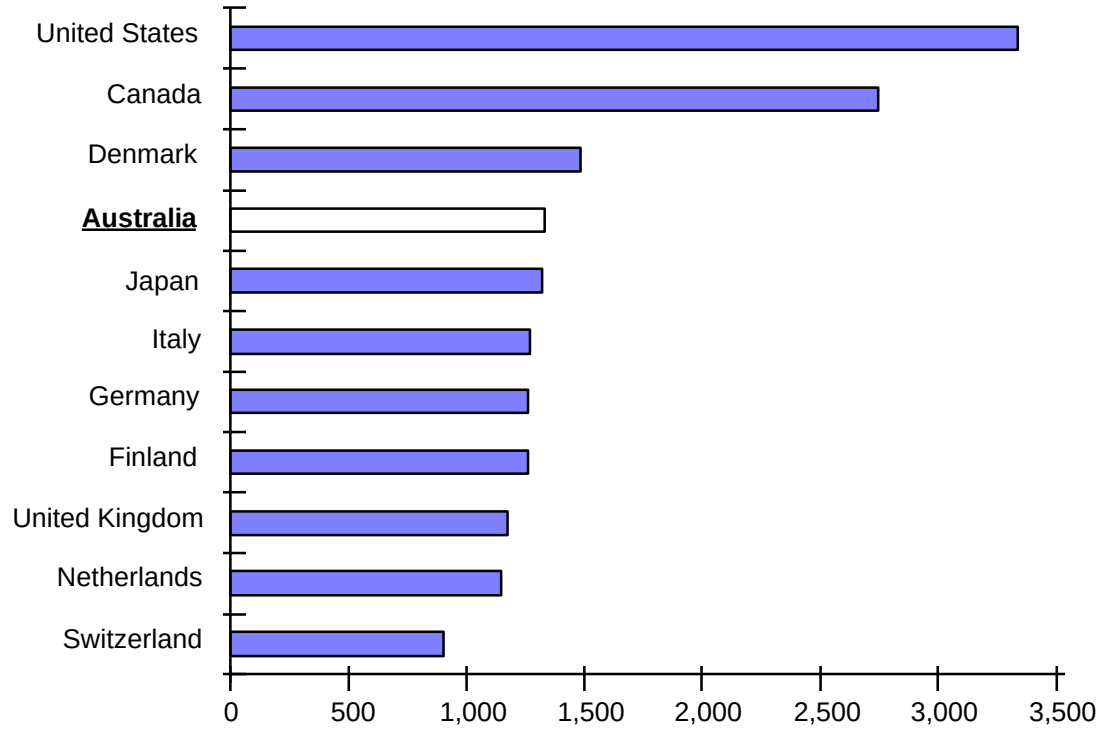
An example of the latter is Japan, where the Government is reputed to have pushed NTT into infrastructure investment ahead of demand (Salomon Brothers 1993, p.32). Such investment decisions may well be a factor in Japan's relatively poor capital productivity performance. Italy's similarly poor capital productivity may be due to the former circumstance, namely an imbalance of

investment due to relatively suddenly addressing a longer-term investment shortfall. Germany's relatively poor overall showing is related, in part, to the problems associated with reunification. Germany also suffers from an historically switch-intensive network topography in the west (McKinsey 1992, p.12).

Usage is also a key driver of capital productivity and, as noted above, traffic levels tend to be higher in the United States, Canada, Denmark and the United Kingdom (as indicated by calls per dollar network capital stock) than in the other countries. A comparison of calls per line shows that there is much higher network usage in the United States and Canada than in most of the other countries in the sample, and lower network usage in Switzerland than the rest (Figure 5.6). Usage levels among the other countries are quite similar. The level of usage would appear to be a major factor in explaining the strong capital productivity performance of the United States and Canada. Usage also explains Australia's relatively stronger capital productivity performance.

Countries with telecommunications operators aggressive in increasing demand are likely to enjoy greater capital productivity for their network investment dollar. Competition, rate rebalancing and pricing aimed at maximising demand are a key to increasing capital productivity. Price cutting for long distance and international, while maintaining or raising local call prices (the impact of price elasticities of demand and price cap regulation being taken into account) are likely to become increasingly evident in countries with competitive regimes. The resultant increase in capital productivity potential will contribute to improvements in operational efficiency. However, the tendency for new telecommunications carriers to duplicate the networks, for capital investment surges in specific areas creating investment imbalances and for labour restructuring and reskilling to lag investment in modernisation may result in some brake on the rate of increase in capital productivity in the short run.

Figure 5.6 Calls per Line, 1992



Source: ITU 1994.

5.3 Total Factor Productivity

In this section the economic performance of Telstra over the period 1979-80 to 1993-94 is assessed. This is done by estimating Telstra's total factor productivity (TFP) and economic rate of return earned on capital employed. Analysis is complicated by the fact that Telstra ceased publishing much of the data necessary for calculating TFP, and in some cases it is necessary to extrapolate data from past trends. Details of these estimations are discussed in Appendix III, while the description of the output and input measures used and an outline of the methodology appear below.

Prior to 1992 data for OTC and Telecom are combined, while data thereafter are for Telstra. OTC inputs and outputs are subsumed in the category 'other'. Sufficient data are not available to allow us to factor out OTC's payments to Telecom, and no attempt has been made to do so. On the basis of the limited data available the impact of this on the indexes appears minimal.

Outputs

For the purposes of calculating a TFP index Telstra's services are divided into seven main activities. Table 5.6 describes each of these, and how they are measured. To estimate the output index for Telstra these quantities are weighted by sales revenue earned from providing the service.

Table 5.6 Outputs

Output (Services)	*Measure used*
Telephone calls	Number of telephone calls made in Australia
Services in operation (Telephone rentals)	Total number of telephones rented in Australia (including mobile phones)
Installation and connection	New service connections
Telex rental	Total number of telex services in operation
Telex calls	Total number of telex calls made in Australia
International and other network services	International and other network services consists of international network calls, leased lines, digital data services, paging, advertising and sales, contract work, and other unspecified network services. It is measured as an implicit quantity calculated as other revenue (total revenue less revenue from all other telecommunication services) deflated by the implicit price deflator for telecommunications revenue[a]

[a] The implicit price deflator for telecommunications revenue is estimated by converting the telecommunications revenue escalator to an implicit price deflator, assuming that the base year 1984-85 equals 100. The telecommunications revenue escalator is calculated as the average of annual price movements of unit revenue for calls and services in operation for the period 1980 to 1988, spliced with the movement in the overall price cap (CPI-x) for the years after 1988.
Sources: Telstra 1994, AOTC 1993, Telecom 1991 and OTC 1991 and earlier issues, and BIE estimates.

Most of the quantity and sales data are sourced from Telecom, OTC, AOTC and Telstra *Annual Reports*. However, in some cases Telstra ceased publishing the required data, and it was necessary to extrapolate this information. Where quantity data was unavailable, the quantity of each service was estimated from the trend growth over the previous five years. Revenue earned from providing each service is then estimated as the unit revenue from providing the service multiplied by the quantity of service. The unit revenue from providing the service was estimated as the unit revenue in the previous year escalated by the *telecommunications revenue escalator.* The telecommunications revenue escalator is calculated as the average of annual price movements of unit revenue for calls and services in operation for the period 1980 to 1988, spliced with the movement in the overall price cap (CPI-x) for the years after 1988. The escalator was then converted to an implicit price deflator with a base equal to 100 in 1984-85. Details on the method used for output estimates are described in Appendix III.

Inputs

Three main inputs are labour, capital, and other costs. Prior to 1991 the value of labour was estimated as the total wage bill, as published in *Annual Reports.* From 1992 onwards Telstra ceased publishing its wages costs, so wage and salary costs were sourced from the OECD for subsequent years. In 1993 and 1994, Telstra's value-added going to employees, which consists of payment for wages, superannuation and workers compensation, was used to represent the value of labour. Comparison with previous data suggests that this may lead to a slight over-estimate of labour costs relative to previous years, but it is the closest proxy to previously used data available. The quantity of labour is represented by the average full-time staff employed each year, as published in *Annual Reports.* For 1992, employment figures are sourced from the ITU (1994); for 1993, Telstra employment numbers are sourced from IBIS (1994); and for 1994, the total number of full-time staff are sourced from Telstra (1994). Other costs are calculated as the residual of total operating expenses after deducting labour, interest and depreciation costs. The quantity of other inputs is estimated by deflating other costs by the ABS implicit price deflator for communications equipment.

A point estimate of the economic value of Telstra's fixed assets is derived from the Davidson Committee (1982) point estimate of Telecom's fixed assets for 1980-81 plus the net book value of OTC fixed assets in 1980-81. Time series estimates of Telstra's fixed assets are then obtained using the method employed by Lawrence et al (1992). Using this method the point estimate is updated and back-dated with investment information and adjusted for an assumed declining balance rate of depreciation of approximately 13 per cent based on an assumed asset life of 12 years.

The quantity of Telstra's capital stock is estimated by deflating the value of the capital stock by the ABS implicit price deflator for communications. For Telecom, investment information is sourced from the *Annual Reports.* OTC did not publish investment information, therefore, it is necessary to estimate investment as the difference between the net book value of assets in the current year (excluding depreciation) and the previous year, adjusted for any revaluation of assets.

Mathematically this can be represented using the following formula:

$$I_t = \left(NBV_t + D_t\right) - NBV_{t-1} - R_t$$

Where: I_t represents net investment (gross investment less asset disposals) in period t, NBV_t is the net book value of assets in period t, D_t is the value of depreciation in period t, R_t the change in the revaluation asset reserve between period t and period t-1.

For details refer to Appendix III

Telstra's investment spending for 1992 is sourced from the ITU (1994). It is necessary to estimate the value of investment in fixed assets for 1993 and 1994 by applying the method used to estimate the value of investment for OTC. The value of the annual user cost of capital is estimated as a proportion of the current cost value of the capital stock after allowing for depreciation, financing charges and capital gains using the method of Lawrence et al (1992) (described in Appendix III). Having obtained estimates of the value and quantity of each of Telstra's outputs and inputs for the

period 1980 to 1994 a TFP index is calculated using the Tornqvist indexing procedure described in Appendix III. The output, input and TFP indexes for Telstra for the period 1979-80 to 1993-94 are shown in Table 5.7 and Figure 5.7.

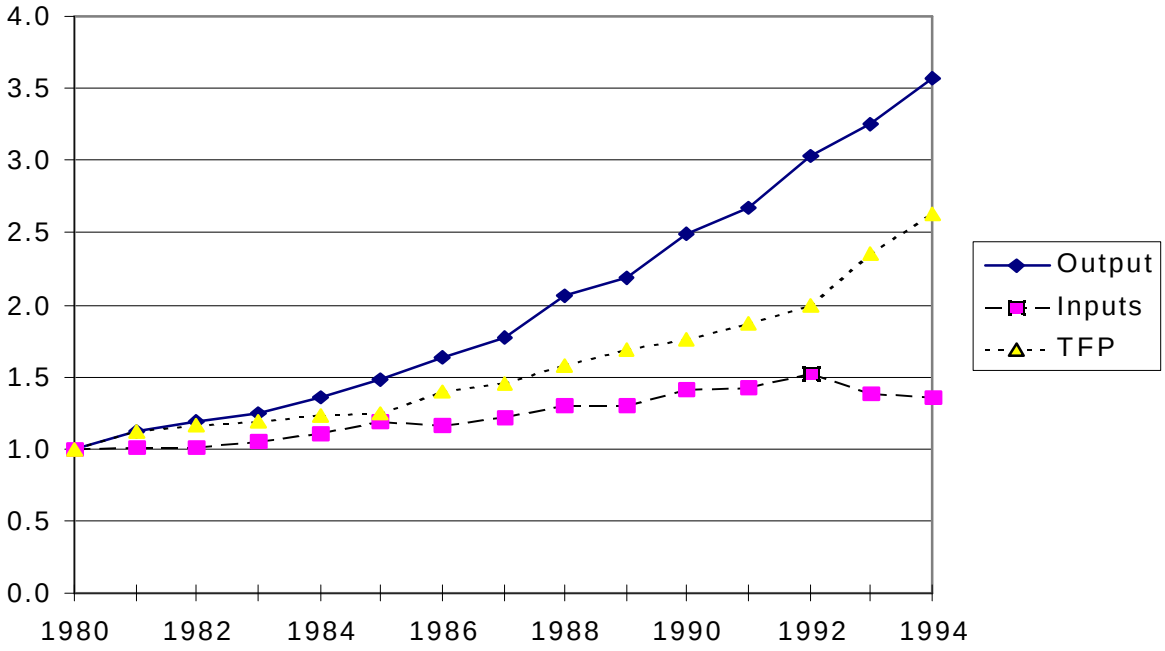
Table 5.7 Output, Input and TFP indexes

Year ending 30 June	*Output*	*Input*	*TFP*
1980	1.0	1.0	1.0
1981	1.1	1.0	1.1
1982	1.2	1.0	1.2
1983	1.2	1.0	1.2
1984	1.4	1.1	1.2
1985	1.5	1.2	1.3
1986	1.6	1.2	1.4
1987	1.8	1.2	1.5
1988	2.1	1.3	1.6
1989	2.2	1.3	1.7
1990	2.5	1.4	1.8
1991	2.7	1.4	1.9
1992	3.0	1.5	2.0
1993	3.3	1.4	2.4
1994	3.6	1.4	2.6

Source: BIE estimates.

During this period Telstra's TFP grew at an annual average rate of 6.3 per cent. Output increased on average by 9.2 per cent annually, while inputs grew on average by only 3 per cent annually. This reflects reductions in some inputs used, particularly labour. In 1992 Telstra reduced its employment levels by just over 13,000 and is continuing to restructure and reorganise the enterprise. Telstra has achieved its strongest growth in TFP since 1991-92.

Figure 5.7 Total Factor Productivity, Output and Input Indexes for Telstra (1980-94)



Economic Rate of Return

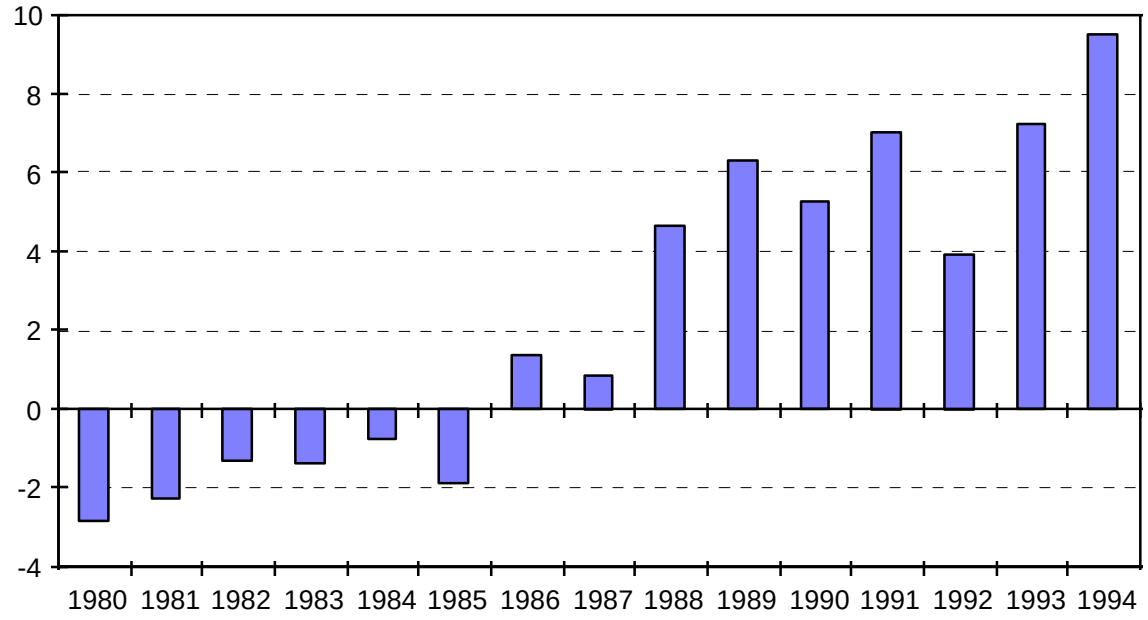
The improvement in Telstra's performance over time is also reflected in relatively high real rates of return. Since 1980, Telstra has improved its real rate of return from -2.8 per cent to 9.5 per cent in 1994 (see Table 5.8 and Figure 5.8). This is a relatively good return, and compares favourably with the risk-free investment in 10 year government bonds in 1994 of 7.9 per cent.

Table 5.8 Economic Rate of Return Earned by Telstra (1980-94)

Year	Total revenue	Interest received	Expenses	Interest paid	Depreciation		EBIT[a]	Capital stock[b]	Real rate of return
					Book value	Current			
	$m	$m	$m	$m	$m	$m	$m	$m	Per cent
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]=[7]/[8]
1980	2 461.28	16.66	2 199.42	367.13	455.50	1 364.03	- 296.19	10 357.5	-2.83
1981	2 821.83	26.51	2 539.21	408.13	543.82	1 459.38	- 251.33	**11 106.4**	-2.26
1982	3 344.88	28.41	3 026.02	518.70	596.45	1 557.39	- 151.79	11 877.1	-1.31
1983	3 935.97	25.70	3 713.78	658.78	732.22	1 755.27	- 167.78	13 485.5	-1.37
1984	4 560.06	23.96	4 254.59	870.12	591.57	1 825.68	- 82.47	14 075.3	-0.76
1985	5 176.87	36.64	5 056.41	911.60	677.11	1 916.51	- 243.98	14 823.9	-1.86
1986	5 944.99	43.30	5 379.53	947.65	853.41	2 056.48	266.74	15 999.0	1.38
1987	6 600.16	37.27	6 020.24	1 050.74	890.85	2 272.13	212.11	17 781.3	0.83
1988	8 366.69	42.02	7 400.09	1 177.65	1 237.96	2 401.83	938.34	18 794.9	4.63
1989	9 256.84	108.73	7 988.90	1 170.03	1 556.56	2 550.10	1 335.71	19 958.3	6.33
1990	10 396.11	172.19	9 105.61	1 175.90	1 575.91	2 685.19	1 184.92	21 063.8	5.23
1991	11 222.46	150.75	9 596.96	1 198.12	1 754.72	2 796.60	1 630.99	21 971.7	7.01
1992	12 228.50	102.65	11 570.30	1 201.44	2 100.23	2 889.07	968.15	22 600.7	3.93
1993	12 656.00	83.40	10 661.80	898.20	2 122.50	3 106.36	1 825.14	24 228.2	7.21
1994	13 362.50	69.20	10 837.60	824.20	2 139.50	3 075.64	2 343.76	23 929.7	9.51

[a] Earning including abnormal items before interest and tax {[7]=([1]-[2])-([3]-[4]-[5]+[6])}.
[b] BIE estimates of the current value of Telstra fixed assets.
Sources: Telstra 1994, AOTC 1992, Telecom 1991, OTC 1991 and earlier issues. BIE estimates.

Figure 5.8 Telstra's Economic Rate of Return on the Current Value of Assets (Per cent)



Source: BIE Chart.

Despite showing a relatively strong growth in productivity over time, the discussion earlier in this chapter suggests that Telstra needs to improve its performance to match international best practice for telecommunications operators. The improvement in Telstra's TFP since the introduction of competition suggests that competition may be contributing to improved performance.

5.4 Summary

The traditional indicators of capital and labour productivity, revenue per employee, lines per employee and revenue per line, suggest that Australia fell some way below international best practice in 1993. Labour productivity, as measured by revenue and lines per employee, appears to have been particularly low in Australia, while revenue per line (capital productivity) is buoyed somewhat by Australia's relatively high network usage. Increasing revenue per employee, price effects notwithstanding, is an encouraging sign that labour productivity in Australia has been improving. This is supported by evidence of improvement in lines per employee, which is price independent. Australia performs significantly better in terms of capital productivity, as indicated by revenue per line, ranking 7th among the 30 countries in the sample in 1993.

International comparisons of multifactor productivity indexes among the 11 countries for which data are available reveal a similar story. In terms of lines and calls per employee and the labour productivity index Australia is the worst performed country in the sample. This clearly suggests low labour productivity. Australia ranked 7th of the 11 countries in terms of calls per dollar of network capital stock and the capital productivity index in 1992. In terms of the MFP index Australia ranked 8th out of the 11 countries in 1992.

Table 5.9 Summary of Productivity Indicators

	Year	*Best Observed*	*Worst Observed*	*Australia Ranked*
Revenue per Employee	1993	Switzerland	Turkey	19th of 27
Lines per Employee	1993	Korea (Rep. of)	Thailand	26th of 30
Revenue per Line	1993	Switzerland	Turkey	7th of 28
Labour Productivity	1992	United States	Australia	11th of 11
Capital Productivity	1992	United States	Switzerland	7th of 11
Multifactor Productivity	1992	United States	Switzerland	8th of 11

Source: BIE.

The time series total factor productivity index for Telstra covering the period 1979-80 to 1993-94 supplements the international comparisons with a view of change over time. Encouragingly Telstra's TFP grew at a average annual rate of 6.3 per cent. Output increased by 9.2 per cent average annual, while inputs grew by only 3 per cent average annual. This reflects reductions in inputs used, particularly labour, and may reflect the impact of competition. It is notable that Telstra has achieved its strongest growth in TFP since 1992 when competition was introduced. Telstra has also shown a marked improvement in its rate of return since the late 1980s.

Market growth, innovation, the impact of competition and further rationalisation are likely to see a continued improvement in performance, but some concern must remain as to the rate of change relative to our international counterparts and competitors, and the distance between Australia's recent public telecommunications infrastructure operating performance and international best practice. The clear message is that labour productivity in telecommunications in Australia remained low by international standards up to and including 1992-93.

Chapter 6 Developing Performance Indicators for the Future

Telecommunications is a rapidly changing industry in technological, regulatory and market terms. If performance indicators are to remain relevant they must evolve too. The challenge for benchmarking is to strike a balance between developing new indicators in response to changing circumstances, and continuing an established indicators series to allow comparative assessments of performance on the various indicators over time. It is also important to focus on a few key indicators, rather than simply multiply the number of indicators and lose sight of the critical dimensions of performance.

In each of the sections of this report a set of indicators relating to a particular performance dimension has been examined, and in each a number of issues relating to the future development of appropriate indicators has arisen. This chapter examines and briefly discusses some of these issues.

Coverage

In undertaking price comparisons we have used both simple rate comparisons and tariff basket comparisons in order to extend the range of coverage of the international benchmarking sample beyond the OECD countries, for which tariff baskets exist, and include some of the increasingly important Asian countries. A sample of 30 countries including the OECD 24 and 7 Asian countries is used in this study. The task of extending OECD tariff models to include Asian countries in a comparable fashion is a considerable one, but may, nevertheless, be an important and worthwhile project. Future studies should aim to extend the coverage of price comparisons to as wide a sample as is relevant for comparison.

As new telecommunications technologies and services emerge it is important to extend the range of comparisons to achieve a sufficient coverage of available services to enable thorough international comparisons. Such things as ISDN (Integrated Services Digital Network) and interpersonal messaging (such as voice mail) may be among the likely candidates for such extension of coverage in the short term. No doubt others will emerge in the coming years. It will be necessary to review and adapt the range of services used in comparisons to reflect the proliferation of telecommunications services.

As the shape and make-up of the telecommunications industry itself evolves it is also important to re-examine the appropriate industry coverage for analysis of prices, quality of services and operational efficiency. In Australia there has been a quite rapid development of a service provider industry since the introduction of competition in value-added services in 1989 and the extension of full competition into resale in 1991, and the introduction of a specialist mobile carrier in 1993-94. The activities of specialist mobile carriers and service providers raise the question of adequacy of

coverage in price and quality of service comparisons and, perhaps more importantly, of industry participants in comparisons of operational efficiency.

It may still be appropriate at the time of the next update to focus on the fixed network carriers, although some accommodation for Vodafone will be necessary since mobile subscriptions are factored into calculations of the total number of national telephone connections (lines). Extension of analysis into the service provider industry may for some time be limited to an awareness of the implications of these players for calculations of operational efficiency. There is, for example, a sense in which 'switchless resellers' represent an alternative to, or implicit contracting out of some the carriers' customer relations and marketing functions. Hence, as the service provider industry develops some accommodation of it must be made in future studies.

As the telecommunications industry evolves there are also industry development criteria being applied to the fixed network carriers and to service providers, such as BT Australasia, as they join the Partnerships for Development/Fixed-Term Arrangements schemes. If the performance of carriers and service providers is to be assessed in entirety, it may be desirable to extend the Bureau's telecommunications benchmarking to include industry development performance indicators.

Prices

In order to interpret price comparisons in this report some mention has been made of affordability. As a first proxy of affordability we have sought to interpret price comparisons in the light of the per capita Gross Domestic Product (GDP) of the countries in the sample. A price outcome that ranks a country lower than its ranking in terms of per capita GDP indicates a good performance in terms of affordability. This has provided a means in this report by which to overcome the disadvantage of using exchange rates rather than purchasing power parities (PPPs) in price comparisons. However, it suffers from the same disadvantage as a comparison using PPPs. Namely, that it is not particularly appropriate for the business user perspective that underlies this study. Future studies should explore the possibility of examining affordability using an appropriate internationally comparable business services price series.

One of the major issues arising in the section on price comparisons is the increasing importance of developing ways to accommodate volume discounts in the calculations. Because of international differences in the regulatory and competitive environments, the situation regarding volume discounts varies from country to country. Where national monopoly carriers remain such arrangements tend to be treated as commercial-in-confidence, while carriers operating in competitive environments are usually required to publish their tariffs; including any discounts available. Service providers in such environments may or may not be subject to similar requirements.

While it is important to factor in volume discounts, especially if the aim is to assess price performance from a business user perspective, discount information is not readily available in an internationally comparable form. No competitive carriers will divulge information about the customer take-up of discount schemes, making a thorough international comparison of prices paid by users impossible.

In this report we began to tackle the problem of discounts by constructing three representative business user baskets. Discount data are applied according to the best available published discount in each country on a category-by-category basis. This procedure gives some indication of the best prices available to business users of various sizes in each country. This is a first and important step, but requires refinement in future benchmarking studies.

Quality of Service

It is also important to continually reassess the coverage of quality of service indicators in the context of emerging services. For quality of service indicators to serve as a basis for assessing the quality of telecommunications services in the future they will need to cover a range of mobile technologies and services. Cellular mobile drop-out has been introduced as a quality of service indicator in this report, despite the lack of internationally comparable data. Much more work is required on mobile indicators, including drop-out and, perhaps more importantly, congestion. Developing appropriate indicators for mobile technologies and services is an important task for the future.

The Price-Quality Nexus

Price and quality are so closely related, especially for the business user, that it is becoming increasingly necessary to explore methods by which to combine price and quality indicators into a composite overall assessment of performance. The tables in Chapter 7 provide an elementary way to assess overall performance. The main problem is, of course, applying the most appropriate weightings to each of the individual indicators *and* dimensions of performance in order to arrive at a meaningful numeric overall indicator. One possible approach, since everyone has their own opinion as to the most appropriate weighting, might be to develop a model which allows users to vary weightings within a range to reflect the importance of the various dimensions of performance and/or service categories to them as users. The provision of such a model on diskette with subsequent performance benchmarking reports might be a worthwhile step towards this end.

Innovation

It is particularly difficult to maintain an appropriate focus for indicators of innovation. Indicators of digitalisation and the deployment of optical fibre display the kinds of problems typical of indicators of innovation. The percentage of digital mainlines has been widely used for some time as an indicator of network digitalisation, but as digitalisation proceeds many of the developed countries are approaching 100 per cent, and the indicator will soon become unusable. An alternative is required for such indicators, and it may be that it will be necessary to focus on services, such as those relating to centrex capabilities, for example, as proxies for the underlying technologies. Such derived indicators may introduce a further degree of complication, but may, on the other hand, be more obviously related to the services with which users are familiar.

Fibre deployment is particularly problematic. It is measured variously as network route kilometres, fibre kilometres and cable and/or sheath kilometres; which can be significantly different where, for

example, multiple cables are laid along the same trunk route and/or fibres within the same sheath. Moreover, none of these measures takes account of the practical operational bandwidth of the cable. In this study we have used growth rates in whatever national measure is used as an indicator of fibre deployment, but it is a relatively poor indicator as it is limited to the short period for which such deployment data have been available. Refinement of the fibre deployment indicator is required in the future, and it should involve, at a minimum, a greater time period for the calculation of the growth rates. Further refinement might also aim to take account of such factors as network size, population density and land mass in order to further international comparability.

The deployment of mobile technologies will be increasingly important in the future. Not only is mobile becoming an increasingly important element in telecommunications services through rapid take-up, it is also a crucial ingredient in the introduction of competition in many countries, and globally. Many countries are licensing new mobile operators to compete with their fixed-network carriers, because it is a new field and new players can start at much the same point on the learning curve as established fixed-network players, it requires less fixed capital investment and offers operators a completely different range of economies of scale. The deployment of cellular mobile has been included in this report as an indicator of such new competitive possibilities.

This report also marks a first step towards incorporating mobile technologies into basic telecommunications performance indicators by adding mobile subscriptions to fixed-network mainlines as the base indicator of access paths to the network. Indicators based on fixed-network access paths (mainlines or access lines) are no longer adequate. Future reports should continue to incorporate mobiles into the basic measures and indicators.

There is often thought to be a link between competition and innovation. In future studies of performance it might be interesting to pursue means to explore this link. This could take the form of either a correlation of the national regimes with a composite of the innovation indicators used, or the addition of an indicator that explores the number of new services introduced in a given period and/or the number of existing services. While such an indicator raises enormous difficulties relating to the definition and identification of services it may be possible to begin to get an overall picture by combining such indicators.

Operational Efficiency

One of the major difficulties faced in calculating operational efficiency is that of estimating the value of capital stock. Capital stock is not consumed in the current period in the way that other inputs are, but is durable, being used over a number of years. Estimates of the value of capital stock must account for this gradual consumption over time. Moreover, in industries such as telecommunications technological change can have a profound and sometimes unpredictable effect on the value of the existing network capital stock and on the fraction of that stock consumed in an individual year. In calculating capital stock values across countries in this study we have used accumulated capital investment. Capital stock is estimated as the accumulation of a 12 year investment series for the years 1981 to 1992. By following a simple accumulation some account is taken of the pace of technological change and cost/functionality changes, although it is at best only a

first approximation. In future studies it may be worthwhile pursuing a methodological refinement that factors in cost/functionality changes in a more systematic way.

Benchmarking... Next Steps

The focus of this and other Bureau of Industry Economics benchmarking studies is to identify the importance of major infrastructure services in business costs, develop an understanding of relevant measures for international comparison of infrastructure services provision, and to publish international performance comparisons. The development of performance indicators for such industries offers a means of introducing competitive pressures indirectly and/or assessing the impact of competition as it is introduced. A focus on performance indicators raises awareness of both relative performance and, importantly, of the key drivers of performance in that industry. The aim is to give an indication of the extent to which operational efficiency might be improved. The key questions for both government and the enterprises themselves are: how do we rate against international peers and competitors; what are the major drivers of performance in this sector; and what can be done to improve performance in the future?

A possible next step is for the carriers and service providers to further their work in identifying the indicators of most importance to them, and setting targets for their enterprises relating to these indicators taking account of what is realistically achievable and what fits in with the enterprise's overall strategic direction. It might also prove fruitful for them to pursue further work with their customers in the development of indicators of importance to the user and to work towards establishing service provision targets.

Telecommunications performance indicators have traditionally had a supply side, engineering focus. In assessing quality of service, for example, attention has typically been given to the technical operation of the network. It is inevitable that there will be an increasing focus on the customers' perspective in the future, and there will be greater use of surveys and customer responses. Many carriers are already moving in this direction.

While this trend is to be welcomed, a degree of caution is required. In the context of deregulation and evolving competition in telecommunications, customers are bombarded with well funded and targeted advertising campaigns, which would not attract the hundreds of millions of dollars spent on them if they were not effective in changing customer perceptions. In such a context it would be misleading to rely on customer perceptions as the only indicator of quality of service and, perhaps, even price. While opinions and perceptions can complement the more traditional indicators, they cannot and should not be substitutes for them.

Chapter 7 Summary and Conclusions

This chapter summarises key findings and assesses Australia's performance relative to international counterparts and competitors. Each of the main areas of concern, price, quality of service, innovation and operational efficiency, are treated in turn, key concerns are raised and possible courses of action, positive and remedial, are suggested. A summary presentation of Australia's performance relative to international best and worst practice among the selected countries in our sample appears in the tables below.

Prices

In terms of simple rate comparisons Australia performs relatively well on cellular mobile charges and international call charges, but rather less well on business user fixed and national trunk usage charges. Affordability comparisons of charges, using the yardstick of GDP per capita, suggest that Australia performs relatively well. Scandinavian countries perform well across the board, and in some comparisons Asian countries also perform well. The Asian countries in the sample (Korea, Taiwan, Singapore, Hong Kong and Malaysia), excluding Japan, have among the lowest business user fixed charges, but do not perform so well in terms of usage charges. Malaysia and Singapore also enjoy relatively low cellular mobile charges, while Japan is probably the most expensive country for mobile overall in our sample.

Australia performs relatively poorly in price comparisons of the business user national services basket, with charges above the OECD average and higher than the Scandinavian countries, the United Kingdom, United States, New Zealand and Canada. While national differences in geography, demography and regulation regarding local call charging make the comparison of national call charges relatively vulnerable to external factors, we must conclude that Australia falls some way behind international best practice on this indicator, being below the OECD average. In view of Australia's unchanged ranking, it is clear that Australia has not gained ground relative to its OECD counterparts over the period 1992 to 1994.

In contrast, Australia performs well in terms of the international call basket charges. Australia also performs relatively well in comparisons of cellular mobile charges, currently ranking 4th among the 24 mobile operators listed. In light of the likely disadvantage of distance assumptions in the model for larger countries this is a good performance. A comparison of the 1992 and 1994 rankings suggests that mobile charges in Australia are moving in line with those of OECD counterparts.

Table 7.1 Prices: Australia, Best and Worst Observed

	Year	*Best Observed*	*Worst Observed*	*Australia Ranked*
Simple Rate Comparisons				
Business Fixed Charges	1993	United States	Canada	18th of 28
Long Distance Call Charges	1993	Luxembourg	Portugal	16th of 26
International Call Charges	1994	Norway	Japan	14th of 24
Mobile Fixed Charges	1992	Malaysia	Luxembourg	8th of 29
Mobile Call Charges	1992	Singapore	Germany	7th of 29
Basket Comparisons				
National basket	1994	Iceland	Austria	14th of 23
International call basket	1994	Australia	Turkey	1st of 24
Mobile basket	1994	Iceland	Japan	4th of 24
PSDN basket	1994	Finland	Japan	18th of 24
Leased line Basket, 9.6 Kbit	1994	Belgium	Austria	9th of 24
Leased line Basket, 64 Kbit	1994	Australia	Spain	1st of 24
Leased line Basket, 1.5/2 Mbit	1994	United Kingdom	Luxembourg	5th of 22
Composite basket	1994	Finland	Japan	11th of 22

Source: BIE.

Australia falls marginally below the OECD average in terms of charges for the basket of packed-switched data network (PSDN) services, ranking 18th among the OECD countries. Australia's ranking in terms of charges for this basket of PSDN services deteriorated from 7th among the OECD countries in 1992. However, prices for this basket of PSDN services appear to be volatile over time, suggesting that caution should be exercised in interpreting this finding. In terms of the leased line basket Australia performs relatively well overall, ranking 9th for the slower 9.6Kbps rate lines, 1st for the mid-range 56/64Kbps line speeds, and 5th for the high speed 1.5/2Mbps lines. Australia has been improving its position over the period 1992 to 1994 relative to OECD counterparts in terms of charges for this basket of leased line services.

Putting this all together into a composite business basket we find that Australia ranks slightly above the OECD average, at 11th out of 24 in both 1992 and 1994, a position unchanged since 1989. Australia performs better than Japan, Germany, France and the United States in terms of the composite basket, but below the Scandinavian countries, New Zealand, the United Kingdom and Canada.

A comparative static analysis over the period 1992 to 1994 gives a picture of Australia's position relative to its OECD counterparts that is substantially independent of the effects of the tariff basket modelling assumptions. In comparative static terms Australia's position has remained unchanged in respect to the national business basket, the international call basket and the mobile basket, improved in respect to the leased line basket, while falling behind in respect to the packet-switched data network services basket. Australia's position in terms of the composite business basket has remained unchanged since 1989.

The overall picture from price comparisons based on tariff baskets is one of having to run to keep pace with international counterparts, and barely managing to keep up. Prices appear to be falling more slowly in Australia than in some other comparable countries. Although it is notable that

Australia's performance seems better in the more highly contested markets of international and mobile than in markets where there is less competition.

These tariff basket comparisons are based on list prices and do not accurately reflect prices paid by customers able to take advantage of discount schemes. Taking account of best available discounts in international price comparisons is fraught with difficulty and caveats apply. Nevertheless, our analysis suggests that large business users have access to the largest proportional discounts, and the discounts available in Australia appear to be among the highest in OECD countries. However, these discounts do not result in substantial change to the relative ranking among the OECD countries.

In Australia, the best discounts available for small business users, as defined in the basket constructed herein, are 6.4 per cent below list prices, for medium business users 7.7 per cent below and for large business users 10.1 per cent below. Businesses can, however, obtain greater volume discounts in specific areas of services, and overall through aggregating under aggregators or resellers, who currently offer discounts of up to 25 per cent on voice communications charges.

The time series analysis of a basket of national services charges for business users reveals that charges have fallen since the introduction of competition in 1992. However, price falls for the basket of national services in Australia, at 8.9 per cent over the period 1990 to 1994, were somewhat less than the OECD average of 15.3 per cent. The time series analysis for peak rate 3 minute international call charges indicates that although prices in Australia declined by 28.4 per cent over the period 1990 to 1994, the OECD average decline was 34.6 per cent. Charges for the basket of cellular mobile services in most OECD countries declined over the period 1990-94, with an OECD average decline of 20.6 per cent. In Australia, the cost of the mobile basket declined by 26.3 per cent, suggesting that Australia is performing well in this area.

The time series analysis also reveals that countries with competitive market structures experienced larger price reductions than countries with non-competitive market structures. On average, countries with competitive market structures experienced declines of 21.6 per cent for national and 31.4 per cent for mobile services baskets, compared to declines of 12 per cent and 16.9 per cent for non-competitive countries, respectively, between 1990 and 1994.

Quality of Service

Examining quality of service indicators reveals that Australia's local call failure rates continue to be above those for Japan, the United Kingdom and Canada, and long distance call failure rates are considerably higher than those for the United Kingdom and the United States. Austel estimates for call failure rates in Australia in 1993 and 1994, however, suggest that there has been some improvement in the reliability of the network since the introduction of competition. Australia's performance in respect of IDD completion rates is also somewhat disappointing. With a completion rate of 57.5 per cent in 1992, Australia's performance was below that of the United States, Japan, the United Kingdom and Canada, but marginally better than that of New Zealand. The evidence suggests that Australia's performance on call completion/call failure was some way below international best practice in 1992, but has improved since then.

Australia also performs relatively poorly on fault clearance, ranking 15th out of the 19 countries in 1992 for which data are available. This suggests that there is scope for improvement in this area too. In terms of cellular mobile call drop-out Austel report a declining call drop-out rate of 3.8 per cent in 1994 at the national level, and note that mobile drop-out in Sydney occasionally exceeded the internationally accepted performance standard of 5 per cent during the first half of 1994.

Table 7.2 Quality of Service: Australia, Best and Worst Observed

	Year	*Best Observed*	*Worst Observed*	*Australia Ranked*
IDD Completion Rates	1992	United States	Greece	15th of 24
Fault Clearance	1992	Netherlands	Taiwan	15th of 19

Source: BIE.

Innovation

Examining indicators of innovation reveals that Australia's performance on the penetration of cellular mobile is above average. However, Australia ranked well below most comparable countries in terms of digitalisation of fixed network mainlines in 1993. It would seem that significant investment in modernisation is required if Australia is to catch up with international best practice in respect of network digitalisation.

Australia performs relatively well in terms of optical fibre deployment, ranking 6th out of the 12 countries for which data are available for 1992. While great care must be taken in interpreting such a poor indicator, it seems apparent that Australia is among the leading countries in fibre deployment.

Table 7.3 Innovation: Australia, Best and Worst Observed

	Year	*Best Observed*	*Worst Observed*	*Australia Ranked*
Mobile Penetration	1994	Sweden	Turkey	8th of 30
Digitalisation	1993	Hongkong	Austria	23rd of 30
Optical Fibre Deployment	1990-92	Sweden	Canada	6th of 12
Itemised Billing	1992	Canada/France	Denmark	5th of 13
Proportion Cardphones	1992	Japan	Norway	2nd of 25

Source: BIE.

Australia performs relatively well in terms of the availability of itemised billing, and the proportion of public payphones that are cardphones, ranking 5th of 13 and 2nd among the 25 countries for which data are available for 1992, respectively.

The evidence suggests that Australia is performing reasonably well, but at below international best practice on most quality of service indicators. Overall, Australia's performance in terms of indicators of innovation is also relatively poor. It may be that attention to fulfilling proposed increases in network investment and innovation opportunities is required if Australia is to move towards international best practice on such indicators.

Operational Efficiency

The traditional indicators of partial capital and labour productivity (revenue per employee, revenue per line and lines per employee) suggest that Australia fell some way below international best practice in 1993. Labour productivity, as measured by revenue and lines per employee, was particularly low in Australia, while revenue per line (capital productivity) is buoyed somewhat by Australia's relatively high level of network usage. Increasing revenue per employee, price effects notwithstanding, is an encouraging sign that labour productivity in Australia is improving. This is supported by evidence of improvement in lines per employee, which is price independent. Australia performs significantly better in terms of capital productivity, as indicated by revenue per line, ranking 7th among the 30 countries in the sample.

International comparisons of multifactor productivity (MFP) indexes among the 11 countries for which data are available reveal a similar story. In terms of lines and calls per employee (the labour productivity index) Australia was the worst performing country in the sample in 1992. Australia ranked 7th of the 11 countries in terms of calls per dollar of network capital stock (the capital productivity index). In terms of the MFP index Australia ranked 8th out of the 11 countries in 1992. It is clear from these results that Australia's labour productivity has been low by international standards.

Table 7.4 Operational Efficiency: Australia, Best and Worst Observed

	Year	*Best Observed*	*Worst Observed*	*Australia Ranked*
Revenue per Employee	1993	Switzerland	Turkey	19th of 27
Lines per Employee	1993	South Korea	Thailand	26th of 30
Revenue per Line	1993	Switzerland	Turkey	7th of 28
Partial Labour Productivity	1992	United States	Australia	11th of 11
Partial Capital Productivity	1992	United States	Switzerland	7th of 11
Multifactor Productivity	1992	United States	Switzerland	8th of 11

Source: BIE.

The time series total factor productivity (TFP) index for Telstra covering the period 1979-80 to 1993-94 supplements the international comparisons with a view of change over time. Encouragingly Telstra's TFP grew at an annual average rate of 6.3 per cent. Output increased on average by 9.2 per cent annually, while inputs grew on average by only 3 per cent annually. This reflects reductions in some inputs used, particularly labour. In 1992 Telstra reduced its employment levels by just over 13,000 and is continuing to restructure and reorganise the enterprise. It is notable that Telstra has achieved its strongest growth in TFP since 1992, when competition was introduced.

Telstra has also shown a marked improvement in its economic rate of return since the late 1980s, but some concern must remain as to the rate of change relative to our international counterparts and competitors, and the distance between Australia's recent public telecommunications infrastructure operating performance and international best practice. The unequivocal message of an analysis of operating efficiency is that labour productivity in telecommunications in Australia remained low by international standards up to and including 1992-93.

Conclusion

Overall, Australia's performance is reasonably encouraging, but there is no room for complacency. Now is certainly not the time for reform fatigue. Telecommunications prices are falling, but they have further to fall. Quality of service is improving, but again there is further to go. Operational efficiency is also improving, but further restructuring is required. Investment in network development and renewed effort in respect to labour productivity appear to be the areas requiring most attention.

Since the introduction of competition in telecommunications Australia has moved ahead with the leading pack, but it is at the back of the leading group rather than the front. Relaxing the pace of reform would see Australia fall back into the trailing group of also-rans. Renewed effort is required to lift Australia towards international best practice.

Appendix I Guiding Principles and Assumptions Underlying the OECD Tariff Models

In this Appendix the guiding principles and assumptions used in the construction of the OECD tariff baskets are outlined. The results of the tariff basket comparisons are presented in Chapter 3.

Guiding principles for the OECD's international telephone tariff comparison methodology:

1. The methodology for tariff comparisons should initially be developed for national, non-mobile, real-time, voice telephony charges and later extended to a wider range of services including international calls, leased lines, packet-switched data services and mobile communications services.
2. The methodology should include installation charges, subscription charges (rental) and usage charges, but should exclude equipment rental. Value added tax should be included in the basket for residential subscribers but excluded from that of business subscribers.
3. Rather than simple rate comparisons, the methodology should use a basket of charges composed of fixed charges and national call charges. These two components should be calculated separately and then combined in a ratio which approximates to the OECD average revenue pattern for Public Telecommunications Operators (PTOs) and weighted according to average subscription telephone bills.
4. The fixed charges should include annual subscription (rental) plus a proportion of the installation (connection) charge for new subscribers.
5. The usage charges should be based on a basket of calls distributed by distance, time of day/week and duration according to usage patterns identified in international research.
6. A separate basket should be calculated for international calls using call pairs weighted by the likelihood of calling a particular destination (approximated by the population of the called country).
7. Separate baskets should be constructed to reflect distinctive usage patterns, for instance for business and residential subscriber groups.

Source: OECD, 1990, pp.43-44.

Assumptions of the Basic Model:

- The methodology assumes that the ratio between the fixed and usage charges approximates to the OECD average (33:67) adapted to different subscriber groups (20:80 for the business subscribers and 40:60 for the residential subscriber).
- The basic business model excludes tax from both the fixed charges and the call charges because most businesses are able to reclaim value-added (or sales) tax.
- The basic model employs a duration variable that ranges from 2.5 to 4.5 minutes for business calls and 2.5 to 7 minutes for residential calls.
- Six different charge rates according to time of day/week are applied in the basic model.
- The basic model has a maximum of 11 different distance zones, ranging from 3km to 450+km.
- The model assumes that the user has a direct line to the PTO which is not shared or routed via a private branch exchange.
- The business user is assumed to be located in the capital city or the largest exchange area.
- The basic model assumes that the user does not make any intra-company calls which are included in the basket and does not take advantage of any discounts which may be available for high-volume usage. The model also assumes that the user is not eligible for discounts as a low-volume user or a disadvantaged member of society.
- In those countries where there is more than one operator, the following assumptions have been made:
  - In the USA, the NYNEX tariffs for New York are used at the local level (up to 150km) and AT&T tariffs for long distance and international calls;
  - In the UK, BT tariffs have been used but Mercury tariffs have also been calculated for the business telephone basket;
  - In Japan, NTT tariffs are used at the national level and KDD tariffs at the international level;
  - In New Zealand, TCNZ tariffs are used;
  - In Canada, Bell Canada tariffs are used;
  - In Australia, Telstra tariffs are used;
  - In Denmark, a weighted average of the four regional telephone company tariffs have been used;
  - In Finland, the user is presumed to be a “member” of the Helsinki Telephone Company (HTC); and
  - Where necessary, tariffs for different operators have been used at the national and international levels.

- The basket for international calls is based on call pairs, which represent the relative price of making a call from one country to another. The call pairs are weighted by the population size of the terminating country to derive an index for each country.
- The country index is defined as:

$$\delta_i = [(\sum_j \sigma_{ij} p_j)/\sum_j p_j]*100$$

where $\sigma_{ij} = x_{ij}/[(x_{ij} + x_{ji})/2\ ]$

and x_{ij} is the actual cost of calling country i from country j (in common currency)

p_j is the population of country j.

Source: OECD 1990, pp.49-59.

Appendix II Multifactor Productivity

In this Appendix the methodology used to calculate the multifactor productivity (MFP) indexes is described, and details of the database employed are given. The results of the multifactor productivity analysis are presented in Chapter 5. The MFP analysis extends and improves work reported in McKinsey (1992). A superior indexing procedure is used in the current study to form the MFP index and several countries have been added to the analysis.

MFP Methodology

The telecommunications industry, like most other industries, produces a range of outputs using a variety of inputs. Since it is not meaningful to simply add these various input and output quantities directly the Bureau has used the multilateral indexing procedure to calculate an MFP index. The multilateral index method is a means of estimating a weighted sum of the rates of change of the component output or input quantities.

It is defined in log-change form as:

$$\ln\left(\frac{MFP_m}{MFP_n}\right) = \sum_i \frac{1}{2}\left(R_{im} + R_i^*\right)\ln\left(\frac{Y_{im}}{Y_i^*}\right) - \sum_i \frac{1}{2}\left(R_{in} + R_i^*\right)\ln\left(\frac{Y_{in}}{Y_i^*}\right) - \sum_j \frac{1}{2}\left(S_{jm} + S_j^*\right)\ln\left(\frac{X_{jm}}{X_j^*}\right) + \sum_j \frac{1}{2}\left(S_{jn} + S_j^*\right)\ln\left(\frac{X_{jn}}{X_j^*}\right)$$

Where: m and n are adjacent observations, there are i outputs (Y), j inputs (X), the Rs are output revenue shares, and the Ss are input cost shares.

Outputs

Outputs have been divided into two categories, call services and the provision of the network infrastructure. These activities represent the core business activities for PTOs. The quantity of call service output is measured in terms of total calls (including mobiles). Mobile calls for each country are estimated assuming that mobile calls move in line with the average number of calls per mainline

adjusted for the average ratio of mobile calls to national calls across the OECD as reflected in the OECD national business user and mobile tariff basket models for 1994.

Mathematically this can be represented as:

$$\frac{Calls}{Mainlines} \times Mobile\ subscribers \times \left(\frac{Mobile\ calls}{National\ calls} \right)_{OECD\ average}$$

The total number of calls is not an ideal measure of call services because it does not take account of the length of time for each call and there is no distinction made between local, national and international. However, total calls represent the best available data for international comparisons. Call data are sourced from the ITU (1994), although Canadian data are sourced from TeleGeography Inc. (1993), and UK call data are sourced from Oftel (1994) for BT, with Mercury calls estimated based on market share. US call data are adjusted to exclude the proportion of local calls provided by operators not included in ITU data for the United States.

The provision of network infrastructure has been approximated by the total number of lines. For the purposes of this study lines are defined as fixed network mainlines plus cellular mobile subscriptions. Lines are a good proxy for the supply of the network.

It is usual to use revenue shares to weight output quantities when calculating MFP. However, in the case of telecommunications fixed and usage charges do not accurately reflected the cost of provision. Consequently the weightings were calculated as described in Chapter 5, and 70:30 is the ratio that is used, with lines making up 70 per cent of the total and calls 30 per cent.

Table A2.1 Outputs, 1992

	Calls	*Lines*
Australia	11 626 281 892	8 754 000
Canada	47 451 289 827	17 269 343
Denmark	4 777 673 274	3 216 007
Finland	3 944 890 206	3 128 067
Germany	45 984 615 420	36 395 734
Italy	31 021 455 721	24 492 000
Japan	78 274 833 555	59 364 877
Netherlands	8 686 756 338	7 561 000
Switzerland	3 987 114 145	4 399 902
United Kingdom	33 840 829 219	28 865 688
United States	517 005 508 765	155 089 457

Sources: ITU 1994, OECD 1994, TeleGeography Inc. 1993, Oftel 1990, and BIE estimates.

Inputs

Due to data limitations only two input categories have been used: labour and capital. However, these inputs represent the bulk of costs for most PTOs. The quantity of labour has been approximated by the number of full-time equivalent (FTE) staff employed by the country PTO(s). Labour costs are represented by wage and salary costs sourced from the OECD (1994).

Table A2.2 Inputs, 1992

	Labour Value, millions (Local Currency)	*Labour Quantity (FTE)*	*Value of the user cost of capital, millions (Local Currency)*	*Capital Quantity (US$ m)*
Australia	2 985	70 800	5,373	18 483
Canada	4 280	92 263	8,262	33 500
Denmark	3 203	17 274	7 009	5 659
Finland	3 948	16 120	6 013	5 919
Germany	12 297	231 000	34 863	130 519
Italy	6 705 489	90 536	15 685 990	65 473
Japan	2 255 003	252 970	3 846 556	185 698
Netherlands	2 719	32 327	4 087	13 224
Switzerland	1 962	21 364	3 863	18 856
United Kingdom	4 036	180 292	4 886	46 481
United States	25 875	694 000	42 083	245 819

Sources: ITU 1994, OECD 1994 and BIE estimates.

Calculating the Value of Capital Stock

In the absence of data on the current economic value of assets owned by each PTO/country, the capital stock is estimated by accumulating investment (gross fixed capital formation) over a 12 year period. This was then converted to US dollars using exchange rates to make the figures comparable across countries. The input value or annual user cost of capital inputs was derived as a proportion of the nominal capital stock allowing for depreciation, financing charges and capital gains.

Mathematically this can be represented as:

$$VAUC_{ct} = \left(g_{ct} + d - dP_{ct}/P_{ct}\right)P_{ct}K_{ct}$$

Where: c refers to the country, g is the nominal opportunity cost of holding capital (represented by the 10 year bond rate) in year t, d is the declining balance depreciation rate of 13.14 per cent (assuming an average asset life of 12 years), dP_{ct}/P_{ct} is the annual rate of change in the price of capital (CPI), P_{ct} is the price of capital, and K_{ct} is the physical quantity of capital stock in year t.

Data sources

The data used for the multifactor productivity analysis presented are sourced from the ITU (1994), which provides internationally comparable telecommunications data. In some instances it was

necessary to supplement this data with information from other sources, including the OECD, Oftel, Austel, TeleGeography Inc., PTO *Annual Reports* and Budde (1994). Every effort has been made to make supplementary data comparable with the ITU data.

Appendix III Total Factor Productivity

In this Appendix the methodology used to calculate the total factor productivity (TFP) and real rates of return for Telstra over the period 1980 to 1994 is described. The analysis of Telstra's economic performance is presented in Chapter 5.

TFP Methodology

The Tornqvist index method is used to estimate total factor productivity for Telstra. The Tornqvist index method cumulates through time a weighted sum of the rates of change of the component output or input quantities.

It is defined in log-change form as:

$$\ln\left(\frac{TFP_t}{TFP_{t-1}}\right) = \sum_i \frac{1}{2}(R_{it} + R_{it-1})\ln\left(\frac{Y_{it}}{Y_{it-1}}\right) - \sum_j \frac{1}{2}(S_{jt} + S_{jt-1})\ln\left(\frac{X_{jt}}{X_{jt-1}}\right)$$

Where: t and t-1 are adjacent observations, there are i outputs, (Y), j inputs, (X), the Rs are output revenue shares, the Ss are input cost shares and ln is the natural logarithm operator.

As explained in more detail in Lawrence, Swan and Zeitsch (1991a,b), Lawrence et al (1992) and the Steering Committee on National Performance Monitoring of Government Trading Enterprises (1992), this indexing procedure possesses a number of desirable technical properties which make it suitable for calculating TFP. It avoids the traditional index number problem by using moving averages as weights, and is consistent in aggregation in the sense that a Tornqvist index of Tornqvist indexes is approximately equal to a Tronqvist index of all the individual items.

Data Estimation

Methods used for estimating missing data in the calculation of a TFP index for Telstra are described below.

Telephone call services

From 1991 onwards Telstra ceased publishing information on the revenue derived from calls. In this study call revenue is estimated as unit revenue multiplied by the quantity of telephone calls to obtain an estimate of total revenue from telephone calls. The unit revenue from providing call

services was estimated as the unit revenue in the previous year escalated by the telecommunications revenue escalator.

Telephone services in operation (rentals)

From 1991 onwards Telstra ceased publishing information on the revenue derived from services in operation. Revenue from this service is estimated as unit revenue multiplied by the quantity of services in operation. The unit revenue from providing rental services was estimated as the unit revenue in the previous year escalated by the telecommunications revenue (calculated as the average of annual price movements of unit revenue for calls and services in operation for the period 1980 to 1988, spliced with the movement in the overall price cap (CPI-x) for the years after 1988).

Installations and connections

From 1989 Telstra ceased publishing information on the revenue earned from new telephone connections. From 1989 onwards unit revenue from this service is estimated as the unit revenue in the previous year escalated by the telecommunications revenue escalator. Unit revenue was then multiplied by the quantity of new connections to obtain an estimate of the revenue earned from providing this service. From 1992 onwards Telstra ceased publishing information on the number of telephone connections. The quantity of connections is extrapolated assuming that new connections moved in line with services in operation.

Telegram/Faxpost services

From 1985 onwards Telstra did not publish data on the revenue collected from telegram services. Consequently, it was necessary to estimate the unit revenue from telegrams by escalating unit revenue in the previous year by the telecommunications revenue escalator. The estimated unit revenue from telegrams was then multiplied by the quantity of telegrams to obtain an estimate of total revenue from this service. From 1992 onwards the quantity of telegrams sold is estimated based on the trend movement in telegram services over the past five years.

Telex rentals

The same problem is encountered with telex rentals as with telegram services. It was, therefore, necessary to use the same method to estimate missing values.

Telex calls

From 1989 onwards Telstra ceased publishing information on the revenue earned from telex calls. Unit revenue from this service was, therefore, extrapolated by escalating the unit revenue in the previous year by the telecommunications revenue escalator. The estimated unit revenue was then multiplied by the quantity of telex calls to obtain an estimate of total revenue from this service. From 1992 onwards Telstra ceased publishing information on telex calls. The quantity of telex calls was estimated based on the trend in telex calls over the past five years.

International and other network services

Other network services consists of revenue received from the provision of international services (prior to 1992 this is equivalent to all revenue earned by OTC) and all other services including leased lines, digital data services, paging, advertising and sales, contract work, and other unspecified network services. The value of this service was calculated as the residual of total operating revenue after deducting the revenue earned from all other services.

Since other network services is a mixture of a number of different services it was necessary to calculate an implicit quantity. This was derived by deflating the revenue from other network services by the implicit price deflator for telecommunications revenue.

Investment

Due to the lack of published data it was necessary to estimate OTC and Telstra 1993 and 1994 investment as the difference between the net book value of assets in the current year (excluding depreciation) and previous year adjusted for any revaluation of assets.

Mathematically this can be represented using the following formula:

$$I_t = (NBV_t + D_t) - NBV_{t-1} - R_t$$

Where: I_t represents net investment (gross investment less asset disposals) in period t, NBV_t is the net book value of assets in period t, D_t is the value of depreciation in period t, R_t the change in the revaluation asset reserve in between period t and period t-1.

Calculating the Annual User Cost of Capital

The value of the annual user cost of capital is estimated as a proportion of the current cost value of the capital stock after allowing for depreciation, financing charges and capital gains.

Mathematically this can be represented as:

$$VAUC_t = (g_t + d - dP_t / P_t) P_t K_t$$

Where: g is the nominal opportunity cost of holding capital (represented by the 10 year bond rate) in year t, d is the declining balance depreciation rate of 13.14 per cent (assuming an average asset life of 12 years), dP_t / P_t is the annual rate of change in the price of capital, P_t is the price of capital, and K_t is the physical quantity of capital stock in year t.

Calculating Economic Rates of Return

Economic rates of return have been estimated for Telstra using the method adopted by the Industry Commission (1990). The real rate of return is the rate of return earned on the written down current value of assets employed. It is defined as the ratio of earnings before interest and tax and after abnormal items, including current capital cost to the nominal value of the capital stock.

Mathematically the economic rate of return is defined as follows:

$$RRR_t = \frac{I_t - E_t - D_t}{P_t K_t}$$

Where: RRR_t is the real rate of return on invested capital in year t, I_t is the revenue (including abnormals) net of interested earned in year t, E_t is the total expenses (including abnormals), excluding book value depreciation, interest and tax in year t, D_t is the current value of depreciation in year t, and the term $P_t K_t$ represents the nominal value of the capital stock in year t.

TFP and Real Rate of Return Data

The following tables present the data used in the calculation of the TFP index and economic rate of return for Telstra.

Table A3.1 Telecommunications Price Escalators (percentage change)

Year ending 30 June	*Communications (Assets)*	*Telecommunications revenue*	*Communications equipment (Other costs)*
1980	12.34	5.03	10.41
1981	10.26	3.11	7.95
1982	9.93	13.69	7.47
1983	14.48	12.85	11.65
1984	7.57	7.92	6.65
1985	7.85	5.37	6.61
1986	7.90	4.25	7.63
1987	9.52	3.10	9.59
1988	6.81	11.37	6.76
1989	5.98	3.56	5.92
1990	3.64	3.27	3.41
1991	3.07	-0.78	3.21
1992	2.63	-3.01	2.63
1993	10.23	-3.60	10.23
1994	2.45	-3.60	2.45

Sources ABS, Austel and BIE estimates.

Table A3.2 Estimated Net Investment and Current Value of Fixed Assets

Year ending 30 June	*Investment*	*Communications (Asset) escalator*	*Depreciation*[a]	*Capital stock*
	$m	*Per cent*	*$m*	*$m*
1980	1 022.1	12.3	1 361.0	10 357.5
1981	1 186.7	10.3	1 459.4	11 106.4[b]
1982	1 272.4	9.9	1 560.6	11 877.1
1983	1 675.8	14.5	1 772.0	13 485.5
1984	1 475.1	7.6	1 849.5	14 075.3
1985	1 639.0	7.8	1 947.9	14 823.9
1986	2 105.7	7.9	2 102.3	15 999.0
1987	2 561.3	9.5	2 336.5	17 781.3
1988	2 298.0	6.8	2 469.7	18 794.9
1989	2 656.5	6.0	2 622.5	19 958.3
1990	3 096.2	3.6	2 767.8	21 063.8
1991	3 114.9	3.1	2 887.1	21 971.7
1992	3 015.0	2.6	2 969.7	22 600.7
1993	2 588.5	10.2	3 183.6	24 228.2
1994	2 370.1	2.4	3 144.4	23 929.7

[a] Based on a declining balance depreciation rate of 13.14 per cent.
[b] Point estimate of the capital stock from the Davidson Committee plus the net book value of OTC's assets.
Sources: Telstra 1994, AOTC 1992, OTC 1991, Telecom 1991 and earlier issues, ITU 1994, Lawrence et al 1992, and BIE estimates.

Table A3.3 Estimated Value of the Annual User Cost of Capital

Year ending 30 June	*Bond rate plus depreciation*[a]	*dP/P*	*Value of the annual user cost of capital $m*
1980	0.25	0.12	1 300.72
1981	0.26	0.10	1 774.63
1982	0.30	0.10	2 329.45
1983	0.28	0.14	1 822.51
1984	0.27	0.08	2 719.40
1985	0.27	0.08	2 786.04
1986	0.26	0.08	2 910.22
1987	0.26	0.10	2 919.21
1988	0.25	0.07	3 435.35
1989	0.27	0.06	4 123.11
1990	0.27	0.04	4 822.72
1991	0.25	0.03	4 740.34
1992	0.22	0.03	4 387.86
1993	0.20	0.10	2 485.19
1994	0.21	0.02	4 445.61

[a] The declining balance depreciation rate of 13.14 per cent.
Sources: Reserve Bank of Australia 1994, and earlier issues, ABS 1994, unpublished information, and Lawrence et al 1992.

Table A3.4 Output, Input and TFP Indexes

Year ending 30 June	*Output*	*Input*	*TFP*
1980	1.0	1.0	1.0
1981	1.1	1.0	1.1
1982	1.2	1.0	1.2
1983	1.2	1.0	1.2
1984	1.4	1.1	1.2
1985	1.5	1.2	1.3
1986	1.6	1.2	1.4
1987	1.8	1.2	1.5
1988	2.1	1.3	1.6
1989	2.2	1.3	1.7
1990	2.5	1.4	1.8
1991	2.7	1.4	1.9
1992	3.0	1.5	2.0
1993	3.3	1.4	2.4
1994	3.6	1.4	2.6

Source: BIE estimates.

Table A3.5 Value and Quantity of Services offered by Telstra

Year ending 30 June	Telephone calls		Telephone services in operation		Telephone connections	
	$m	m	$m	m	$m	m
1980	1 355.37	5 391.90	602.66	4.74	102.90	0.50
1981	1 533.17	6 004.60	674.10	5.07	119.56	0.53
1982	1 761.61	6 249.40	833.20	5.36	142.73	0.51
1983	2 011.55	6 452.30	1 001.21	5.59	157.75	0.50
1984	2 328.98	7 146.20	1 165.91	5.85	178.63	0.51
1985	2 640.43	7 637.70	1 290.55	6.19	187.84	0.59
1986	3 003.76	8 299.80	1 407.68	6.50	224.05	0.61
1987	3 282.90	8 914.80	1 542.40	6.82	258.20	0.62
1988	3 904.20	9 656.90	1 819.50	7.12	303.80	0.64
1989	4 278.20	9 893.30	2 003.50	7.51	333.72[a]	0.68
1990	4 704.20	10 805.10	2 034.90	7.97	336.30[a]	0.71
1991	5 083.50	11 553.80	2 252.80	8.34	253.67[a]	0.51
1992	4 960.33[a]	11 624.00[b]	2 163.80[a]	8.26	243.65[a]	0.50[e]
1993	5 059.78[a]	12 300.00[c]	2 157.42[a]	8.54[c]	242.93[a]	0.52[e]
1994	5175.52[a]	13 051.19[d]	2 155.24[a]	8.85	242.69[a]	0.54[e]

Table A3.5 Value and Quantity of Services offered by Telstra *(continued)*

Year ending 30 June	Telegrams /Faxpost		Telex services in operation		Telex calls		Other network services	
	$m	m	$m	m	$m	m	$m	quantity[f]
1980	32.50	7.06	25.64	0.03	28.94	45.82	313.28	471.25
1981	33.01	6.52	29.83	0.03	29.35	52.95	402.81	587.66
1982	30.17	5.78	40.02	0.04	32.49	55.01	504.67	647.62
1983	29.00	5.02	56.75	0.04	34.56	57.78	645.16	733.60
1984	27.42	4.45	59.44	0.04	35.01	60.06	764.66	805.70
1985	26.11[a]	4.03	66.62[a]	0.04	40.32	63.64	925.00	925.00
1986	23.09[a]	3.41	71.89[a]	0.05	35.73	66.42	1 178.79	1130.72
1987	19.28[a]	2.77	68.20[a]	0.04	28.53	61.54	1 400.65	1 303.17
1988	15.55[a]	2.00	58.47[a]	0.03	25.08	50.25	2 240.08	1 871.38
1989	11.04[a]	1.37	46.01[a]	0.02	11.53[a]	22.30	2 572.84	2 075.45
1990	5.82[a]	0.70	34.24[a]	0.02	6.41[a]	12.00	3 254.23	2 541.85
1991	0.24[a]	0.03	22.86[a]	0.01	4.45[a]	8.40	3 604.93	2 838.01
1992	0.27[a]	0.03[d]	17.08[a]	0.01[d]	2.36[a]	4.60	4 841.02	3 929.54
1993	0.06[a]	0.01[d]	11.71[a]	0.01[d]	1.22[a]	2.47	5 182.87	4 364.14
1994	0.01[a]	0.00[d]	8.04[a]	0.00[d]	0.73[a]	1.53[b]	5 780.27	5 048.92

[a] Estimated by escalating unit revenue in the previous year by the telecommunications revenue escalator multiplied by the output quantity.
[b] ITU (1994) adjusted to include mobiles.
[c] InterData (1994).
[d] Estimated on the basis of the trend growth over the past five years.
[e] Estimated based on the annual growth in services in operation.
[f] The implicit quantity of other network services was estimated as other network revenue deflated by the telecommunications revenue price index.

Sources: Telecom 1991 and earlier issues, OTC 1991, and earlier issues , AOTC 1992, Telstra 1994, and earlier issues, ITU 1994, Lawrence et al 1992, and BIE estimates.

Table A3.6 Value and Quantity of Inputs used by Telstra

Year	Labour		Capital		Other	
	$m	Employees[a]	$m	quantity[b]	$m[c]	Quantity[d]
1980	1 175.20	87 835.00	1 300.72	16 672.00	201.59	296.89
1981	1 330.00	89 111.00	1 774.63	16 213.73	257.27	350.98
1982	1 540.60	89 798.00	2 329.45	15 773.01	370.27	470.03
1983	1 750.70	89 333.00	1 822.51	15 644.47	572.09	650.47
1984	1 831.30	89 193.00	2 719.40	15 179.59	961.60	1 025.16
1985	2 006.90	91 387.00	2 786.04	14 823.94	1 460.80	1 460.80
1986	2 186.10	94 420.00	2 910.22	14 827.62	1 392.37	1 293.72
1987	2 300.50	93 857.00	2 919.21	15 046.61	1 778.15	1 507.54
1988	2 393.00	89 669.00	3 435.35	14 890.03	2 591.49	2 057.96
1989	2 423.90	84 104.00	4 123.11	14 919.31	2 838.41	2 128.14
1990	2 643.70	86 728.00	4 822.72	15 192.04	3 710.10	2 689.94
1991	2 699.50	83 932.00	4 740.34	15 375.61	3 944.61	2 771.07
1992	2 985.20[e]	70 800.00[g]	4 387.86	15 411.15	5 283.43	3 616.63
1993	2 687.00[f]	67 000.00[h]	2 485.19	14 987.35	4 954.10	3 076.40
1994	2 851.60[f]	65 953.00[i]	4 445.61	14 449.11	5 022.30	3 044.25

[a] Average number of full-time staff.
[b] Estimated using IC (1990) method. Implicit quantity of capital is derived by deflating the nominal value of the capital stock by ABS implicit price deflator for total communications.
[c] Other expenses are calculated as total operating expenses less depreciation, interest paid and labour costs.
[d] Implicit quantity of other expenses is given by deflating the value of other expenses by the ABS implicit price deflator for communications equipment.
[e] OECD 1994.
[f] Value added, which consists of wages, superannuation and worker's compensation.
[g] ITU 1994.
[h] IBIS 1994.
[i] Telstra 1994a.

Sources: Telecom 1991, and earlier issues, OTC 1991, and earlier issues, AOTC 1992, Telstra 1994, and earlier issues, Telstra 1994, ABS 1994, unpublished data, ITU 1994, OECD 1994, Lawrence et al 1992.

Table A3.7 Contribution of growth in TFP and input use to growth in output

Period	Annual average growth in output	Annual average growth in inputs	Annual average growth in TFP	Contribution of TFP to output growth
1980 to 1986	7.9	3.2	4.7	60
1986 to 1994	9.8	1.8	8.0	81
1980 to 1994	9.2	3.0	6.3	68
1991 to 1994	9.3	-2.5	11.9	127

Note: Growth in output, input use and total factor productivity was found by regressing the natural logarithm of these variables against time and a constant term.
Source: BIE estimates.

Table A3.8 Economic Rate of Return Earned by Telstra

Year	Total revenue	Interest received	Expenses	Interest paid	Depreciation		EBIT[a]	Capital stock[b]	Real rate of return
					Book value	Current			
	$m	$m	$m	$m	$m	$m	$m	$m	Per cent
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]=[7]/[8]
1980	2 461.28	16.66	2 199.42	367.13	455.50	1 364.03	- 296.19	10 357.5	-2.83
1981	2 821.83	26.51	2 539.21	408.13	543.82	1 459.38	- 251.33	**11 106.4**	-2.26
1982	3 344.88	28.41	3 026.02	518.70	596.45	1 557.39	- 151.79	11 877.1	-1.31
1983	3 935.97	25.70	3 713.78	658.78	732.22	1 755.27	- 167.78	13 485.5	-1.37
1984	4 560.06	23.96	4 254.59	870.12	591.57	1 825.68	- 82.47	14 075.3	-0.76
1985	5 176.87	36.64	5 056.41	911.60	677.11	1 916.51	- 243.98	14 823.9	-1.86
1986	5 944.99	43.30	5 379.53	947.65	853.41	2 056.48	266.74	15 999.0	1.38
1987	6 600.16	37.27	6 020.24	1 050.74	890.85	2 272.13	212.11	17 781.3	0.83
1988	8 366.69	42.02	7 400.09	1 177.65	1 237.96	2 401.83	938.34	18 794.9	4.63
1989	9 256.84	108.73	7 988.90	1 170.03	1 556.56	2 550.10	1 335.71	19 958.3	6.33
1990	10 396.11	172.19	9 105.61	1 175.90	1 575.91	2 685.19	1 184.92	21 063.8	5.23
1991	11 222.46	150.75	9 596.96	1 198.12	1 754.72	2 796.60	1 630.99	21 971.7	7.01
1992	12 228.50	102.65	11 570.30	1 201.44	2 100.23	2 889.07	968.15	22 600.7	3.93
1993	12 656.00	83.40	10 661.80	898.20	2 122.50	3 106.36	1 825.14	24 228.2	7.21
1994	13 362.50	69.20	10 837.60	824.20	2 139.50	3 075.64	2 343.76	23 929.7	9.51

[a] Earning including abnormal items before interest and tax {[7]=([1]-[2])-([3]-[4]-[5]+[6])}.
[b] BIE estimates of the current value of Telstra fixed assets.
Sources: Telstra 1994, OTC 1991, Telecom 1991, AOTC 1992 and earlier issues, and BIE estimates.

Abbreviations

AARNet	Australian Academic and Research Network
AAPT	AAP Telecommunications
ABS	Australian Bureau of Statistics
AMPs	Advanced Mobile Phone System
APEC	Asia-Pacific Economic Co-operation
AOTC	Australian and Overseas Telecommunications Corporation
ATUG	Australian Telecommunications User Group
AUSTEL	Australian Telecommunications Authority
BCS	Basic Carriage Service
BT	British Telecom
CAGR	Compound Annual Growth Rate
CAN	Customer Access Network
CIT	Communications and Information Technology
CPE	Customer Premises Equipment
CPI	Consumer Price Index
DMF	Decision Making Framework
EDI	Electronic Document Interchange
FCC	Federal Communications Commission
FNA	Financial Network Association
FY	Financial Year
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
GSM	Group Speciale Mobile
IDD	International Direct Dial
ISDN	Integrated Services Digital Network
ISPCL	International Service Providers Class Licence

IT	Information Technology
ITU	International Telecommunications Union
IXN	Inter-exchange network
LEC	Local Exchange Company
LEO	Low Earth Orbit
MEO	Medium Earth Orbit
MFP	Multifactor Productivity
MiTTs	Minutes of International Telecommunications Traffic
MNEs	Multinational Enterprises
OECD	Organisation for Economic Co-operation and Development
OTC	Overseas Telecommunications Corporation
PACTS	Public Access Cordless Telephone Service
PMTS	Public Mobile Telephone Licences
PNS	Private Network Services
PPP	Purchasing Power Parities
PSDN	Packet-Switched Data Network
PSTN	Public Switched Telephone Network
PTO	Public Telecommunications Operator
RHQs	Regional Head Quarters
SP	Service Provider
SPA	Strategic Partnership Arrangement
SPAN	Service Providers Action Network
SPCL	Service Providers Class Licence
TFP	Total Factor Productivity
TIDA	Telecommunications Industry Development Authority
VAS	Value-added Services
WAN	Wide Area Network

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