
Population Distribution and Telecommunication Costs: Supplementary analyses

This is a supplement to the Staff Research Paper *Population Distribution and Telecommunication Costs* (Cribbett 2000) and should be read in conjunction with that Paper.

The supplementary analyses presented were undertaken at the suggestion of interested parties and because of the Commission's desire to enrich the analysis by examining other countries and US States. This analysis covers the US States examined by Ovum in their study for the ACCC into overseas access charges where the influence of line density was considered.

The Commission proposes to undertake additional analysis for its current international benchmarking study, which will compare the relative levels of telecommunications services between rural and remote areas and cities across a number of countries. The results of this work may be added to this supplement as this study progresses.

Supplementary analyses were undertaken for a number of US States (see table below).

US States and carriers examined

<i>US States</i>	<i>Carrier</i>
Illinois	Ameritech
Pennsylvania	Bell Atlantic ^a
Ohio	Cincinnati Bell
Nevada	Nevada Bell
New York	Bell Atlantic ^{a,b}
Massachusetts	Bell Atlantic ^{a,b}

^a Bell Atlantic merged with GTE on 3 July 2000 to form Verizon. ^b Nynex, which served New York and Massachusetts, merged with Bell Atlantic in August 1997.

The Staff Research Paper tables and figures listed in the table below have been reproduced with information from the supplementary analyses.

Tables and figures in Staff Paper reproduced for supplementary US States

<i>Title</i>	<i>Table</i>	<i>Figure</i>	<i>Staff Paper page no.</i>
Average lines per person by US State	3.3		19
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The tables and figures below have the same numbers as the corresponding numbers in the Staff Paper.

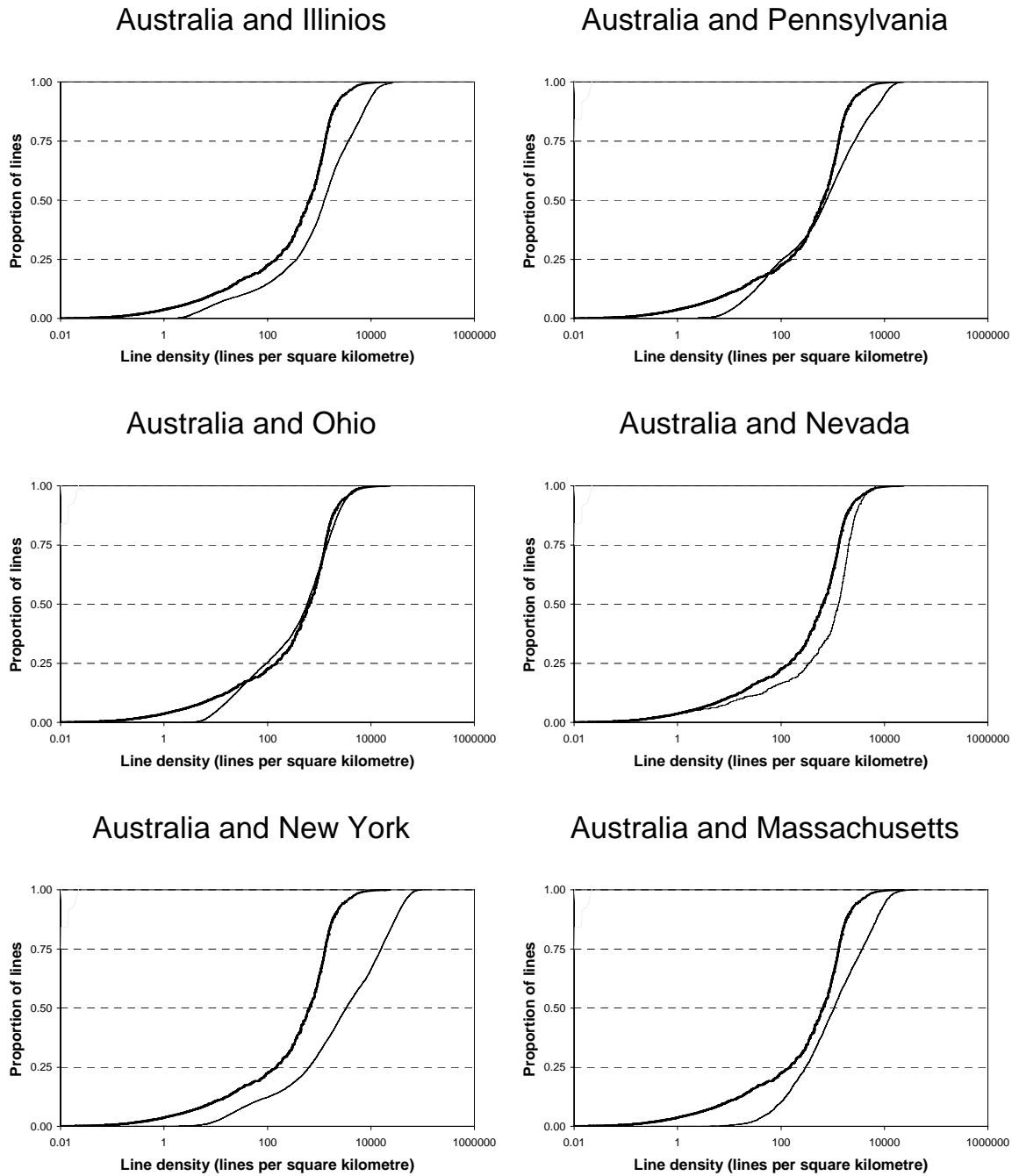
Table 3.3 Australia and selected US State average lines per person

	<i>Lines per person</i>
Australia	0.5188
Illinois	0.6645
Pennsylvania	0.6617
Ohio	0.7203
Nevada	0.7203
New York	0.7008
Massachusetts	0.7299

^a Australian lines per person from *World Telecommunications Development Report, Universal Access*, International Telecommunications Union, March 1998. US State estimates of lines per person based on US Census Bureau 1999 and US Federal Communications Commission 1999 — see appendix B.

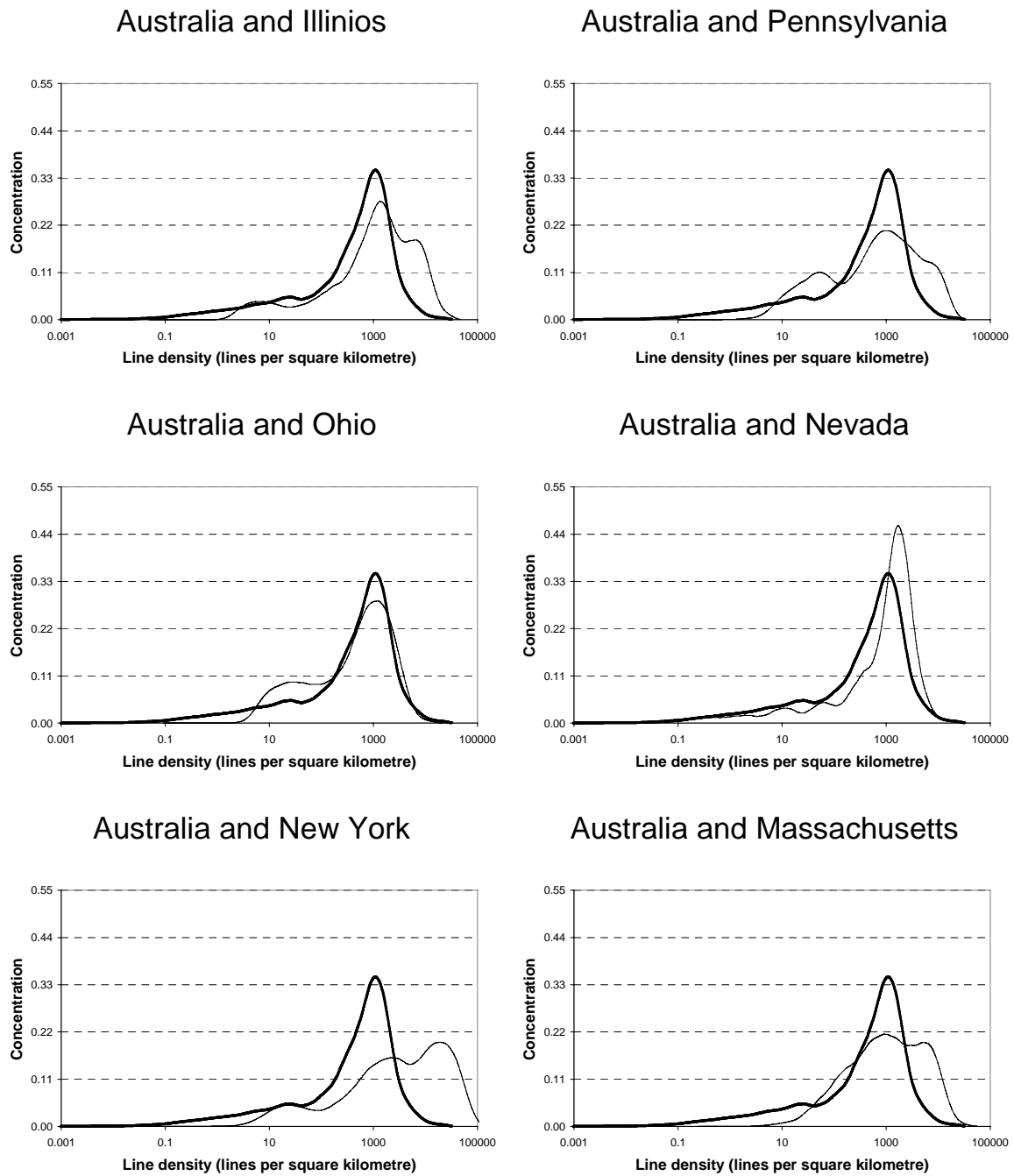
Source: International Telecommunications Union 1998, US Census Bureau 1999, US Federal Communications Commission 1999, Appendix B.

Figure 3.4 Line density — cumulative distribution functions



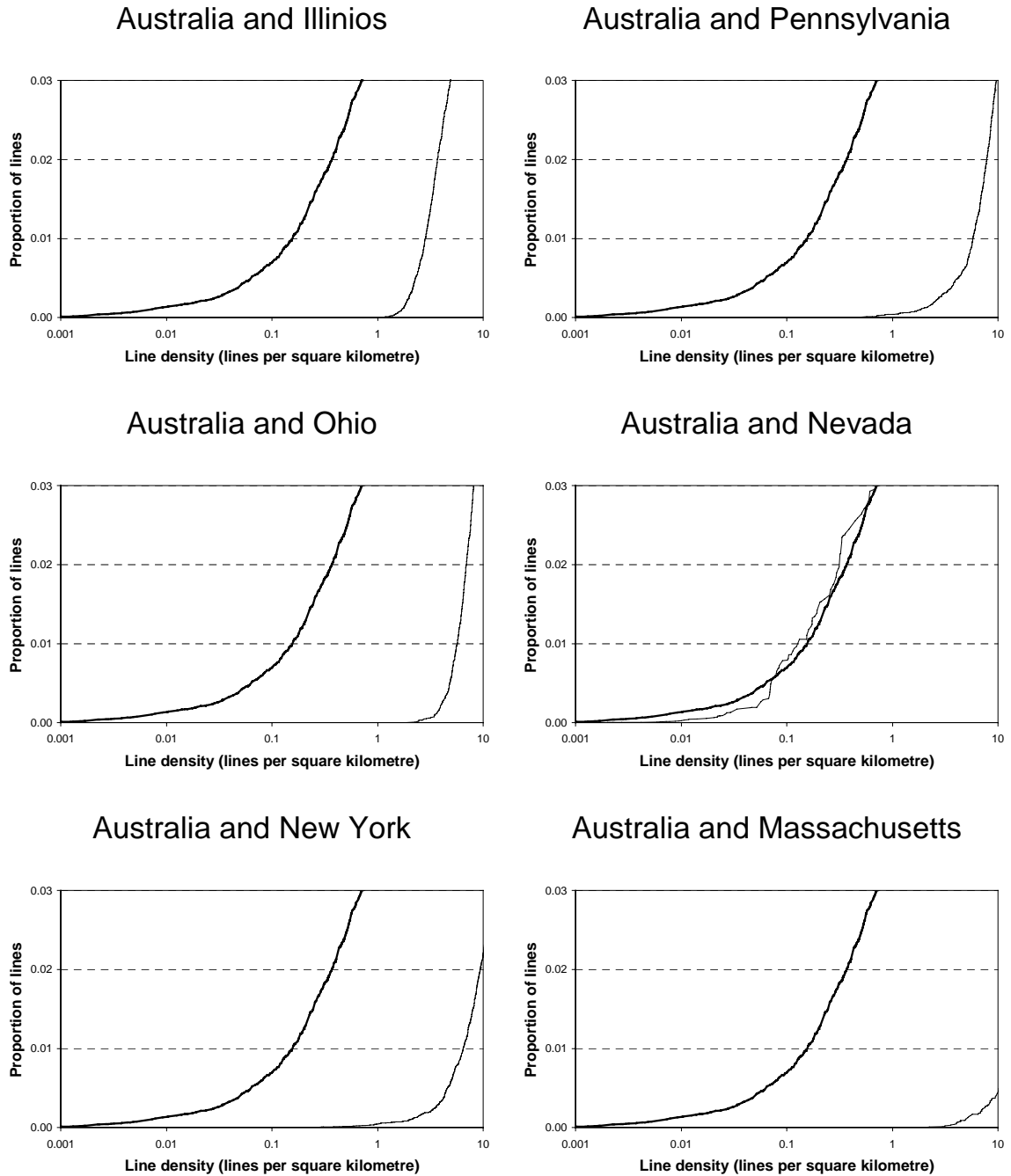
Note The darker line represents Australia's cumulative distribution function (CDF). Each country's CDF represents the proportion of total lines at or below a given line density.

Figure 3.5 Line density — probability density functions



Note The darker line represents Australia's probability density function (PDF). Each country's PDF represents the concentration (or probability density) of population at that population density. The area under a PDF curve, between two population densities, represents the proportion of population within that range.

Figure 3.6 Line density — cumulative distribution functions in low-density areas



Note The darker line represents Australia.

Table 4.2 Distributions of lines by line density categories
(per cent)

Line density categories (lines per square kilometre)	Country or State						
	Australia	Illinois	Pennsylvania	Ohio	Nevada	New York	Massachusetts
0 to 0.1	0.70	0.00 ^a	0.00	0.00	0.79	0.00 ^a	0.00
0.1 to 0.2	0.55	0.00 ^a	0.00 ^a	0.00 ^a	0.64	0.00 ^a	0.00
0.1 to 1.93	3.92	0.23	0.11	0.00 ^a	3.23	0.08	0.00 ^a
1.93 to 38.58	12.20	10.27	14.12	16.83	7.12	8.55	3.38
38.58 to 77.16	2.81	2.80	7.68	6.47	3.54	2.88	4.55
77.16 to 250.76	10.40	8.45	10.36	11.44	5.76	5.28	14.38
250.76 to 327.92	4.26	2.17	3.24	3.95	3.14	1.85	4.07
327.92 to 983.76	27.80	18.88	20.10	25.56	15.94	12.37	21.86
983.76 to 1928.94	25.97	19.09	13.87	19.12	31.08	10.03	14.43
1928.94 to 3857.88	7.62	14.02	11.88	13.02	22.98	11.35	13.06
3857.88 and above	3.76	24.08	18.64	3.60	5.81	47.61	24.27

Note The line share distributions were estimated from each country's population census data. Population shares were converted to line shares based on a line–population share relationship estimated from Australian data (Telstra's Exchange Service Area data). Comprehensive detail on the method of estimating the line share distributions is provided in appendix B. ^a Numbers range from 0.00007 to 0.004 per cent.

Table 4.3 Indexes of average line costs

Country or US State	Average country- or State-wide line density (lines per square kilometre)	Index of average line cost	
		BCPM (Telstra 1)	HAI (Telstra 1)
Australia	1.20	100	100
Nevada	4.24	92	88
Ohio	63.44	85	76
Pennsylvania	68.50	80	70
US average ^a	51.75	75	63
Illinois	55.43	74	61
Massachusetts	219.90	69	54
New York	103.96	68	53

Note The method of estimating Australian and US State average line costs is described in appendix B. The same cost relationship (cost per line as a function of lines per square kilometre) was used for each country and state in order to isolate the impact of different population distributions. All factors that might affect costs, other than line density, held constant. The BCPM and HAI based cost schedules were adjusted using Telstra cost data to improve cost estimates over the range 0 to 1.93 lines per square kilometre. ^a The weighted average of all US States considered (line shares were used as weights).

Table 4.4 Index of line costs using the adjusted BCPM cost schedule

Low density — 0 to 1.93 lines per square kilometre

<i>Country or US State</i>	<i>Per cent of lines in low density areas</i>	<i>Index of average line cost</i>		
		<i>Low density areas^a</i>	<i>Remaining areas^b</i>	<i>Overall</i>
Australia	5.17	460	80	100
Nevada	4.65	477	73	92
Ohio	0.002	389	85	85
Pennsylvania	0.11	389	80	80
Illinois	0.23	389	73	74
Massachusetts	0.004	389	69	69
New York	0.08	389	68	68

Note The method of estimating Australian and US State average line costs is described in appendix B. The same cost relationship (cost per line as a function of lines per square kilometre) was used for each country and state in order to isolate the impact of different population distributions. All factors that might affect costs, other than line density, held constant. The BCPM based cost schedule was adjusted using Telstra cost data to improve cost estimates over the range 0 to 1.93 lines per square kilometre.

^a Low-density areas are those with line densities between 0 and 1.93 lines per square kilometre (0 and 5 lines per square mile). ^b Remaining areas are those with more than 1.93 lines per square kilometre.

Table 4.5 Index of line costs using the adjusted HAI cost schedule

Low density — 0 to 1.93 lines per square kilometre

<i>Country or US State</i>	<i>Per cent of lines in low density areas</i>	<i>Index of average line cost</i>		
		<i>Low density areas^a</i>	<i>Remaining areas^b</i>	<i>Overall</i>
Australia	5.17	666	69	100
Nevada	4.65	691	58	88
Ohio	0.002	563	76	76
Pennsylvania	0.11	563	70	70
Illinois	0.23	563	60	61
Massachusetts	0.004	563	54	54
New York	0.08	564	52	53

Note The method of estimating Australian and US State average line costs is outlined in appendix B. The same cost relationship (cost per line as a function of lines per square kilometre) was used for each country and state in order to isolate the impact of different population distributions. All factors that might affect costs, other than line density, held constant. The HAI based cost schedule was adjusted using Telstra cost data to improve cost estimates over the range 0 to 1.93 lines per square kilometre.

^a Low-density areas are those with line densities between 0 and 1.93 lines per square kilometre (0 and 5 lines per square mile). ^b Remaining areas are those with more than 1.93 lines per square kilometre.

The results for the original countries and US States examined together with those included in the supplementary analyses are presented in the tables below (again with the same table numbers as the corresponding numbers in the Staff Paper).

Table 4.3 Indexes of average line costs

<i>Country or US State</i>	<i>Average country- or State-wide line density (lines per square kilometre)</i>	<i>Index of average line cost</i>	
		<i>BCPM (Telstra 1)</i>	<i>HAI (Telstra 1)</i>
Finland	9.10	115	123
Australia	1.20	100	100
Oregon	8.13	98	96
New Zealand	6.50	96	93
Nevada	4.24	92	88
Washington	20.29	87	80
Ohio	63.44	85	76
Pennsylvania	68.50	80	70
Illinois	55.43	74	61
Massachusetts	219.90	69	54
California	53.18	69	53
New York	103.96	68	53

Note The method of estimating Country and US State average line costs is described in appendix B. The same cost relationship (cost per line as a function of lines per square kilometre) was used for each country and state in order to isolate the impact of different population distributions. All factors that might affect costs, other than line density, held constant. The BCPM and HAI based cost schedules were adjusted using Telstra cost data to improve cost estimates over the range 0 to 1.93 lines per square kilometre.

Table 4.4 Index of line costs using the adjusted BCPM cost schedule

Low density — 0 to 1.93 lines per square kilometre

<i>Country or US State</i>	<i>Per cent of lines in low density areas</i>	<i>Index of average line cost</i>		
		<i>Low density areas^a</i>	<i>Remaining areas^b</i>	<i>Overall</i>
Finland	4.29	396	103	115
Australia	5.17	460	80	100
Oregon	3.52	422	86	98
New Zealand	5.43	402	78	96
Nevada	4.65	477	73	92
Washington	2.12	397	80	87
Ohio	0.002	389	85	85
Pennsylvania	0.11	389	80	80
Illinois	0.23	389	73	74
Massachusetts	0.004	389	69	69
California	0.66	399	66	69
New York	0.08	389	68	68

Note The method of estimating Country and US State average line costs is described in appendix B. The same cost relationship (cost per line as a function of lines per square kilometre) was used for each country and state in order to isolate the impact of different population distributions. The BCPM based cost schedule was adjusted using Telstra cost data to improve cost estimates over the range 0 to 1.93 lines per square kilometre. ^a Low-density areas are those with line densities between 0 and 1.93 lines per square kilometre (0 and 5 lines per square mile). ^b Remaining areas are those with more than 1.93 lines per square kilometre.

Table 4.5 Index of line costs using the adjusted HAI cost schedule
 Low density — 0 to 1.93 lines per square kilometre

<i>Country or US State</i>	<i>Per cent of lines in low density areas</i>	<i>Index of average line cost</i>		
		<i>Low density areas^a</i>	<i>Remaining areas^b</i>	<i>Overall</i>
Finland	4.29	574	103	123
Australia	5.17	666	69	100
Oregon	3.52	612	77	96
New Zealand	5.43	582	65	93
Nevada	4.65	691	58	88
Washington	2.12	576	69	80
Ohio	0.002	563	76	76
Pennsylvania	0.11	563	70	70
Illinois	0.23	563	60	61
Massachusetts	0.004	563	54	54
California	0.66	578	50	53
New York	0.08	564	52	53

Note The method of estimating Country and US State average line costs is outlined in appendix B. The same cost relationship (cost per line as a function of lines per square kilometre) was used for each country and state in order to isolate the impact of different population distributions. All factors that might affect costs, other than line density, held constant. The HAI based cost schedule was adjusted using Telstra cost data to improve cost estimates over the range 0 to 1.93 lines per square kilometre. ^a Low-density areas are those with line densities between 0 and 1.93 lines per square kilometre (0 and 5 lines per square mile). ^b Remaining areas are those with more than 1.93 lines per square kilometre.