I Regional data analysis

In chapter 10, the Commission discussed the results from a basic analysis of estimating the relationships between income levels, number of gaming machines and expenditure on gaming machines in different regions within New South Wales, Victoria, Queensland and South Australia. The econometric analysis involves the regression of cross-sectional data to provide an indication of the relationships between these variables. Chapter 10 presented a summary of the results *weighted* by the *adult population* in each region.

This appendix outlines the data and methodology underlying those results, as well as presenting similar results, on an *unweighted* basis — that is, not adjusting for the population in a region. The results from the analyses show correlation and not causation between the variables.

I.1 Data sources and issues

The data are sourced from the Australian Bureau of Statistics (ABS) and the state gaming authorities (table I.1) for New South Wales, Victoria, Queensland and South Australia. The Commission did not undertake analyses of other jurisdictions because of data limitations and, in the case of Western Australia, its prohibition on gaming machines outside the casino.

Australian Bureau of Statistics data

The ABS data is the *median weekly income* and *adult population* for regions. It is sourced from *1996 Census of Population and Housing — State Summaries* (ABS 1996a). Regional *median weekly income* per person is the median personal weekly income and the regional *adult population* is the sum of people aged over 18. The only income data provided by the ABS for regions is *median weekly income*. The data is as recorded on 1996 census night for each statistical local area (SLA), as defined by the ABS.

State Gaming Authorities data

The state gaming authorities data mainly includes:

- the *number of venues* — mainly, hotels and clubs — in each region;
- the *number of gaming machines* in each region; and
- data to calculate the *average annual expenditure on gaming machines* per person in each region (total profit, total metered wins and net revenue).

In Victoria, data was unavailable to calculate the *average annual expenditure on gaming machines*.

Table I.1 **Data sources and calculations**

	New South Wales	*Victoria*[a]	*Queensland*	*South Australia*
Year	1997-98	1997-98	1997-98	Year ended 31 August 1999
Data sources	Department of Gaming and Racing (DGR 1999b)	Victorian Casino and Gaming Authority (VCGA 1998a)	Queensland Office of Gaming Regulation (QOGR 1998b)	South Australian Liquor and Gaming Commission
Data	Number of venues per region Number of gaming machines per region Total profit on gaming machines per region (table I.6)	Number of venues per Local Government Area (LGA) Number of gaming machines per LGA (tables I.7 and I.8)	Adult population per region Average metered win per gaming machine per region Number of venues per region Number of gaming machines per region (table I.9)	Number of gaming machines per region Net revenue from gaming machines per region
Estimated average expenditure on gaming machines per person per region	Total profit on gaming machines divided by adult population	na	Total metered wins[b] divided by divided by adult population	Net revenue from gaming machines divided by adult population

na not available **a** Data was not available for Victoria to estimate *average annual expenditure on gaming machines* per person in each region. **b** Total metered wins is the average metered win per venue for each region multiplied by the number of venues in each region.

Adjustments and calculations

While there was a reasonable, but not perfect, concordance between the data sourced from the state gaming authorities and the ABS, a number of adjustments and calculations were made to the data to improve this:

- In Victoria, the ABS SLAs were aggregated to concord exactly with each local government area (LGA) (ABS 1998a).
- The *median weekly income* data for regions in New South Wales, Queensland and South Australia were estimated as the weighted-average of median incomes of all SLAs (defined by the ABS) in a region (defined by state authorities). Weights were based on *adult population* size.
- The *adult population* data for each region in New South Wales, Victoria and South Australia was concorded with the regions defined by the state gaming authorities for their data on the *number of venues* and the *number of gaming machines*. In Queensland, the regional *adult population* data was sourced from the Queensland Office of Gaming Regulation. There was no need to do an *adult population* concordance for Queensland.
- The *average annual expenditure on gaming machines* per person in a region was estimated from data sourced from state authorities, except Victoria where the data was not available (table I.1).

I.2 Methodology

The regional data was used to estimate the relationships between income, number of gaming machines and expenditure on gaming machines on an *unweighted* and *weighted* basis for each state.

Unweighted estimation

The relationships estimated between *median weekly income*, the *number of gaming machines* and *average annual expenditure on gaming machines* in each state on an *unweighted* basis are represented in table I.2. The equations were econometrically estimated using 'ordinary least squares' technique.

Table I.2 **Unweighted estimation**

Median weekly income and the number of gaming machines	*Average annual expenditure on gaming machines and the number of gaming machines*	*Median weekly income and average annual expenditure on gaming machines*
$Y_{ij} = \beta_{1j} + \beta_{2j} NGM_{ij}$	$GE_{ij} = \beta_{1j} + \beta_{2j} NGM_{ij}$	$Y_{ij} = \beta_{1j} + \beta_{2j} GE_{ij}$

where:

Y_{ij} median weekly income per person in region *i* in state *j*;

NGM_{ij} number of gaming machines in region *i* in state *j;* and

GE_{ij} average annual expenditure on gaming machines per person in region *i* in state *j.*

Weighted estimation

A potential problem with the *unweighted* approach is that it fails to take account of differences in the size of the adult population between regions. For example, in Victoria the *unweighted* analysis applies the same weight to the Borough of Queenscliff, which has an adult population of 2600, as to the City of Greater Geelong, which has a population of over 130 000. The *unweighted* analysis applies too much weight to regions with small populations and, conversely, too little weight to regions with large populations.

To take account of the differing populations for regions within a state, the Commission included a 'weighted variable' in the *unweighted* equations in table I.2. The input for this variable is the *adult population* per region divided by the adult population of all regions with gaming machines in that state. The equations are then estimated using 'weighted least squares' where the input for the weighted variable is square rooted and multiplied by each observation of the dependent and independent variables. The weights are then normalised to sum to the number of observations. The weighted variable is represented by the term W_{ij} in the equations in table I.3.

The relationship between *median weekly income*, the *number of gaming machines* in a region and *average annual expenditure on gaming machines* on a *weighted* basis are represented in table I.3.

Table I.3 **Weighted estimation**

Relationship between	*Equations*
Median weekly income and the number of gaming machines	$Y_{ij} \times W_{ij} = \beta_{1j} + \beta_{2j}(NGM_{ij} \times W_{ij})$
Average annual expenditure on gaming machines and the number of gaming machines	$GE_{ij} \times W_{ij} = \beta_{1j} + \beta_{2j}(NGM_{ij} \times W_{ij})$
Median weekly income and average annual expenditure on gaming machines	$Y_{ij} \times W_{ij} = \beta_{1j} + \beta_{2j}(GE_{ij} \times W_{ij})$

where:

Y_{ij} median weekly income per person in region *i* in state *j*;

NGM_{ij} number of gaming machines in region *i* in state *j;*

GE_{ij} average annual expenditure on gaming machines in region *i* in state *j*; and

W_{ij} the population in region *i* in state *j*, divided by the population of all regions with gaming machines in state *j.*

I.3 Results

The *unweighted* and *weighted* analysis yields similar results for the selected states. The *weighted* results are a better estimation of the relationships, but the unweighted provide an indication of the results that can also be shown graphically. The statistical significance of the results have been assessed at the 5 per cent level.

Unweighted results

The *unweighted* results provide an indication of the relationship between income, gaming expenditure and the number of gaming machines in selected states. This analysis has only been provided to show the nature of the relationship diagrammatically. The results from the *weighted* analysis, presented in the following section, are a better indicator of these relationships, but are unable to be shown graphically because of their three dimensional nature.

The Commission's *unweighted* analysis suggests that there is:

- a negative and statistically significant relationship between *median weekly income* and the *number of gaming machines* in New South Wales and South Australia — at lower income levels there were a greater the number of gaming

machines. There is no statistically significant relationship in Queensland and Victoria;

- a positive and statistically significant relationship between *average annual expenditure on gaming machines* and the *number of gaming machines* in all states examined — at higher levels of expenditure on gaming machines there were a greater the number of machines; and
- no statistically significant relationship between *median weekly income* and *average annual expenditure on gaming machines* for all states examined (table I.4 and figures I.1 to I.3).

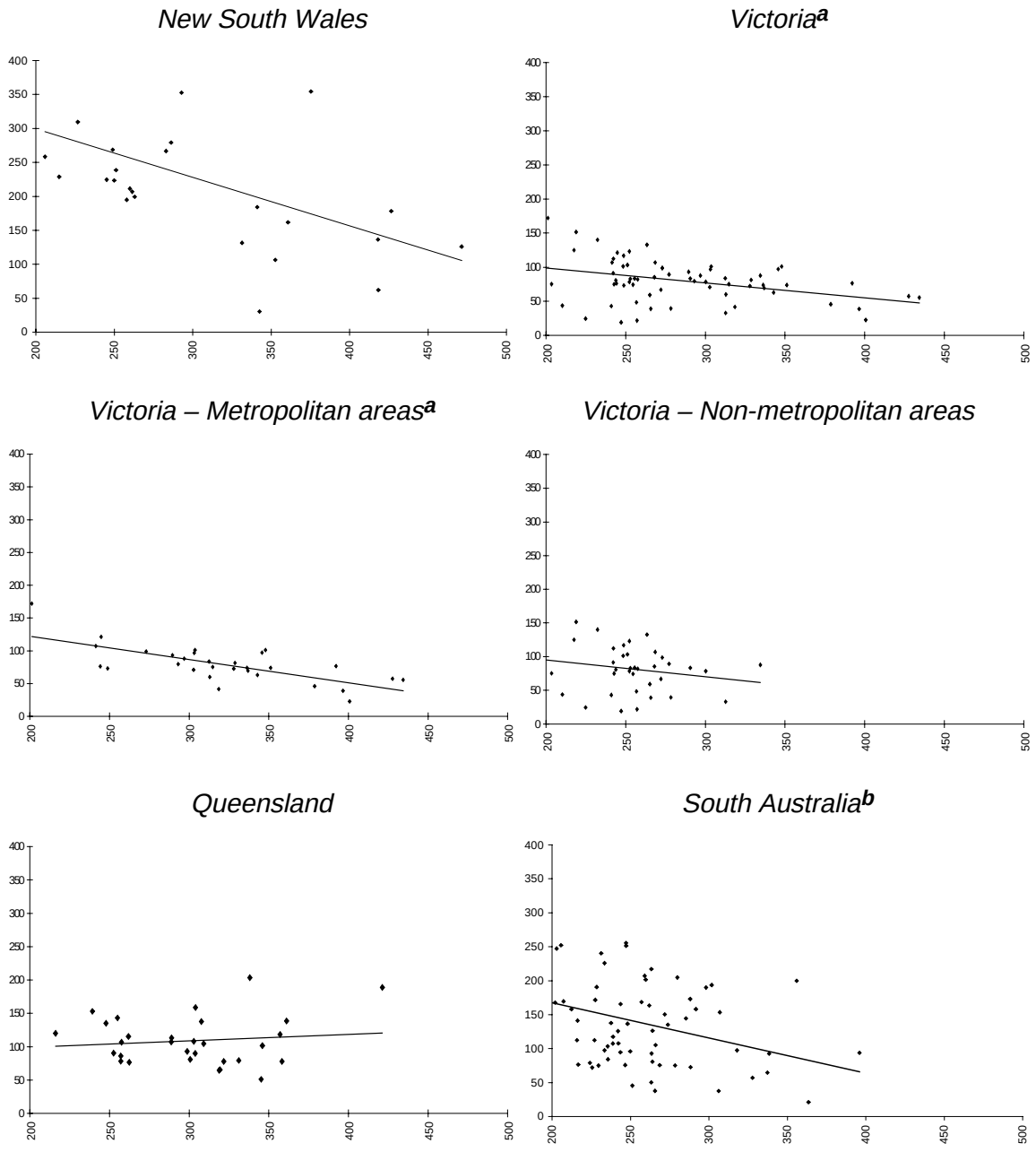
Table I.4 **Unweighted results for selected states**[ab]

	Unweighted coefficient (t statistic)			
Relationship between	*NSW*	*Vic*[cde]	*Qld*	*SA*[f]
Median weekly income and the number of gaming machines	Negative and significant -0.71 (-3.48)	No significant relationship -0.05 (-0.62)	No significant relationship 0.10 (0.52)	Negative and significant -0.52 (-2.82)
Average annual expenditure on gaming machines and the number of gaming machines	Positive and significant 2.12 (7.51)	na	Positive and significant 2.76 (8.81)	Positive and significant 1.66 (5.69)
Median weekly income and average annual expenditure on gaming machines	No significant relationship -0.69 (-1.10)	na	No significant relationship 0.50 (0.72)	No significant relationship -0.51 (-0.98)

na not available **a** The data used for *median weekly income*, the *number of gaming machines* and *average annual expenditure on gaming machines* are explained in section I.1. **b** The results are statistically significant at the 5 per cent level. **c** Data are unavailable on *average annual expenditure on gaming machines* in Victoria. **d** Data for the City of Melbourne produces an outlier that has been removed from the analysis. This region has a large number of gaming machines and high median incomes. Including the City of Melbourne yields the following results: *median weekly income* and the *number of gaming machines* 0.01 (0.08). **e** Analysis was also undertaken for metropolitan and non-metropolitan regions. The results for metropolitan regions (excluding the City of Melbourne) are -0.35 (-3.98) and for non-metropolitan regions are 0.07 (0.32). **f** Data for the City of Adelaide and Roxby Downs produce two outliers that have been removed from the analysis. These regions have a large number of gaming machines and high median incomes. Including the City of Adelaide and Roxby Downs yields the following results: *median weekly income* and the *number of gaming machines* 0.06 (0.32), *average annual expenditure on gaming machines* and the *number of gaming machines* 2.09 (10.30) and *median weekly income* and *average expenditure on gaming machines* 1.48 (2.17).

Figure I.1 **Income and the number of gaming machines for selected states**

Vertical axis – number of gaming machines per 10 000 adults in each region
Horizontal axis – median weekly income per person in each region



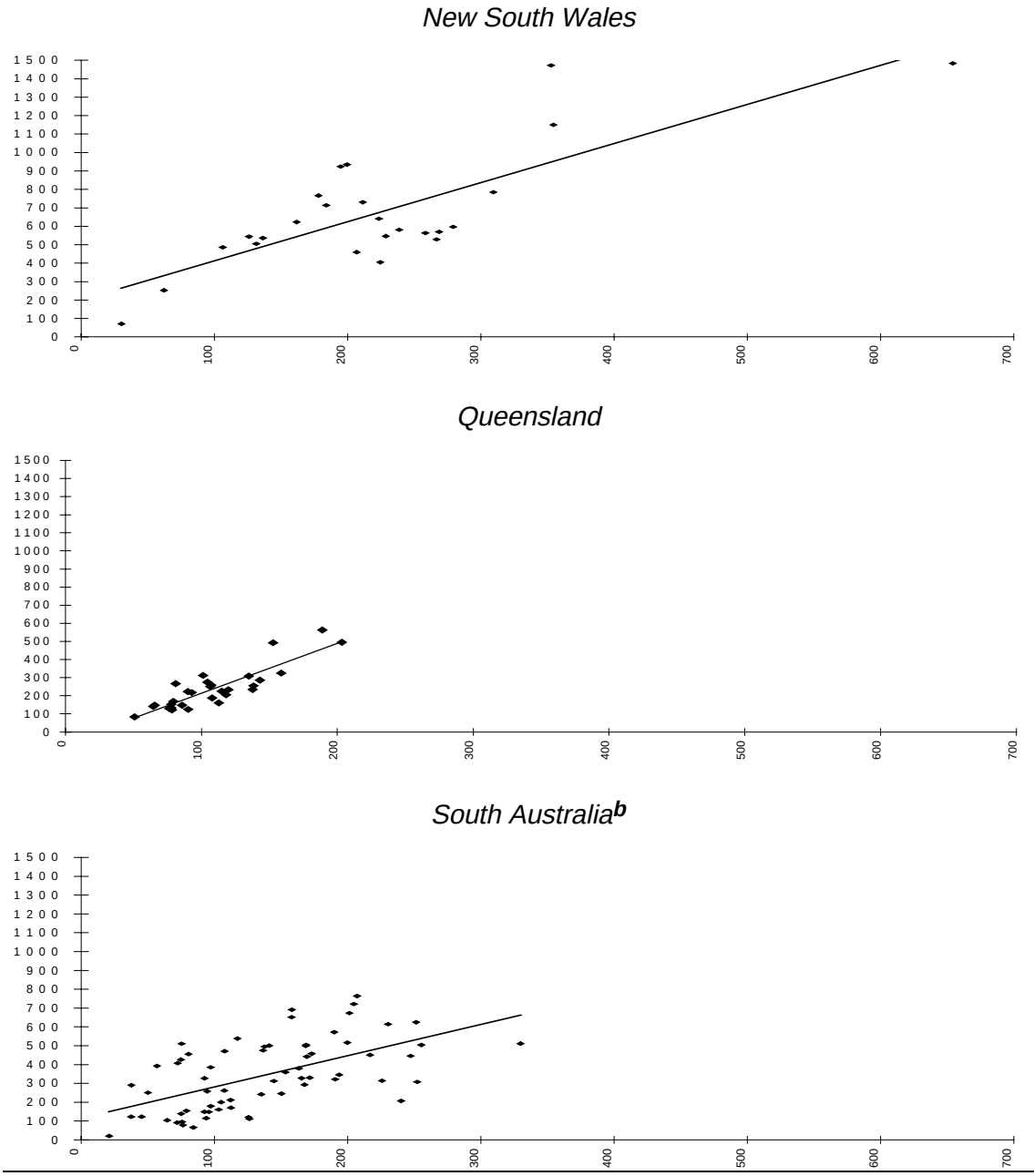
a Data for the City of Melbourne produces an outlier that has been removed from the analysis. **b** Data for the City of Adelaide and Roxby Downs produce two outliers that have been removed from the analysis

Data source: ABS (1996a), DGR(1996b), QOGR (1998b) and VCGA (1998).

Figure I.2 **Expenditure on gaming machines and the number of gaming machines for selected states**[a]

Vertical axis – average annual expenditure on gaming machines per person in each region

Horizontal axis – number of gaming machines per 10 000 adults in each region



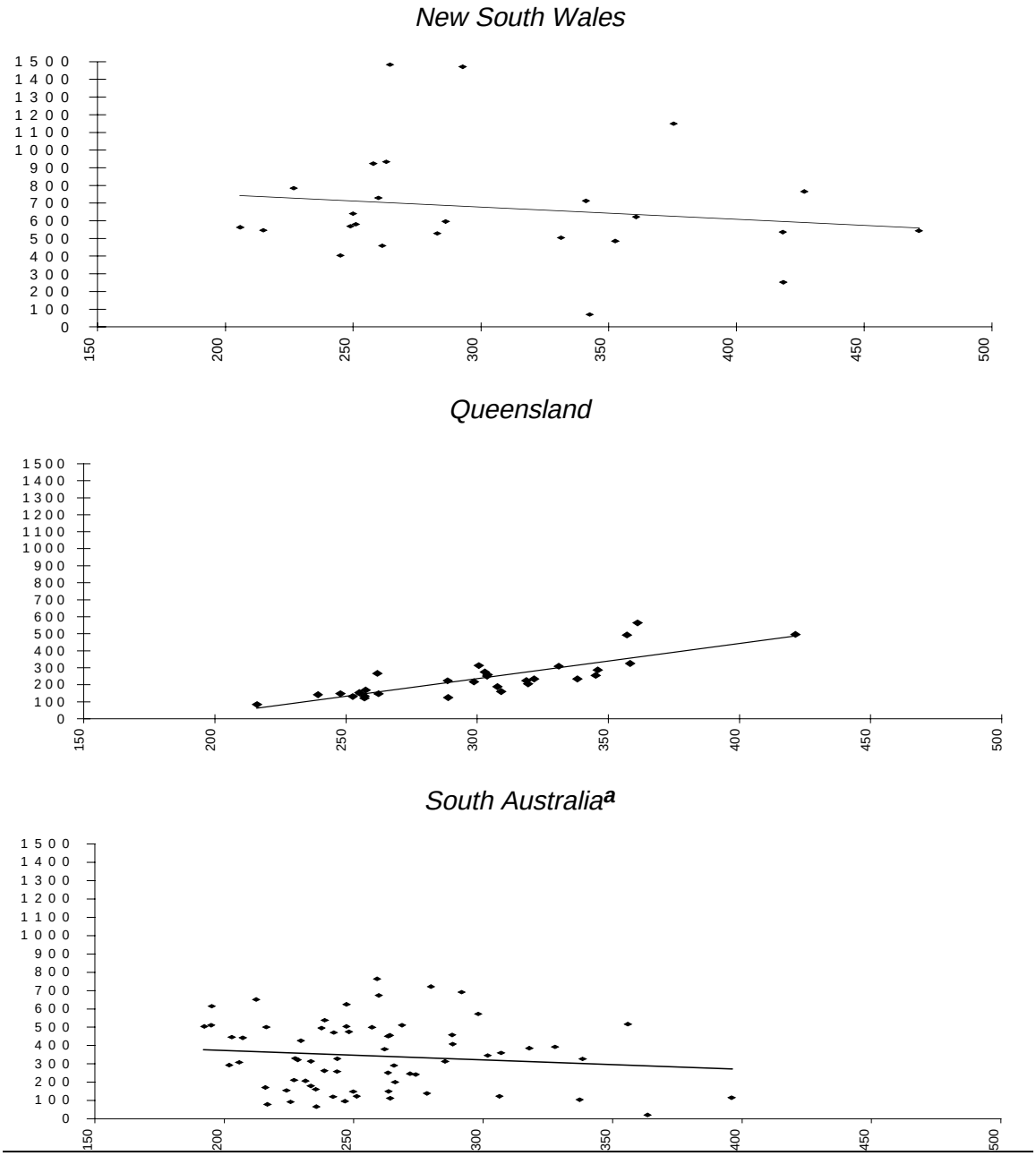
a Data are unavailable to calculate *average annual expenditure on gaming machines* for Victoria. **b** Data for the City of Adelaide and Roxby Downs produce two outliers that have been removed from the analysis.

Data source: ABS (1996a), DGR (1996b) and QOGR (1998b).

Figure I.3 **Income and expenditure on gaming machines for selected states**[a]

Vertical axis – average annual expenditure on gaming machines per person in each region

Horizontal axis – median weekly income per person in each region



a Data are unavailable to calculate *average annual expenditure on gaming machines* for Victoria. **b** Data for the City of Adelaide and Roxby Downs produce two outliers that have been removed from the analysis.

Data source: ABS (1996a), DGR (1996b) and QOGR (1998b).

Weighted results

The Commission's *weighted* analysis shows that there is:

- a negative and statistically significant relationship between *median weekly income* and the *number of gaming machines*, in all states examined (except Queensland) — at lower income levels there were a greater number of gaming machines. In Queensland, there is no statistically significant relationship;
- a positive and statistically significant relationship between *average annual expenditure on gaming machines* and the *number of gaming machines* in all states examined — at higher levels of expenditure on gaming machines there were a greater the number of gaming machines; and
- a negative and significant relationship between *median weekly income* and *average annual expenditure on gaming machines* in South Australia — at lower income levels there were higher levels of the expenditure on gaming machines. In the remaining states, there is no statistically significant relationship (table I.5).

Table I.5 **Weighted results for selected states**[ab]

	Weighted coefficient (t statistic)			
Relationship between	*NSW*	*Vic* [cde]	*Qld*	*SA*[f]
Median weekly income and the number of gaming machines	Negative and significant -0.62 (-2.36)	Negative and significant -0.25 (-4.73)	No significant relationship -0.12 (-0.91)	Negative and significant -0.60 (-3.85)
Average annual expenditure on gaming machines and the number of gaming machines	Positive and significant 2.37 (5.98)	na	Positive and significant 2.43 (7.94)	Positive and significant 1.76 (6.04)
Median weekly income and average annual expenditure on gaming machines	No significant relationship -0.72 (-0.83)	na	No significant relationship -0.15 (-0.37)	Negative and significant -1.63 (-3.55)

na not available **a** The data used for *median weekly income*, the *number of gaming machines* and *average annual expenditure on gaming machines* are explained in section I.1. **b** The results are statistically significant at the 5 per cent level. **c** Data are unavailable on *average annual expenditure on gaming machines* in Victoria. **d** Data for the City of Melbourne produces an outlier that has been removed from the analysis. This region has a large number of gaming machines and high median incomes. Including the City of Melbourne yields the following results: *median weekly income* and the *number of gaming machines* -0.23 (-3.08). **e** Analysis was also undertaken for metropolitan and non-metropolitan regions. The results for metropolitan regions (excluding City of Melbourne) are -0.32 (-4.90) and for non-metropolitan regions are -0.40 (-1.63). **f** Data for the City of Adelaide and Roxby Downs produce two outliers that have removed from the analysis. These regions have a large number of gaming machines and high median incomes. Including the City of Adelaide and Roxby Downs yields the following results: *median weekly income* and the *number of gaming machines* -0.25 (-0.98), *average annual expenditure on gaming machines* and the *number of gaming machines* 1.93 (10.68) and *median weekly income* and *average annual expenditure on gaming machines* -0.62 (-1.01).

Table I.6 **Summary of New South Wales regional data**

Region	*Adult population*	*Median weekly income per person*	*Venues*	*Gaming machines*	*Gaming machines per 10 000 adults*	*Average annual expenditure on gaming machines*
	No.	$	No.	No.	No.	$
Sydney						
Canterbury-Bankstown	217 710	263	77	4 343	199	934
Central Western	202 720	293	138	7 149	353	1 472
Eastern Suburbs	188 395	427	98	3 356	178	766
Fairfield-Liverpool	215 058	258	65	4 190	195	924
Inner City	214 963	375	326	7 620	354	1 149
Inner Western	117 832	341	58	2 168	184	713
Lower Northern	214 443	471	80	2 702	126	544
Northern	125 286	245	205	2 813	225	404
Northern Beaches	166 798	418	55	2 276	136	536
North Western	80 920	249	167	2 174	269	570
Outer South Western	139 396	331	41	1 833	131	505
Outer Western	204 271	343	27	618	30	71
Saint George-Sutherland	302 139	361	110	4 885	162	622
South Eastern	132 000	286	183	3 686	279	596
Rest of NSW						
Blacktown-Baulkham Hills	247751	353	46	2 633	106	486
Central West	120 681	261	221	2 496	207	460
Far West	18 542	206	37	479	258	563
Gosford-Wyong	193 731	260	74	4 096	211	730
Hornsby-Kurringgai	175 814	418	41	1 093	62	253
Hunter	401 931	251	380	9 596	239	581
Illawarra	266 391	250	175	5 954	224	640
Mid North Coast	186 518	215	181	4 266	229	547
Murray	78 383	264	151	5 128	654	1 483
Murrumbidgee	99 402	283	172	2 651	267	529
Richmond-Tweed	143 045	227	125	4 426	309	784

Data source: ABS (1996a) and DGR (1999b).

Table I.7 **Summary of Victorian metropolitan data by Local Government Area**

Local Government Area	*Adult population*	*Median weekly income per person*	*Venues*	*Gaming machines*	*Gaming machines per 10 000 adults*
	No.	$	No.	No.	No.
City of Banyule	86 643	328	11	628	72
City of Bayside	64 274	379	10	294	46
City of Boroondara	115 135	401	7	261	23
City of Brimbank	107 376	249	15	787	73
City of Casey	98 466	351	10	726	74
City of Darebin	98 446	241	19	1 054	107
City of Frankston	77 086	303	9	545	71
City of Glen Eira	92 211	336	12	681	74
City of Greater Dandenong	95 244	245	15	1 156	121
City of Hobsons Bay	56 692	290	10	529	93
City of Hume	79 590	297	13	699	88
City of Kingston	96 743	303	16	938	97
City of Knox	93 656	346	12	911	97
City of Melbourne	33 049	326	23	1 129	342
City of Manningham	81 357	343	6	511	63
City of Maribyrnong	46 707	201	15	804	172
City of Maroondah	68 589	337	8	477	70
City of Monash	122 585	312	14	1 027	84
City of Moreland	104 936	244	17	800	76
City of Moonee Valley	83 845	304	18	848	101
City of Port Philip	63 135	392	10	482	76
City of Stonnington	70 678	434	8	391	55
City of Whittlesea	72 838	293	9	580	80
City of Wydham	50 523	348	9	511	101
City of Yarra	54 348	329	13	442	81
Shire of Cardinia	28 669	313	5	172	60
Shire of Melton	26 222	315	3	197	75
Shire of Mornington Peninsula	84 676	273	19	838	99
Shire of Nillumbik	37 870	397	4	147	39
Shire of Yarra Ranges	93 331	319	9	388	42

Data source: ABS (1996a) and VCGA (1998a).

Table I.8 **Summary of Victorian non-metropolitan data by Local Government Area**

Local Government Area	*Adult population*	*Median weekly income per person*	*Venues*	*Gaming machines*	*Gaming machines per 10 000 adults*
	No.	$	No.	No.	No.
Alpine Shire	8 772	335	3	77	88
Bass Coast Shire	16 161	219	9	245	152
Borough of Queenscliff	2 633	263	1	35	133
City of Ballarat	56 703	242	15	638	113
City of Greater Bendigo	59 973	244	12	485	81
City of Greater Geelong	132 816	251	28	1 372	103
City of Greater Shepparton	37 878	268	7	323	85
City of Moorabool	15 230	278	2	60	39
City of Warrnambool	19 655	252	6	242	123
Rural City of Ararat	8 485	248	2	86	101
Rural City of Horsham	12 814	269	4	137	107
Rural City of Mildura	32 225	252	7	253	79
Rural City of Swan Hill	14 397	255	4	107	74
Rural City of Wangaratta	18 537	272	4	124	67
Rural City of Wodonga	20 627	300	4	162	79
Shire of Baw Baw	23 600	265	3	140	59
Shire of Campaspe	24 510	257	3	119	49
Shire of Central Goldfields	9 454	198	2	114	121
Shire of Colac Otway	14 611	253	5	121	83
Shire of Corangamite	12 585	266	2	49	39
Shire of Delatite	14 175	273	4	140	99
Shire of East Gippsland	28 077	218	12	351	125
Shire of Glenelg	14 723	257	5	121	82
Shire of Hepburn	9 982	203	3	75	75
Shire of La Trobe	48 909	232	18	685	140
Shire of Macedon Ranges	22 687	313	3	75	33
Shire of Mitchell	17 061	291	4	142	83
Shire of Moira	18 289	247	1	35	19
Shire of Mount Alexander	12 134	225	1	30	25
Shire of Murrindindi	9 120	257	1	20	22
Shire of Northern Grampians	9 638	242	3	88	91
Shire of South Gippsland	17 725	256	5	148	83
Shire of Southern Grampians	12 517	243	3	94	75
Shire of Strathbogie	6 856	210	1	30	44
Shire of Towong	4 634	241	1	20	43
Shire of Wellington	28 513	249	10	333	117
Surf Coast Shire	12 532	277	4	112	89

Data source: ABS (1996a) and VCGA (1998a).

Table I.9 **Summary of Queensland regional data**

Region	*Adult population*	*Median weekly income per person*	*Venues*	*Gaming machines*	*Gaming machines per 10 000 adults*	*Average annual expenditure on gaming machines*
	No.	$	No.	No.	No.	$
Brisbane						
Central	57 081	338	60	1 161	203	496
East Inner	59 792	346	19	606	101	313
East Outer	41 048	308	17	565	138	234
North Inner	87 502	358	28	682	78	133
North Outer	202 143	331	58	1 603	79	169
South Inner	45 783	319	14	300	66	148
South Outer	98 880	304	28	889	90	223
West Inner	49 899	319	15	322	65	141
West Outer	71 844	345	17	366	51	84
Rest of Queensland						
Caboolture	71 936	257	32	767	107	251
Cairns	74 843	361	39	1 036	138	255
Darling Downs district	79 571	253	65	719	90	124
Far North district	79 225	262	45	605	76	131
Fitzroy district	83 587	303	57	902	108	188
Gold Coast	256 390	289	94	2 748	107	259
Ipswich	92 223	299	42	856	93	218
Logan	153 543	301	34	1 243	81	267
Mackay	48 307	304	34	767	159	325
Mackay district	36 515	357	34	431	118	205
Moreton district	43 381	257	36	339	78	122
Mount Isa	15 613	421	10	295	189	564
Northern district	47 283	257	38	406	86	147
Redcliffe	38 164	239	15	590	153	493
Redland Bay	73 870	309	25	772	105	275
Rockhampton	42 095	255	28	602	143	287
South-West, Central-West and North-West districts	34 353	289	44	388	113	160
Sunshine Coast	155 021	248	90	2 092	135	309
Toowoomba	65 800	262	33	757	115	225
Townsville	92 076	322	40	717	78	153
Wide Bay	160 314	216	105	1 923	120	234

Data source: ABS (1996a) and QOGR (1998b).