
8 Multivariate analysis

Key points

- Multivariate analysis can overcome some of the shortcomings of reporting individual partial indicators by generating a single measure of performance that simultaneously accounts for the diversity of hospital activity and the range of factors outside the control of hospitals.
- The Commission obtained the permission of 122 for-profit and not-for-profit private hospitals to use their hospital-level morbidity data. This group accounts for 60 per cent of private hospital sector separations.
- Together with data for 368 public acute hospitals and 18 non-government hospitals that provide public hospital services, the Commission had access to a unique dataset of 508 public and private acute hospitals.
- The Commission modelled a number of factors using stochastic frontier analysis. The factors considered included:
 - outputs — admitted patient, emergency department and outpatient activities
 - inputs — labour inputs, drug, medical and surgical supplies, and beds
 - quality and patient safety — in-hospital mortality
 - patient risk characteristics — comorbidity scores and socioeconomic status of patients
 - roles and functions — whether a hospital had a teaching role, and the complexity of services of the hospital.
- Factors that were found to influence hospital performance include higher comorbidity rates among patients, patients from lower socioeconomic areas and a greater proportion of medical cases and complex cases.
- Using data for 2006-07, it was estimated that, on average, the technical efficiencies of the hospitals within the sample were about 20 per cent below best practice.
- The efficiencies of public and private hospitals were broadly similar, except that:
 - large and very large private hospitals were slightly more technically efficient than public hospitals
 - very small and small public hospitals were more technically efficient than private hospitals, although this may in part reflect the way such hospitals were modelled in the analysis.
- The Commission will undertake further analysis using data for 2003-04 to 2006-07, where it will examine the cost performance of hospitals as well as the performance of individual peer groups of hospitals.

The partial indicators discussed in the previous chapters are readily computable and well understood by practitioners, but they suffer from at least two limitations. First, since they are by definition partial, no one indicator provides an overall assessment of a hospital's performance. Instead, a large number of indicators that cover costs, quality and patient safety need to be read in conjunction to infer an overall assessment of hospital performance.

Second, there are a large range of factors outside the control of a hospital that can influence its performance. These include the characteristics of its patients (such as the patient's Indigenous status, socioeconomic status, gender, age and comorbidities), and the roles and functions of the hospital (such as whether it provides teaching services). Many of the partial indicators presented in chapters 5 to 7 do not take account of these factors.

The multivariate analysis undertaken here has the potential to advance our understanding of the performance of public and private hospital systems. This chapter provides an overview of the data, methods employed in the multivariate analysis and the findings. A more detailed discussion is provided in appendix E.

The Commission examined the scope for improving technical efficiency for hospitals in 2006-07. The Commission intends to undertake further analysis into hospital costs, and to use additional years of data (2003-04 to 2005-06). The results are to be published in March 2010.

8.1 About the Commission's multivariate analysis

To measure 'what hospitals do' and 'how well they do their tasks', the Commission treated hospital establishments (and in some instances, campuses) as the principal object of measurement. It is generally at the hospital level that decisions are made to use a variety of 'inputs' (such as nurses, administration and clerical staff, medications, and technologies) to produce a range of 'outputs' (such as surgical medical and surgical procedures, emergency department episodes of care).

Measuring the relationship between inputs and outputs, known as the production function approach, is a well-established method for analysing the performance of hospitals (Hollingsworth and Peacock 2008) and establishments in other industries. In the case of hospitals, its chief advantage is that it permits public, for-profit and not-for-profit hospitals to be directly compared because the approach does not, unlike the cost function approach, depend upon hospitals behaving in a particular manner (such as minimising costs).

Technical efficiency

The production function approach permits the calculation of each hospital's technical efficiency. Technical efficiency is one of several measures of efficiency, and is the extent to which a hospital's outputs can be increased without increasing input use, or conversely, the extent to which inputs can be reduced without decreasing outputs. One of the first steps in measuring technical efficiency is to identify the factors that determine the frontiers (or best-practice benchmarks), against which each hospital will be compared. It is recognised that a hospital's range of services vary markedly due to a number of reasons, including the relative comorbidities of their patient population and the community's expectations about the types of services that hospitals should provide.

While technical efficiency is a measure of hospital performance, it is not a measure of cost efficiency. Technical efficiency represents whether the most is being made out of the hospital's scarce resources. Although technical efficiency contributes to a hospital's cost efficiency, a hospital's cost efficiency can be influenced by many other factors, including its price and input mix. It is entirely feasible that a hospital might be less technically efficient than another hospital, but because of superior buying power, might still be reported to have lower costs.

Stochastic frontier analysis

The Commission used stochastic frontier analysis (SFA) to estimate the production function and each hospital's technical efficiency. Like any other multivariate regression analysis, SFA allows for statistical relationships to be established between the dependent variable and the independent variables. In addition to establishing the 'slope' of the regression equation, the coefficients can also be interpreted as establishing the best-practice benchmarks faced by each hospital. This is the subject of section 8.4.

SFA also simultaneously determines the technical efficiency of each hospital after controlling for:

- factors that affect hospital performance
- random variations between hospitals reflecting
 - the effect of measurement error in the variables and other random factors that affect hospital outputs, such as disease outbreaks
 - the combined effects of other omitted factors, many of which cannot be measured.

Compared with alternative methods, such as data envelopment analysis, SFA yields more conservative estimates of the scope to increase output, because the estimated potential to raise output is determined after controlling for the identified factors, random events and differences among hospitals. The technical efficiency of public and private hospitals is reported in section 8.5.

A detailed description of SFA is provided in appendix E.

Scope of the analysis

The analysis covers hospitals only. It does not include the medical workforce — except to the extent that diagnostic and allied health professionals are also employed by each hospital. This scope differs from that of the cost analysis in chapter 5, which explicitly examined all of the costs incurred in supplying hospital services.

While the analysis considers the majority of public acute hospitals, only 122 private sector acute (overnight) hospitals are represented in the sample. The majority of these are for-profit hospitals. While this does not affect any conclusions drawn about the hospitals *in the sample*, care must be taken when inferring about the performance of the private hospital sector as a whole, and of not-for-profit hospitals in particular.

8.2 Profile of hospitals in the sample

The Commission obtained permission to access the morbidity and hospital establishment data for 703 public hospitals. The financial variables for a number of Victorian hospital observations were reported at the network level. Tasmania provided a single observation for all public hospitals. In both cases, the respective observations were disaggregated into hospital-level observations on the basis of casemix-adjusted separations or the number of beds.

The Commission also obtained the permission of 130 privately owned and operated hospitals to use their data and unique hospital identifiers in the study. The state and territory health departments in all jurisdictions agreed to supply their private hospital data and identifiers to the Commission except for Tasmania, which was unable to release the private hospital identifiers in time for this study.

From the total sample of 833 observations, 325 hospital observations were excluded as these were classified as non-acute, sub-acute, psychiatric or free-standing day hospital facilities. The remaining dataset comprises 508 public and private acute

hospital observations for 2006-07 (table 8.1). One private hospital observation is an aggregate of all Tasmanian private hospitals. In total, there were observations for 368 public acute hospitals, 122 private acute hospitals and 18 hospitals that were classified ‘public contract’ because they were managed by non-government entities and offered public hospital services.

Table 8.1 Profile of sample hospitals by location and size, 2006-07^a

	<i>Major cities</i>			<i>Outside major cities</i>			<i>All hospitals</i>
	Public	Private	Public contract	Public	Private	Public contract	
Very large	53	np	np	15	np	–	98
Large	21	16	np	16	6	np	70
Medium	14	26	–	31	12	–	83
Very small & small	8	np	–	210	np	np	257
All hospitals	96	93	15	272	29	3	508

^a Sample refers to all the acute hospitals included in the Commission’s multivariate analysis. Hospital location is defined by the Australia Standard Geographical Classification (ABS 2001). Hospital size is defined by number of casemix-adjusted separations per year, where *Very large* refers to 20 001 or more casemix-adjusted separations; *Large* is defined as 10 001 to 20 000 casemix-adjusted separations per year; *Medium* is defined as 5001 to 10 000 casemix-adjusted separations per year; *Small* is defined as 2001 to 5000 casemix-adjusted separations per year; and *Very small* is defined as 2000 or fewer casemix-adjusted separations per year. **np** Not published due to confidentiality requirements but included in totals where applicable. – Nil.

Source: Unpublished ABS and AIHW data; Productivity Commission estimates.

The remaining acute private hospital in the sample account for around 60 per cent of all private hospital separations in Australia (excluding same-day facilities), with a higher representation of for-profit private hospitals compared to not-for-profit private hospitals (AIHW unpublished data).

Measures of output and productivity for the sample of hospitals included in the analysis are reported in table 8.2. These data indicate the volume and type of activity undertaken by hospitals, as well as the productivity of the inputs used. Observable differences between the public and private sectors can be used to identify the factors driving hospital efficiency and explain comparative differentials.

Service and patient characteristics of the hospitals in the analysis are profiled in table 8.3. Observable variations between public and private hospitals — in terms of the functions they undertake and the patients they treat — draw attention to the need to control for these factors when calculating and assessing their technical efficiency.

Table 8.2 Profile of sample hospitals, output and partial productivity measures, 2006-07^a

	All hospital sizes						Very large		Large		Medium		Small & very small	
	Public	Private		Public contract	Private not-for-profit	Public	Private	Public	Private	Public	Private	Public	Private	
		for-profit	not-for-profit											
Output measures (average, per hospital)														
All separations (not casemix-adjusted)	11 245	np	15 686	19 186	19 186	40 550	28 066	16 509	13 331	8 405	7 898	1 797	3 070	
All separations ^b	11 571	np	18 173	20 216	20 216	45 032	32 910	15 297	14 591	7 166	7 229	1 410	2 840	
Acute separations ^b	9 043	np	15 296	16 459	16 459	35 616	28 942	11 623	12 106	5 373	4 924	1 074	1 775	
Pregnancy/neonatal separations ^b	1 245	np	1 446	2 077	2 077	4 819	1 663	2 003	1 499	606	679	134	79	
Mental/alcohol services separations ^b	562	np	233	790	790	2 121	365	617	191	450	519	89	501	
Other separations ^b	458	np	778	470	470	1 440	1 106	741	410	589	1 001	77	447	
Emergency dept occasions of service	15 035	np	-	564	564	41 556	9 603	26 310	1 363	15 363	170	4 781	-	
Outpatient occasions of service	34 371	np	-	42 409	42 409	136 634	1 826	45 265	251	17 725	1 953	4 059	2 642	
Partial productivity measures														
Casemix-adjusted separations per staff ^c	22.9	np	63.2	32.2	32.2	25.3	61.7	27.3	66.8	26.1	71.4	20.6	60.9	
Casemix-adjusted separations per bed	70.9	np	114.0	106.6	106.6	110.3	141.9	103.8	125.7	87.0	102.4	49.6	62.3	
Patient days per bed	246.0	np	335.5	309.5	309.5	352.2	363.9	317.6	323.0	296.1	316.3	189.8	244.5	
Patient days per staff ^c	84.8	np	196.0	94.2	94.2	82.2	157.6	86.3	175.9	95.3	224.1	83.1	234.5	
Non-medical staff per bed	3.0	np	1.9	3.6	3.6	4.4	2.4	4.0	2.0	3.4	1.5	2.3	1.2	
Occupancy rate	67.4	np	91.9	84.8	84.8	96.5	99.7	87.0	88.5	81.1	86.7	52.0	67.0	
Average length of stay (days)	3.2	np	4.0	3.1	3.1	3.6	2.8	3.0	2.5	3.4	3.0	3.1	6.5	
Number of observations	368	94	28	18	18	68	24	37	22	45	38	218	38	

^a Sample refers to all the acute hospitals included in the Commission's multivariate analysis. Data disaggregated by size excludes public contract hospitals due to confidentiality requirements. Private hospital data disaggregated by size refers to both for-profit and not-for-profit hospitals. ^b Casemix-adjusted. ^c Per non-medical staff member. **np** Not published due to confidentiality requirements but included in totals where applicable. - Nil or rounded to zero.

Source: Unpublished ABS and AIHW data; Productivity Commission estimates

Table 8.3 Profile of sample hospitals, by service and patient characteristics, 2006-07^a

	All hospital sizes												
	Very large			Large			Medium			Small & very small			
	Public	Private for-profit	Private not-for-profit	Public	Private	Public	Private	Public	Private	Public	Private	Public	Private
Services													
Medical DRG (% of separations)	75.7	np	53.5	63.8	72.7	45.7	68.3	37.3	66.3	48.0	79.8	60.4	
Surgical/other DRG (% separations)	24.3	np	46.5	36.2	27.3	54.3	31.7	62.7	33.7	52.0	20.2	39.6	
Same-day separations (% separations)	52.4	np	44.5	51.5	45.7	43.4	55.7	52.9	62.6	68.2	51.9	65.1	
Cost weight (ratio)	0.84	np	1.01	1.05	1.10	1.15	0.94	1.03	0.91	0.93	0.73	1.08	
E&W 1 – Complexity (ratio) ^b	0.55	np	0.68	0.94	1.45	1.13	0.91	0.74	0.63	0.36	0.20	0.12	
E&W 2 – Compl. adj. for size (ratio) ^b	0.49	np	0.58	0.81	1.17	0.95	0.81	0.65	0.60	0.34	0.20	0.12	
Teaching hospital (%)	17.1	np	75.0	44.4	75.0	95.8	24.3	15.6	4.4	68.4	0.5	60.5	
Network (%)	6.8	np	–	–	23.5	–	13.5	–	20.0	–	5.5	–	
Patient characteristics (average %)													
Funding election status													
Public	77.9	np	16.7	77.4	83.4	7.0	81.5	7.7	82.5	4.5	74.6	5.8	
Private or other non-public	21.9	np	83.3	22.5	16.4	93.0	18.3	92.0	17.4	95.2	25.1	93.8	
Residence													
From major city	26.4	np	66.0	78.4	71.2	80.4	54.1	71.3	34.3	67.8	6.0	66.5	
From inner regional	36.2	np	23.7	14.1	20.2	13.3	36.5	18.3	31.1	24.3	42.2	25.6	
From outer regional	26.5	np	9.1	7.0	7.2	5.5	6.1	9.6	30.9	7.2	35.2	7.3	
From remote	5.0	np	0.9	0.3	0.8	0.7	1.6	0.6	3.0	0.4	7.3	0.5	
From very remote	5.9	np	0.3	0.1	0.5	0.2	1.7	0.2	0.8	0.2	9.4	0.1	
Index of socio-economic advantage													
SEIFA 1 (most disadvantaged)	40.3	12.4	24.3	19.9	21.4	14.3	28.4	15.6	36.5	14.0	48.9	16.6	
SEIFA 2	26.5	15.2	11.1	18.9	22.4	12.5	22.3	14.8	26.7	17.5	28.4	11.9	
SEIFA 3	16.6	26.0	13.7	17.8	22.7	18.9	17.7	28.0	17.1	18.6	14.4	27.5	
SEIFA 4	9.9	23.5	20.7	24.7	18.3	25.4	15.8	24.6	13.7	23.6	5.5	19.4	
SEIFA 5 (most advantaged)	6.8	22.9	30.2	18.8	15.1	29.0	15.9	17.0	6.0	26.3	2.8	24.6	

(Continued next page)

Table 8.3 (continued)

	All hospital sizes						Very large		Large		Medium		Small & very small	
	Public	Private for-profit	Private not-for-profit	Public contract	Public	Private	Public	Private	Public	Private	Public	Private	Public	Private
Charlson comorbidity score														
Score 0 (no comorbidities)	74.1	82.2	70.9	71.2	69.4	72.2	75.0	80.5	71.3	81.6	76.0	81.8		
Score 1 (fewest comorbidities)	9.1	5.2	6.6	7.2	7.6	5.9	7.0	5.4	8.1	5.4	10.2	5.4		
Score 2	10.4	7.2	10.5	14.2	15.1	11.8	11.0	7.9	12.7	8.0	8.4	5.4		
Score 3	1.6	1.1	1.5	1.6	1.9	1.1	1.4	0.8	1.7	1.3	1.6	1.3		
Score 4	1.5	0.5	1.2	1.3	1.7	1.0	1.4	0.7	2.6	0.6	1.3	0.6		
Score 5	2.6	3.6	8.2	3.6	3.6	7.6	3.7	4.3	3.0	2.8	2.1	4.9		
Score 6 or higher (most comorbid.)	0.5	0.2	1.0	0.9	0.7	0.4	0.5	0.3	0.6	0.2	0.4	0.6		
Average score	0.55	0.42	0.72	0.70	0.73	0.72	0.60	0.43	0.67	0.39	0.46	0.47		
Age														
<1yr	2.2	np	2.0	2.8	3.4	0.7	3.2	1.1	1.6	1.4	1.7	0.9		
1-4yrs	2.9	np	2.5	3.1	3.6	1.2	4.6	1.1	2.0	1.2	2.6	1.4		
5-14yrs	3.9	np	3.2	4.0	4.8	1.6	5.4	1.9	2.9	2.0	3.6	2.0		
15-49yrs	36.1	np	30.2	38.7	35.8	30.2	35.9	36.1	34.7	34.1	34.5	33.4		
50-59yrs	12.2	np	15.6	12.7	11.9	17.6	11.6	17.3	13.1	14.8	12.2	18.3		
60-69yrs	13.8	np	17.1	13.6	13.8	19.0	13.3	17.6	15.6	16.3	13.5	15.3		
>70yrs	28.8	np	29.4	25.1	26.8	29.7	25.9	24.8	30.0	30.2	29.7	28.8		
Female, share	0.53	np	0.55	0.55	0.53	0.52	0.55	0.55	0.54	0.58	0.53	0.56		
Indigenous, percentage	9.1	np	0.7	2.1	4.2	0.3	5.0	0.8	6.2	0.3	12.0	0.2		
Quality indicator														
Mortality rates	1.36	0.42	3.97 ^c	1.30	1.14	0.70	0.98	0.57	1.15	0.46	1.54	2.74		
Number of observations	368	94	28	18	68	24	37	22	45	38	218	38		

a Sample refers to all the acute hospitals included in the Commission's multivariate analysis. Data disaggregated by size excludes public contract hospitals due to confidentiality requirements. Private hospital data disaggregated by size refers to both for-profit and not-for-profit hospitals. **b** Evans and Walker index of complexity (appendix E). **c** Subject to outlier observations (median is 0.70). **np** Not published due to confidentiality requirements but included in totals where applicable. – Nil or rounded to zero.

Source: Unpublished ABS and AIHW data; Productivity Commission estimates.

Output

Public hospitals report a lower volume of average casemix-adjusted separations than not-for-profit private hospitals. The extent of variation among public hospitals, however, is much larger than that of the private hospitals in the sample. Public contract hospitals report the highest average volume of activity compared to all other hospitals included in the sample.

Emergency department services are concentrated in the public hospital sector. There are no emergency departments in any of the not-for-profit private hospitals in the sample. A similar pattern of activity is observed for outpatient services. A high volume of outpatient service activity, on par with public hospitals, is reported for public contract hospitals. Public contract hospitals, not surprisingly, show similar characteristics to very large and large public hospitals.

Partial productivity measures

Rates of separations per non-medical staff member and per bed are higher among private hospitals than among public hospitals. This differential is consistent across all hospital sizes and is applicable to not-for-profit private hospitals. The same trends are observed for patient days per non-medical staff member and per bed. For these partial productivity measures, the public contract hospitals in the sample generally report rates that are higher than public hospitals yet lower than private hospitals.

Similar occupancy rates are reported for public and private hospitals, except in the small and very small size category, where private hospitals report a higher rate than public hospitals.¹ This differential has the effect of reducing the average rate for all public hospitals relative to all private hospitals. Not-for-profit hospitals report relatively high average occupancy rates. Public contract hospitals report a similar rate to private hospitals.

Public hospitals report a higher average length of stay (ALOS) than private hospitals, except in the small and very small hospital category, where private hospitals have a higher ALOS. This differential has the effect of increasing the average value for all private hospitals relative to all public hospitals. Negligible difference is observed in ALOS between not-for-profit and public hospitals, while public contract hospitals report a similar ALOS to public hospitals.

¹ The occupancy rates count same-day separations as one day's length of stay.

Services

The data confirm that public hospital activity is concentrated in medical separations, whereas private hospital activity is more evenly spread across medical and surgical or other separations. The average share of surgical or other separations for public contract hospitals is smaller than for private hospitals but higher than for public hospitals.

A hospital's share of same-day separations is greater for public hospitals in the larger hospital sizes, but greater for private hospitals among the smaller hospital sizes. Public contract hospitals report a similar rate to the public hospital average.

Consistent with the findings reported in chapter 5, the average cost weights indicate that private hospitals undertake, on average, relatively more complex cases than public hospitals. This differential is greatest in the small and very small size category. The Commission found there to be little material difference between the average public hospital cost weights for public and private hospitals combined (appendix D).

A larger share of private hospitals in the sample, on average, are classified as teaching hospitals, compared to public hospitals. This is apparent across all hospital sizes except in the large category. These data, however, do not capture the *extent* of teaching activity undertaken by the hospital, and therefore does not distinguish between major teaching hospitals and hospitals offering relatively smaller teaching functions.

Finally, based on the observed distribution of hospitals that belong to a network, it may be expected that any potential efficiency effects related to network membership will be detected among the larger size hospitals.

Patient characteristics

The Charlson index (Charlson et al. 1987) is a measure of the comorbidity of patients. It is an odds-ratio of the risk of mortality within one year. Thus a Charlson score of 6 indicates a 6:1 chance of the patient dying within one year. The Charlson index for this study was prepared using administrative data based on the ICD-10-AM codes (Quan et al. 2005; Sundarajan et al. 2004,).

Very large public and private hospitals treat patients of similar comorbidity levels (based on the average Charlson score). Medium and large public hospitals treat relatively more comorbid patients than private hospitals. Not-for-profit private hospitals treat relatively more comorbid patients than do for-profit private patients.

The most comorbid patients (Charlson score of 5 or more) collectively constitute a larger share of patients in private hospitals than in public hospitals, except in the medium hospital size category. This difference between public and private hospital samples seems to be driven by the patient mix in not-for-profit private hospitals.

The Socio-Economic Index for Areas – Relative Socio-economic Advantage and Disadvantage (SEIFA) is a measure of the relative advantage and disadvantage of people in different geographic areas (ABS 2998a). For this study, the SEIFA 2001 index was calculated for each patient based on their postcode of the usual place of residence.

SEIFA data indicate that patients from the most disadvantaged socio-economic areas constitute a larger share of patients in public hospitals than in private hospitals. This differential is particularly apparent in the small and very small size category. With respect to patients' socio-economics status, public contract hospitals treat a similar patient profile to private hospitals. The majority of private hospital patients are from major city or inner regional areas, whereas public hospital patients are drawn from a broader range of areas.

Public hospitals treat a relatively larger proportion of patients aged less than 14 years, while private hospitals treat a relatively larger proportion of patients aged 50 to 69 years. Similar distributions are observed for all other age categories, including patients aged 70 years and older. Public and private hospitals treat similar proportions of patients on the basis of gender. Indigenous patients represent a larger share of public hospital patients than private hospital patients. This difference is consistent across all hospital sizes but particularly apparent among the smaller hospitals.

8.3 Factors affecting hospital performance

The Commission reviewed the literature for a large number of Australian and overseas studies that have benchmarked the performance of hospitals (a summary of which is in appendix E). A number of submissions to this study also highlighted factors that are thought to influence hospital performance. Not all factors identified in the overseas literature and submissions, however, were included in this analysis. Some variables were excluded because they were inconsistent with the specification of the model — for example, occupancy rates were not included in the production function because the variable is defined in terms of an output (patient days) divided by an input (beds). In other instances, suggested variables were not included because of a lack of suitable data.

In some instances, proxy variables were used instead. For example, since it is not possible to identify each and every policy, regulation and legislation in every state and territory, binary variables for each state and territory were used to control for these and any other jurisdiction-specific effects. For example, the New South Wales binary variable took on a value of ‘1’ if a hospital was located in that state, and ‘0’ if not. A variable was not defined for Queensland, because it was used as the reference category and doing so would introduce collinearity in the model.

Hospital outputs and quality of care

Ideally, a hospital’s performance should be measured in terms of patient outcomes. Patients seek hospital services in order to improve their physical and emotional wellbeing relative to what would otherwise be the case. However, it is not practicable to directly measure the changes to patient health outcomes. Instead, the approach used here, is to use proxies for two dimensions of health outcomes — hospital outputs and quality of care.

Hospitals are complex entities that provide a wide range of services. Furthermore, hospitals vary significantly in terms of their functions and services, such as respective shares of surgical and medical procedures; the delivery of outpatient and emergency department care; and the provision of teaching services and clinical research programs. As such, there is a strong argument that hospitals should be modelled as multi-input multi-output firms (Butler 1995).

Hospital outputs

Admitted patient outputs used in the analysis were measured in terms of casemix-adjusted separations grouped into four categories based on the Australian system of major diagnostic categories (MDCs):

- acute separations — MDCs 1 to 9, 11 to 13, 16 to 18, 21 and 22
- pregnancy and neonate separations — MDCs 14 and 15
- mental and alcohol separations — MDCs 19 and 20
- other separations — MDC 23 (factors influencing health status and other contacts with health services).

MDC 10 (endocrine, nutritional and metabolic diseases and disorders) is used to normalise the output variables (for an explanation on the role of normalising the output variables, see appendix E). This MDC was used as the dependent variable in

the regression analysis. All separations were casemix adjusted using public hospital cost weights (AR-DRG version 5.1).

The categories of non-admitted outputs used in the initial analysis were:

- accident and emergency services — number of accident and emergency department presentations or visits
- allied health and dental services — number of occasions of service for allied health, dental and other outpatient services
- mental and alcohol services — number of mental, alcohol and psychiatric outpatient services
- dialysis and endoscopy — number of occasions of service for dialysis and endoscopy
- diagnostic services — number of pathology and radiology services
- outreach services — number of community services, district nursing and other outreach services.

There is no national casemix classification for outpatient services, and so these services were not adjusted for inter-hospital differences in the types of cases treated.

Quality of hospital care

Several variables were available to the Commission to measure hospital quality, including in-hospital mortality, infection rates and adverse events. As noted in chapters 6 and 7, there are deficiencies in existing datasets on hospital-acquired infection rates and adverse events. Some of the problems include possible under-reporting and the difficulty in attributing the role of hospitals in contributing to the cause of those events.

The Commission chose to use in-hospital mortality rates as the sole measure of quality. However, this raises some issues. The rate of in-hospital mortality can vary for reasons outside the control of hospitals. Some hospitals might specialise in treating the most ill and at-risk patients. Other hospitals offer specialist palliative care facilities.

To account for these external influences, the Commission risk adjusted the mortality rates. The resulting risk-adjusted mortality ratios (RAMRs) (which are defined as the ratio of the observed mortality rate divided by the predicted mortality rate) were used in the stochastic frontier analysis. A positive coefficient for the RAMR variable in the production function would mean that hospitals which have lower mortality rates than predicted would have higher best practice frontiers. RAMRs

differ from the more well-known hospital standardised mortality ratios insofar that the RAMRs do not account for differences in the services hospitals provide. A summary of the variables used in the risk-adjustment process and the resulting RAMRs is provided in appendix E.

Hospital inputs

Following common practice in this area of analysis, inputs into the production of hospital services included:

- nursing staff — number of full-time equivalent nursing staff
- diagnostic staff — number of full-time equivalent pathology and radiology staff
- other staff — number of full-time equivalent domestic, administration and other staff
- medical and surgical supplies — expenditure on medical and surgical supplies
- pharmaceutical supplies — expenditure on pharmaceutical supplies used in the delivery of hospital services
- other inputs — expenditure on other hospital (non-labour) inputs, such as administration and clerical, housekeeping, and repairs and maintenance not counted earlier
- beds — number of beds of the hospital as a proxy for hospital capital. This is given by the number of beds licensed in a private hospital, and the number of beds recorded in the National Public Hospital Establishment Collection for public hospitals.

The total number of beds is not an ideal measure of the usage of capital in a hospital as it does not accurately reflect the differences in capital stock between hospitals. Ideally, capital measures should be disaggregated such as by the number of ICU beds, non-acute beds, palliative care beds, the number of same-day chairs, and the number of operating theatres. Instead, differences in the capital of hospitals were captured in the analysis by using variables that reflected differences in the roles and functions of hospitals (see below).

Characteristics of patients

The characteristics of patients can affect hospital performance in two important ways. First, hospitals that serve catchments of relatively older or sicker patients will have higher activity levels and therefore will be observed to be providing more services to their community. In this instance, it is not necessary to account for the

additional services demanded by patient populations as this activity will be reflected in the measures of casemix-adjusted separations.

Second, patients with more comorbidities consume more hospital resources per episode of care. Failure to account for differences in patient populations can lead to biased estimates of efficiency, because hospitals that serve relatively healthier patient populations will be observed to be using fewer resources. This problem is partly addressed with the casemix adjustment of hospital separations, where a number of individual AR-DRGs are defined specifically to account for differences in patient comorbidity. For example, the AR-DRG category ‘B03 Extra cranial vascular procedures’ is divided into sub-groups: ‘B03A with catastrophic or severe complications’ and ‘B03B without catastrophic or severe complications’.

There is a case to include other variables that account for differences in hospitals’ patient mix. Data for emergency department and outpatient services are not adjusted for casemix. Even if the detailed AR-DRG-level data adequately accounted for variation in patient morbidities, it is possible that the process of aggregating each of the AR-DRGs may diminish some of the statistical variation in morbidity necessary for robust estimation.

The patient-risk characteristics included in the model were:

- *patient comorbidity* — both the average Charlson score (Charlson et al. 1987) across all admitted patients for a hospital, and the proportion of patients with Charlson scores of 1, 2, 3, 4, 5 and 6 or more (where ‘1’ is the least comorbid and ‘6 or more’ the most comorbid)
- *socioeconomic status of patient* — proportions of patients with SEIFA scores of 1, 2, 3, 4 and 5 (where ‘1’ is the most disadvantaged and ‘5’ is the most advantaged)
- *gender* — proportion of females in the admitted patient population
- *Indigenous status* — proportion of the admitted patient population that self-identified as Indigenous
- *age profile* — proportion of the population that was less than one-year old, between 1 and 4 years old, between 5 and 14 years old, between 50 and 59 years old, between 60 and 69 years old, and 70 years old and over
- *remoteness of usual place of residence* — proportion of admitted patients whose usual place of residence was in major cities, inner regional, outer regional, remote and very remote areas, as defined by the ABS Australian Standard Geographical Classification – Remoteness Areas system (ASGC-RA).

A number of these factors are expected to be closely interrelated. For example, it is expected that the most comorbid patients will, on average, also be the oldest. Similarly, there is likely to be a strong association between a patient's socioeconomic status and the remoteness of their usual place of residence.

Role and function of hospitals

Another approach to addressing the differences between hospitals is in terms of their roles and functions. Hospitals that take on teaching roles incur additional overheads compared to those that do not teach. Public hospitals are increasingly being organised into networks in which member hospitals adopt specialist functions. For example, the larger hospitals in a local network might have level-III intensive-care unit beds in order to maximise the utilisation of those beds.

A number of variables were used to explore differences in roles and functions. *Teaching status* is a binary variable that describes whether a hospital offers medical and/or nursing teaching services ('1' indicates that it offers teaching, '0' that it does not). The variable does not reflect the extent of teaching provided.

Level-III intensive-care, palliative and residential care units are three binary variables that indicate whether a hospital operates each of those units ('1' indicates that it operates a particular unit, '0' that it does not)

Proportion of patients treated with surgical and other procedures is a variable that describes the extent to which a hospital specialises in surgical and other DRG cases, or conversely, the degree to which hospitals undertake medical DRG cases. It is often suggested that a difference between public and private hospitals is the ability of private hospitals to maximise their productivity by specialising in elective surgery procedures, which permits them to operate with higher levels of productivity. On the other hand, public hospitals are unable to refuse medical admissions, and since medical DRG cases have a greater likelihood of being unplanned, medical DRGs become inherently more difficult for public hospitals to manage. Ignoring the differences between surgical and medical cases has the potential to distort the interpretations of efficiency measures.

Proportion of patients who are not treated as public patients is a proxy measure for the different levels of resources used by hospitals to treat public and non-public patients. It includes patients who are funded by private health insurance, Department of Veterans' Affairs, third-party motor vehicle accident, workers' compensation patients, and self-funding. Public hospitals are funded with capped budgets, at least when treating public patients. In contrast, the funding of non-public patients is uncapped. It is possible that differences between capped and uncapped

funding provides hospitals with the capacity to provide different service levels to public and non-public patients.

Evans and Walker information indices (Evans and Walker 1972) are used as measures of the relative complexity of work undertaken by hospitals. Two such measures are considered here. The first is a measure of the complexity of hospital work. The second is a measure of the complexity of hospital work while recognising differences in hospital size. While larger hospitals generally treat more complex cases than smaller hospitals, due to their size, they are also expected to treat more complex cases. A detailed explanation and derivation of the indices is given in appendix E.

Care must be exercised when choosing which combination of these variables to include in the analysis, as they might be correlated and lead to distorted results. For example, the presence of level-III intensive-care units may be correlated with the Evans and Walker indices of hospital complexity. Similarly, it is possible that the hospital roles and functions variables may be correlated with the patient characteristic variables, if hospitals adopt certain functions because of their patient mix.

A number of other variables were considered for inclusion, but were subsequently dropped, because it was expected that they measure very similar effects and would be too highly correlated with other variables. For example, it would be expected that average length of stay and the proportion of same-day separations are highly correlated, and would implicitly be reflected in the casemix-adjusted separations measure of hospital outputs.

8.4 Factors contributing to best-practice benchmarks

The Commission analysed a number of models that have been used to examine the performance of hospitals. Ten models are reported in appendix E, two of which are reported in table 8.4. Each model differs in terms of the types of factors that were tested for their relative importance, and in terms of the how the variables are represented. Not all variables that were tested are reported in table 8.4.

The first model in table 8.4, the Cobb-Douglas model, includes variables on inputs and outputs, factors describing both roles and functions of hospitals, as well as patient characteristics. In addition to indicating the extent to which an independent variable influences the dependent variable, the estimated coefficients in this model also indicate how the frontier (or best-practice benchmark) is positioned for each hospital. A positively-signed coefficient indicates that the variable has the effect of

shifting up a hospital's best-practice benchmark. This can be interpreted to mean that a hospital with the characteristics associated with the variable has a higher hurdle to meet when being compared with other hospitals. Conversely, a negatively-signed coefficient indicates the variable has the effect of lowering the hospital's best practice frontier, potentially making it easier for that hospital to meet its best-practice benchmark.

The second model (the restricted translog model) is similar to the first but has one important subtle difference. It includes 'squared' terms for the inputs and outputs to more accurately reflect the presence of scale economies within the hospital sector. By accounting for scale economies, the translog model better describes the data, and it is this model that is used to generate the final technical efficiency scores in table 8.5.

The interpretation of the input and output coefficients are more subtle, however. For every pair of input and output coefficients, the first coefficient describes the tendency of the best-practice frontier to be pushed up or pulled down, in much the same manner as the Cobb-Douglas model. The second (that is, squared) variable, describes the rate at which the frontier is pushed up or pulled down. For example, if an input variable had its first coefficient signed positive and its squared term signed negative, it would be possible to conclude that: hospitals with more of that input would have their frontier increased (positive first coefficient), but that the rate at which the benchmark was raised would diminish with further increases to the input (negative second coefficient).

None of the coefficients indicate the impact of the variables on a hospital's overall technical efficiency. Technical efficiency is determined by the position of the frontier after all adjustments are taken into account, as well as taking into account the effect of random error and omitted variables.

The findings presented here are based on the coefficients which have the highest level of significance. Broadly, the coefficients of outputs and inputs in the production model correspond to prior expectations.

Outputs and inputs

The negative coefficient sign for the output variables in the Cobb-Douglas model indicate that hospitals that provide a higher volume of services (both admitted patient services and non-admitted occasions of service) have their best-practice frontiers shifted downwards, when keeping all other factors unchanged. This means that hospital benchmarks reward those hospitals that produce more with their given resources. A number of the output variables become less statistically significant in

the restricted translog model but their interpretation remains valid. For a number of outputs a negative signed squared term indicates that as the output is increased, the rate at which the frontier is shifted downwards is progressively diminished.

Table 8.4 Coefficient results of stochastic frontier analysis, 2006-07

	<i>Cobb-Douglas model^a</i>	<i>Restricted translog model^b</i>
Primary model		
Inpatient services		
Log of acute separations	-0.506 ***	-0.211
Log of acute separations — squared		-0.022
Log of pregnancy & newborn separations	-0.060 ***	-0.052 ***
Log of pregnancy & newborn separations — squared		-0.004
Log of mental & alcohol separations	-0.106 ***	-0.151 ***
Log of mental & alcohol separations — squared		-0.019 ***
Log of other separations	-0.151 ***	-0.103 ***
Log of other separations — squared		-0.016 ***
Non-admitted services		
Log of emergency department visits	-0.021	-0.069
Log of emergency department visits — squared		0.006
Log of allied & dental health services	-0.050 ***	0.105 ***
Log of allied & dental health services — squared		-0.024 ***
Log of mental & alcohol services	-0.011	0.029
Log of mental & alcohol services — squared		-0.003
Log of outreach & district nursing services	0.004	0.010
Log of outreach & district nursing services — squared		0.000
Log of diagnostic services	-0.041 ***	-0.027
Log of diagnostic services — squared		0.000
Log of dialysis & endoscopy services	0.031	0.014
Log of dialysis & endoscopy services — squared		-0.018
Inputs		
Log of nursing staff	0.241 ***	0.678 ***
Log of nursing staff — squared		-0.061 ***
Log of diagnostic staff	0.030	0.036
Log of diagnostic staff — squared		-0.003
Log of other staff	-0.161 ***	-0.152
Log of other staff — squared		0.000
Log of beds	0.462 ***	0.075
Log of beds — squared		0.068 ***
Log drugs	0.068 ***	-0.005
Log drugs — squared		0.011 ***
Log of medical & surgical supplies	0.015	0.246 ***
Log of medical & surgical supplies — squared		-0.022 ***
Log of other inputs	-0.012	-0.380 ***
Log of other inputs — squared		0.028 ***

(Continued next page)

Table 8.4 (continued)

	<i>Cobb-Douglas model</i> ^a	<i>Restricted translog model</i> ^b
Patient comorbidities		
Percent of patients with Charlson 6 +	-6.518 **	-7.362 **
Percent of patients with Charlson 5	-1.520 **	-1.121
Percent of patients with Charlson 4	-2.641 ***	-2.079 **
Average Charlson comorbidity score	0.394 ***	0.250 **
Patient SEIFA		
Percent of patients from SEIFA 3	-0.307 ***	-0.216 **
Percent of patients from SEIFA 2	-0.332 ***	-0.322 ***
Percent of patients from SEIFA 1	-0.261 ***	-0.238 ***
Role and functions		
Teaching hospital	0.116 *	0.196 ***
Evans & Walker Index 1	-2.098 ***	-1.777 ***
Evans & Walker Index 2	4.011 ***	3.246 ***
Percent of patients that are not public	-1.160 ***	-0.993 ***
Percent of separations that are surgical or other DRGs	1.131 ***	0.862 ***
State or territory^c		
NSW	-0.090	-0.098
Victoria	-0.277 ***	-0.249 ***
South Australia	-0.230 ***	-0.134
Western Australia	-0.069	0.009
Tasmania	1.176 ***	1.001 ***
Northern Territory	-0.217	-0.342 *
ACT	-0.237	-0.253
Constant	3.644 ***	3.318 ***
Secondary model		
Log σ_v^2		
Constant	-2.543 ***	-2.495 ***
Log σ_u^2		
Constant	-1.918 ***	-2.560 ***
Model criteria		
No. of observations	508	508
Log likelihood	-311.3	-242.2
Wald χ^2	7 345.2	9 830.1
Probability > χ^2	0.0000	0.0000
σ_v	0.280	0.287
σ_u	0.383	0.278
$\sigma_{1/2}$	0.226	0.160
λ	1.367	0.968

^a Model 5 (appendix E). ^b Model 10 (appendix E). ^c Queensland is not listed because it was used as the reference category. *** Significant at the 1 per cent level. ** Significant at the 5 per cent level. * Significant at the 10 per cent level.

Source: Unpublished ABS and AIHW data; Productivity Commission estimates

The positive coefficients on the input variables of the Cobb-Douglas model indicate that hospitals that use relatively more of those inputs will have their best-practice frontier moved up, while keeping other factors unchanged. For nursing staff, the restricted translog indicates that increases to nurse staffing raises the best practice benchmark at a diminishing rate. For hospital beds, the coefficient indicates that the best-practice frontier is increased at an increasing rate.

The negative coefficients (Cobb-Douglas and translog models) of two inputs (other labour services and other inputs) appear to reflect the effect of a number of extraneous factors. This seems to be the result of the way the variables have been defined to include all other (residual) inputs to production.

Patient characteristics

Both the broad categories of patient characteristics — patient comorbidity (Charlson) and SEIFA — indices were statistically very significant. The groups of variables suggest that in hospitals that treat relatively more comorbid or economically disadvantaged patients, the best-practice benchmarks are lowered (in both the Cobb-Douglas and translog models), particularly at the higher levels of comorbidity and lowest levels of socioeconomic advantage.

Variables describing the patient's age and the ASGC-RA of their usual place of residence were not included in either Cobb-Douglas or translog models, and so were not reported in table 8.4. Patient age was found to be related with comorbidity, and the geographic remoteness of residence was thought to be too closely related with the patient's SEIFA index.

Role and function

Hospitals with a relatively higher share of non-public patients were found to have a lower best-practice frontier. This may indicate that non-public patients, compared to public patients, are more resource intensive for hospitals. This may reflect the way in which hospitals differentiate their services to public and non-public patients by, for example, offering additional services such as clinical interventions and private ward accommodation to non-public patients.

A hospital's share of surgical and other procedures was found to raise the hospital's best-practice frontier. This is equivalent to finding that hospitals that specialise in medical DRG cases need to have the best-practice frontier adjusted downwards. This finding strengthens the view that surgical procedures are less resource intensive and simpler to manage than medical cases.

The two Evans and Walker indices should be interpreted jointly. The first index indicates that the more complex the caseload that hospitals have, the further inwards the best-practice frontier is positioned. The second index indicates, however, that this effect is offset by hospital size. While larger hospitals are expected to take on more complex cases, they do not appear to be taking on as many complex cases as their size would suggest, so their best-practice benchmarks are adjusted accordingly.

A hospital's teaching status was found to raise a hospital's best-practice frontier. If trainee doctors and nurses were less productive than their fully trained counterparts, one would expect the coefficient to be negatively signed. Instead it seems that the binary nature of the variable is identifying extraneous influences on hospital performance.

Other variables

Variables indicating the states and territories in which the hospitals were located were included to control for differences in state and territory policies, regulations and legislation, which cannot be reflected elsewhere in the model. The significance of the coefficients for Victoria and Tasmania is likely to reflect, in part, the fact that some of their hospital data was provided in aggregated form. Even though attempts were made to rescale the data appropriately, it is possible that inconsistencies still exist that are least are being controlled for by these variables (appendix E). The significance of the Victorian coefficient may also pick up the effect of network membership.

The RAMR variable, as a proxy for the quality of health care, was found to be insignificant in the model and is not reported here. It was found to be highly correlated with the various Charlson indices, and was consequently dropped from the final analysis. The insignificance of the RAMR variable suggests that the quality of hospital care, as modelled here, does not have a sufficiently strong effect on hospital output. The significance of the Charlson and SEIFA variables suggests that patient characteristics affect hospitals output directly. The Commission intends to examine alternative methods to incorporate a quality control factor in future analyses.

FINDING 8.1

A multivariate analysis of Australian hospital-level data established the best-practice benchmarks for each hospital in the sample. The benchmarks were influenced by a number of factors. The best-practice benchmarks were lower for hospitals that treat:

-
- *highly morbid patients*
 - *patients from lower socioeconomic communities*
 - *relatively more medical cases, as these cases are more difficult to manage*
 - *more complex cases, although this is less so for the largest hospitals.*

8.5 Hospital efficiencies

The previous statistical analysis focused on identifying the factors that influence the best-practice frontier of each hospital. The next step is to estimate how far hospitals are from their respective frontiers.

A hospital's technical efficiency is measured as an index with a possible value ranging from zero to less than one. If a hospital has a technical efficiency index of 0.80, it is producing 20 per cent less output than it potentially could achieve if it met its hypothetical benchmark. No hospital has a ranking of 1.00, as each hospital's benchmark is uniquely determined using all of the observations in the data set, not just a few neighbouring peers. Put simply, even the best performing hospitals can still learn from others on how to improve their performance.

The indices of technical efficiency from the restricted translog model (table 8.4) are presented in table 8.5. The efficiency scores already account for differences in hospital size. That is, the technical efficiency scores *do not* reflect the effects of scale economies. Public, for-profit private and not-for-profit private hospitals within this sample were operating with mean efficiencies between 0.75 and 0.80 of the best practice efficiency in 2006-07, although this appears to be pulled downwards by the small and very small hospitals.

There are perceptible differences between various groupings of public and private hospitals, and with those hospitals that are not managed by governments as public hospitals. However, care must be exercised when comparing across groups as there is a large variation in the efficiencies among the members of these groups.

The mean efficiencies of very large and large private hospitals are estimated to be slightly higher than similarly-sized public hospitals. In contrast, the mean technical efficiencies of very small to medium sized public hospitals tend to be higher than for similarly-sized private hospitals. However, caution needs to be exercised when interpreting the results for very small to medium hospitals as there is a wide range between the 5th and 95th percentile technical efficiency scores. For example, the range for very small and small private hospitals is 0.203 to 0.919, suggesting that there are a variety of activities among these hospitals that are yet to be fully accounted in the model.

Table 8.5 Summary of hospital technical efficiency scores, 2006-07^a

		<i>Public hospitals</i>	<i>Private hospitals</i>			<i>Public contract hospitals</i>	<i>All hospitals</i>
			<i>All</i>	<i>For profit</i>	<i>Not-for-profit</i>		
<i>All hospitals</i>							
Mean	rate	0.797	0.750	0.751	0.747	0.800	0.786
Median	rate	0.816	0.822	0.818	0.838	0.805	0.816
5th percentile	rate	0.643	0.313	0.313	0.203	0.583	0.553
95th percentile	rate	0.901	0.916	0.917	0.906	0.908	0.906
No. of observations	no.	368	122	94	28	18	508
<i>Very large hospitals</i>							
Mean	rate	0.813	0.819	0.834	0.795	np	0.814
Median	rate	0.820	0.851	0.863	0.846	np	0.827
5th percentile	rate	0.708	0.655	0.659	0.639	np	0.683
95th percentile	rate	0.905	0.893	0.917	0.877	np	0.905
No. of observations	no.	68	24	15	9	np	98
<i>Large hospitals</i>							
Mean	rate	0.810	0.813	0.810	0.819	np	0.809
Median	rate	0.812	0.829	0.828	0.830	np	0.828
5th percentile	rate	0.648	0.752	0.457	0.757	np	0.644
95th percentile	rate	0.917	0.878	0.918	0.868	np	0.908
No. of observations	no.	37	22	15	7	np	70
<i>Medium hospitals</i>							
Mean	rate	0.803	0.780	0.791	0.707	np	0.741
Median	rate	0.815	0.841	0.820	0.876	np	0.780
5th percentile	rate	0.622	0.427	0.470	0.029	np	0.491
95th percentile	rate	0.907	0.931	0.931	0.906	np	0.915
No. of observations	no.	45	38	33	5	np	83
<i>Small and very small hospitals</i>							
Mean	rate	0.788	0.641	0.640	0.642	np	0.766
Median	rate	0.816	0.700	0.715	0.644	np	0.806
5th percentile	rate	0.575	0.203	0.208	0.203	np	0.415
95th percentile	rate	0.897	0.919	0.916	0.919	np	0.899
No. of observations	no.	218	38	31	7	np	257

^a Based on restricted translog model 10 (appendix E). **np** Not published due to confidentiality.

Source: Unpublished ABS and AIHW data; Productivity Commission estimates.

These findings are broadly consistent with findings of other research undertaken by the Commission as part of its modelling of the potential benefits of the National Reform Agenda in 2006. The Commission had reviewed published research on hospital performance, from which it concluded that the gap between existing and best-practice productivity might be in the order of 20–25 per cent for the Australian (public and private) hospital sector as a whole (PC 2006a). This conclusion was

based on a combination of the limited Australian research, particularly for the private sector, and overseas studies.

What are some of the contributing factors?

Why is it then that some hospitals appear to be better performing than others? Partial productivity, at least for admitted-patient care, is higher among private hospitals than for public hospitals. The productivity difference is noticeable for each of the partial measures of productivity — casemix-adjusted separations and patients days, per non-medical staff and per bed. For example, the number of casemix-adjusted separations per non-medical staff was 63.2 for not-for-profit hospitals and 22.9 for public hospitals (table 8.2). Similar patterns are evident for all sizes of public and private hospitals. This would suggest that private hospitals are more technically efficient than public hospitals.

Public hospitals, however, provide more non-admitted patient care than do private hospitals in this sample. Though the productivity numbers are not reported in table 8.2, productivity for these services will obviously be higher among public hospitals.

Public hospitals also undertake relatively more medical DRG separations (75.7 per cent) than do not-for-profit hospitals (53.5 per cent) as a proportion of their total activity. As estimated in table 8.4, medical DRG separations are more difficult to manage than surgical and other DRG separations, so public hospitals are regarded to have their best-practice benchmarks lowered in this regard. Similarly, public hospitals treat relatively more patients from the more disadvantaged socioeconomic regions of Australia than do private hospitals. For example, 40.3 per cent of all public hospital patients were from the most disadvantaged regions (SEIFA 1).

Similarly, private for-profit hospitals treated the least morbid patients. The average Charlson score for private for-profit hospitals was 0.42, compared to 0.55 for public hospitals, 0.72 for not-for-profit hospitals and 0.70 for public contract hospitals. These patterns are also evident in the highest Charlson comorbidity scores. Over 9 per cent of all the patients of not-for-profit hospitals had comorbidity scores of 5 or higher. These statistics contribute to lowering the best-practice frontiers of not-for-profit and public contract hospitals (and to a lesser extent public hospitals) further than for private for-profit hospitals.

The performance of smaller private hospitals

The efficiency scores for medium, small and very small private hospitals exhibited a considerable degree of variation (table 8.5). This suggests a degree of unexplained differences (heterogeneity) that has not been recognised in the model. Comparing these efficiency scores with some of the data in table 8.3 provides insights on such hospitals.

Small and very small hospitals appear to comprise two distinct groups — one that specialises in high-volume same-day procedures and another that specialises in long-stay cases. For example, the proportion of same-day cases in very small and small private hospitals is 65 per cent, compared to 52 per cent for public hospitals. Yet very small and small hospitals also have an ALOS of 6.5 days. These lengths of stay are likely to represent non- and sub-acute services provided by otherwise acute hospitals. The lengths of stay for these hospitals count against their reported productivity, and at the same time, so does the lack of complexity (as represented by the Evans and Walker indices). There is potential to more accurately model the performance of these hospitals.

FINDING 8.2

After controlling for differences in services provided and types of patients treated, the efficiency of public and private hospitals is, on average, similar. It was estimated that the output of individual hospitals in both sectors is, on average, around 20 per cent below best practice among the sampled hospitals. Among large and very large hospitals, the scope to improve technical efficiency is slightly greater for public hospitals. At the other end of the scale, the scope to improve efficiency is higher for small and very small private hospitals, although these results may be partly due to a number of factors that could not be accounted for in the analysis.

8.6 Further analysis

Given the delays in obtaining data faced by the Commission, the multivariate analysis presented in this report estimates hospital production functions and technical efficiency based on a single year of data (2006-07). Given the large number of hospital observations in this data set, the results are expected to be robust.

Nevertheless, the Commission intends over coming months to replicate this analysis using a larger data set that includes data from the earlier years of 2003-04 to 2005-06. Future analysis will also focus on examining the performance of hospitals for different peer groups (for example, to compare the performance of very large

hospitals). The Commission will also extend this analysis to examine the determinants of hospital costs.

The Commission intends to publish the results from this further analysis in March 2010.