Chapter 10
Methodology: Relative Benefit Estimation Techniques

Relative Expenditure Formula

$$\mathbf{RE_{AUS,MOD,CAT,LEV,EST,Y} = EE_{AUS,MOD,CAT,LEV,EST,Y} - AE_{AUS,CAT,LEV,Y}}$$

...[10.1a]

Where:

$RE_{AUS,MOD,CAT,LEV,EST,Y}$ is the *Australia-wide estimated annual relative expenditure*, or *relative expenditure* (RE) for short, of government structure model MOD, in expenditure category CAT, at government level(s) LEV, as calculated using estimation technique EST, in financial year(s) Y;

$EE_{AUS,MOD,CAT,LEV,EST,Y}$ is the *Australia-wide estimated annual expenditure*, or *estimated expenditure* (EE) for short, of model MOD, in expenditure category CAT, at government level(s) LEV, as calculated using estimation technique EST, in financial year(s) Y;

and

$AE_{AUS,CAT,LEV,Y}$ = the *Australia-wide actual annual expenditure*, or *actual expenditure* (AE) for short, of Australia's current model of government (MOD = CU), in expenditure category CAT, at government level(s) LEV, in financial year(s) Y.

Expression [10.1a] is a standard relative value formula, or, equivalently, a standard numerical difference formula, and without subscripts reduce to simply:

$$\mathbf{RE = EE - AE} \qquad \textbf{...[10.1b]}$$

Relative Benefit Formulas

For private sector expenditure categories
(CAT = $CAT_{PRI)}$, with LEV = ALL in all cases)

$$\mathbf{RB_{AUS,MOD,CAT_{PRI},ALL,EST,Y} = RE_{AUS,MOD,CAT_{PRI},ALL,EST,Y}}$$

...[10.4a]

And for public sector expenditure categories
(CAT = CAT_{PUB} $\mathbf{CAT_{PUB}}$, with no restrictions on LEV, again as explained in Chapter 6):

$$\mathbf{RB_{AUS,MOD,CAT_{PUB},ALL,EST,Y} = -RE_{AUS,MOD,CAT_{PUB},ALL,EST,Y}}$$

...[10.4b]

Relative Benefit Estimation Techniques

Table 10-2: Relative Benefit Estimation Techniques

Relative Benefit Estimation Technique (EST)	EST abbreviation	Government Structure Models Used For	Mathematical Formula Used for Estimated Expenditure = EE(P)
STU-based per capita benchmarking	PCB-U	FSC, NSC, RS, SFC, SNC, SRS	$EE_{PCB-U}(P) = ae_U P$, where ae_U is the inflation adjusted actual per capita expenditure for STU U
linear regression	LR-REG	DNC, NCL, FTC, SFC, SNC, SRS	$EE_{LR}(P) = A_{LR} + B_{LR}P$, where A_{LR} and B_{LR} are numbers derived using the least squares linear regression method
quadratic regression	QR-REG	DNC, NCL, FTC, SFC, SNC, SRS	$EE_{QR}(P) = A_{QR} + B_{QR}P + C_{QR}P^2$, where A_{QR}, B_{QR} and C_{QR} are numbers derived using the least squares quadratic regression method
quadratic regression tangential extension	QT-REG	DNC, NCL, FTC, SFC, SNC, SRS	$EE_{QT}(P) = A_{QT} + B_{QT}P$, where A_{QT} and B_{QT} are numbers derived using the QT method
power regression	PR-REG	DNC, NCL, FTC, SFC, SNC, SRS	$EE_{PR}(P) = KP^L$, where K and L are numbers derived using the least squares power regression method
power regression tangential extension	PT-REG	DNC, NCL, FTC, SFC, SNC, SRS	$EE_{PT}(P) = A_{PT} + B_{PT}P$, where A_{PT} and B_{PT} are numbers derived using the PT method
composite regression technique	CR-REG-cr	DNC, NCL, FTC, SFC, SNC, SRS	uses combinations of results obtained using the LR, QT and PT techniques
progressive amalgamation regression	PA-i,j	DNC, NCL, FTC, SFC, SNC, SRS	uses several different linear regression results (of the form EE = A + BP) at different stages of the calculation process

Regression Sets Used for Regression Techniques

Table 10-3: Regression Sets Employed in Regression Techniques

Regression Set (REG)	Number of STUs	Description	STUs in REG
8ST	8	all 8 STUs	NSW, VIC, QLD, WA, SA, TAS, ACT, NT
7MA	7	7 STUs being all 8 minus ACT	NSW, VIC, QLD, WA, SA, TAS, NT
7MQ	7	7 STUs being all 8 minus QLD	NSW, VIC, WA, SA, TAS, ACT, NT
7MV	7	7 STUs being all 8 minus VIC	NSW, QLD, WA, SA, TAS, ACT, NT
7MW	7	7 STUs being all 8 minus WA	NSW, VIC, QLD, SA, TAS, ACT, NT
6ST	6	6 States	NSW, VIC, QLD, WA, SA, TAS
6PS	6	6 largest STUs by geopolitical size being all 8 minus ACT and TAS	NSW, VIC, QLD, WA, SA, NT
5MS	5	5 mainland States	NSW, VIC, QLD, WA, SA
4LA	4	4 largest States	NSW, VIC, QLD, WA
3PO	3	3 largest States by population	NSW, VIC, QLD
3PS	3	3 largest States by geopolitical size	NSW, QLD, WA

The STU Based Per Capita Benchmarking Technique ...

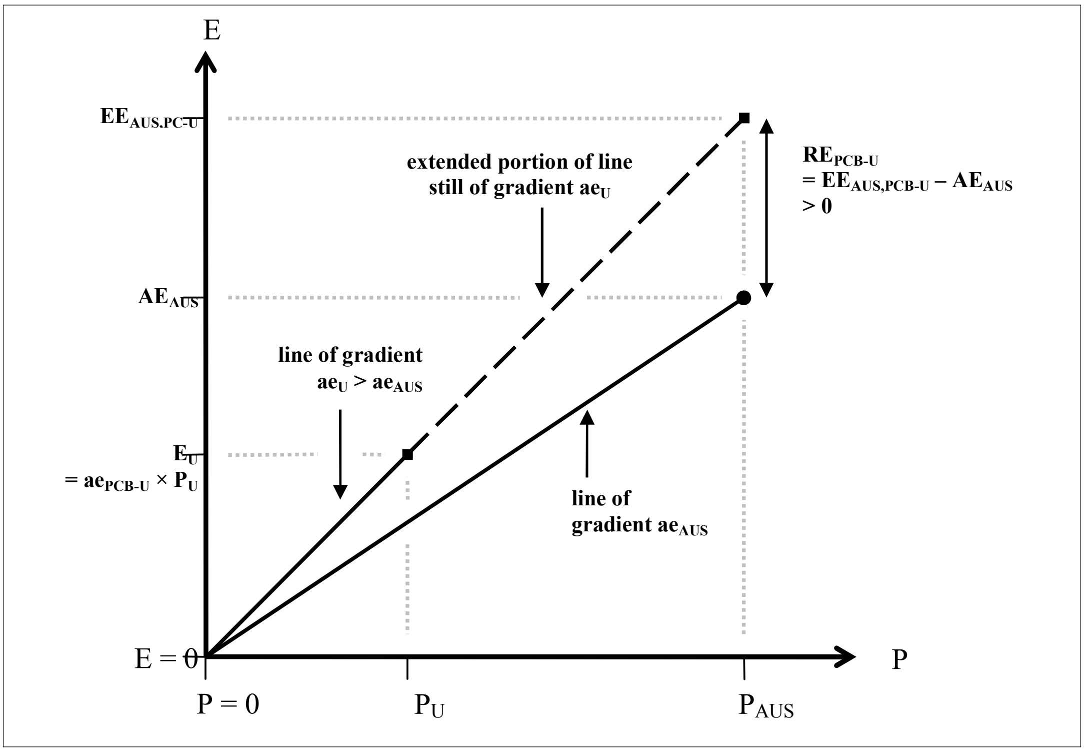
is used to determine RB estimates for New States Current Local (NSC), Fewer States Current Local (FSC) and Regional States (RS) models. The RB estimates for the NSC, FSC and RS models then substantially contribute to the corresponding estimates for three additional models: Simplified New States Current Local (SNC), Simplified Fewer States Current Local (SFC), and Simplified Regional States (SRS).

Estimated Expenditure: $EE_{AUS,PCB\text{-}U} = ae_{PCB\text{-}U} \times P_{AUS}$

Relative Expenditure: $RE_{PCB\text{-}U} = EE_{AUS,PCB\text{-}U} - AE_{AUS}$

Relative Benefit: $RB_{PCB\text{-}U} = RE_{PCB\text{-}U}$ **for private sector CATs, and**
$RB_{PCB\text{-}U} = -RE_{PCB\text{-}U}$ **for public sector CATs**

Figure 10-1: STU Based PCB Technique Estimated Expenditure and Relative Expenditure for the Case of Positive Relative Expenditure (RE > 0)



The Linear Regression Technique ...

is used to determine RB estimates for Dual National Current Local (DNC), National Current Local (NCL) and Functional Transfer Current Local (FTC) Models. The estimates established for FTC models are then combined with estimates for the NSC, FSC and RS model (obtained using the PCB technique) to determine RB estimates for the Simplified New States Current Local (SNC), Simplified Fewer States Current Local (SFC), and Simplified Regional States (SRS) models.

Estimated Expenditure: $EE_{AUS,LR} = A_{LR} + (B_{LR} \times P_{AUS})$

Relative Expenditure: $RE_{LR} = EE_{AUS,LR} - AE_{AUS}$

Relative Benefit: $RB_{LR} = RE_{LR}$ **for private sector CATs, and**
$RB_{LR} = -RE_{LR}$ **for public sector CATs**

Figure 10-4: LR Technique Estimated Expenditure and Relative Expenditure for the Case of Negative Relative Expenditure (RE < 0)

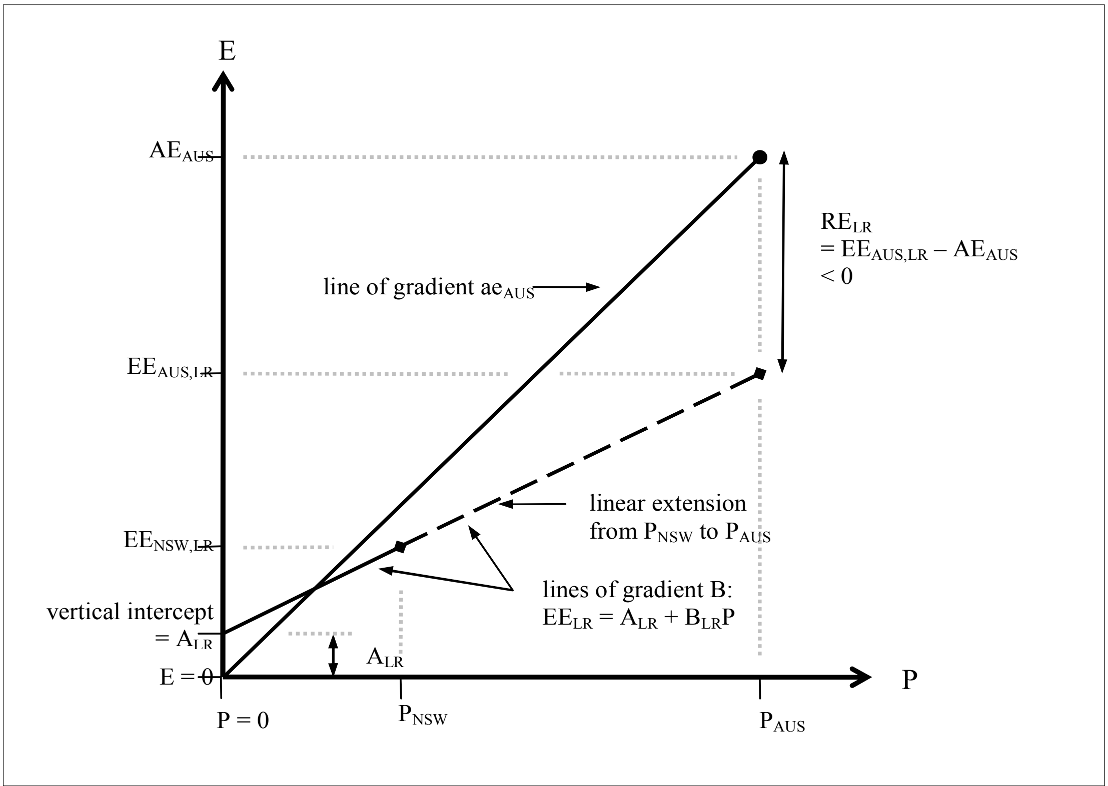


Table 10-6: Median $\underline{r}^2$ Values (adjusted) across all 11 REG Sets

CAT	$\underline{r}^2_{LR}$	$\underline{r}^2_{QR}$	$\underline{r}^2_{PR}$	$\underline{r}^2_{LOGR}$	$\underline{r}^2_{EXPR}$	**CAT**	**Rank LR**	**Rank QR**	**Rank PR**	**Rank LOGR**	**Rank EXPR**
GPP	0.9822	0.9885	0.9712	0.8294	0.8219	GPP	2	1	3	4	5
PFD	0.9948	0.9975	0.9922	0.8348	0.8620	PFD	2	1	3	5	4
HFC	0.9939	0.9990	0.9945	0.8216	0.8832	HFC	3	1	2	5	4
GBP	0.8409	0.8643	0.6502	0.7233	0.6286	GBP	2	1	4	3	5
BFD	0.9758	0.9791	0.9365	0.8434	0.8197	BFD	2	1	3	4	5
TPS	0.9899	0.9912	0.9800	0.8807	0.8390	TPS	2	1	3	4	5
GOV	0.9938	0.9936	0.9749	0.8699	0.8691	GOV	1	2	3	4	5
PSC	0.8316	0.8532	0.8618	0.8414	0.6584	PSC	4	2	1	3	5
EDU	0.9977	0.9977	0.9915	0.8758	0.8645	EDU	2	1	3	4	5
HEA	0.9921	0.9929	0.9815	0.8649	0.8580	HEA	2	1	3	4	5
TAC	0.9650	0.9689	0.9771	0.8062	0.8210	TAC	3	2	1	5	4
POS	0.9910	0.9925	0.9666	0.8542	0.8646	POS	2	1	3	5	4
GPS	0.5253	0.6712	0.6942	0.5730	0.6008	GPS	5	2	1	4	3
HCA	0.9277	0.9446	0.9634	0.8323	0.8087	HCA	3	2	1	4	5
SSW	0.8807	0.8964	0.9310	0.7199	0.8720	SSW	3	2	1	5	4
RAC	0.9722	0.9729	0.9473	0.8498	0.8598	RAC	2	1	3	5	4
BAL	0.8118	0.8381	0.7988	0.6708	0.7371	BAL	2	1	3	5	4
2FC	0.9961	0.9963	0.9878	0.8715	0.8609	2FC	2	1	3	4	5
3FC	0.9972	0.9973	0.9919	0.8720	0.8626	3FC	2	1	3	4	5
4FC	0.9961	0.9966	0.9773	0.8793	0.8709	4FC	2	1	3	4	5
6FA	0.9980	0.9979	0.9882	0.8696	0.8723	6FA	1	2	3	5	4
6FB	0.9951	0.9959	0.9788	0.8838	0.8698	6FB	2	1	3	4	5
8FC	0.9975	0.9976	0.9826	0.8747	0.8704	8FC	2	1	3	4	5
MAX	0.9980	0.9990	0.9945	0.8838	0.8832	MAX	5	2	4	5	5
MIN	0.5253	0.6712	0.6502	0.5730	0.6008	MIN	1	1	1	3	3
MEAN	0.9411	0.9532	0.9356	0.8236	0.8207	MEAN	2.3	1.3	2.6	4.3	4.6
MED	0.9910	0.9925	0.9771	0.8498	0.8609	MED	2.0	1.0	3.0	4.0	5.0
GOF ($\underline{r}^2$)	$\underline{r}^2_{LR}$ (/23)	$\underline{r}^2_{QR}$ (/23)	$\underline{r}^2_{PR}$ (/23)	$\underline{r}^2_{LOGR}$ (/23)	$\underline{r}^2_{EXPR}$ (/23)	# 1	2	16	5	0	0
# > 0.9950	7	9	0	0	0	# 2	15	7	1	0	0
# > 0.9900	12	13	4	0	0	# 3	4	0	16	2	1
# > 0.9800	14	14	9	0	0	# 4	1	0	1	13	8
# > 0.9500	17	17	16	0	0	# 5	1	0	0	8	14
# > 0.9000	18	18	19	0	0	% 1	8.7	69.6	21.7	0.0	0.0
# > 0.8000	22	22	20	19	19	% 2	65.2	30.4	4.3	0.0	0.0
# > 0.7000	22	22	21	21	20	% 3	17.4	0.0	69.6	8.7	4.3
# > 0.6000	22	23	23	22	23	% 4	4.3	0.0	4.3	56.5	34.8
# > 0.5000	23	23	23	23	23	% 5	4.3	0.0	0.0	34.8	60.9
% > 0.9950	30.4	39.1	0.0	0.0	0.0	Total	100.0	100.0	100.0	100.0	100.0
% > 0.9900	52.2	56.5	17.4	0.0	0.0						
% > 0.9800	60.9	60.9	39.1	0.0	0.0						
% > 0.9500	73.9	73.9	69.6	0.0	0.0						
% > 0.9000	78.3	78.3	82.6	0.0	0.0						
% > 0.8000	95.7	95.7	87.0	82.6	82.6						
% > 0.7000	95.7	95.7	91.3	91.3	87.0						
% > 0.6000	95.7	100.0	100.0	95.7	100.0						
% > 0.5000	100.0	100.0	100.0	100.0	100.0						

Non-linear Regression Techniques are employed:

- **in an attempt to establish expenditure function equations that fit actual expenditure and population data better than linear regression equations; and**

- **to establish whether Australia-wide estimated expenditures and relative benefit estimates are more likely to err on the high side or the low side.**