Commonwealth Grants Commission
2015 Methodology Review

Feedback on CGC Staff Assessment Proposals

- Transport (Urban Public Transport Subsidies)
- Interstate Wages

March 2014

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1. OVERVIEW

The Queensland Government Statistician's Office within Queensland Treasury and Trade has undertaken a review of the data and statistical analysis underpinning the Transport Services and Wages Assessments put forward in the Commonwealth Grants Commission 2015 Methodology Review. This review has identified a number of concerns.

Transport Services - Urban Operating Subsidies Assessment Model

- The conceptual case for the model is not strong.
- The quality of the expenses and subsidy data varies, outdated population data have been used and some localities have been excluded.
- There appears to be errors in the simple model as presented and the estimated relationship is not robust.

Interstate Wages

- The model derived from the Survey of Education and Training (SET) has deteriorated over the 4 iterations of the survey and is statistically insignificant.
- Wage setting in Western Australia does not explain the deterioration in the 2009 SET model.
- The geography proposed for narrowing the scope of the SET model is inappropriate even though the model itself is found to be a) statistically insignificant and b) not statistically different from the whole-of-state model.
- Testing the conceptual basis for the assessment against an alternative dataset provides no evidence for a relationship between private and public sector wages.

2. TRANSPORT ASSESSMENT

Background

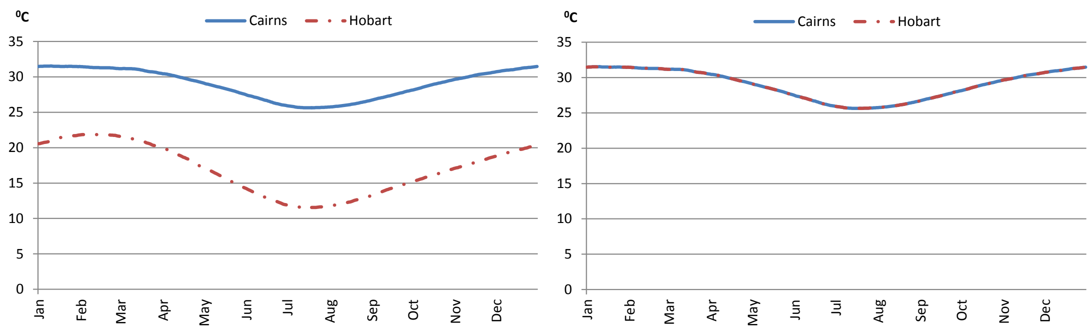
Overall the conceptual case for the assessment is not strong. As indicated in the literature review in the Discussion Paper (the paper), there is little consensus on the drivers of transport services expenses.

Reality Check against US data

The CGC Staff present a "reality check" of the simple model by applying US data to the model specification. The estimated per capita operating subsidies for the US and Australia are presented along with adjusted US estimates scaled by the ratio of Australian to US model estimates.

This is at best a deterministic result within a closed system and provides no "reality check" to the 2010 Review model. While the CGC Staff analysis outlined in Paragraph 13 of the paper was not replicated in full, the data presented in Figure 1 illustrates the outcome.

Figure 1: Mean Maximum Daily Temperature, Cairns versus Hobart



Urban Operating Subsidies Assessment Model

There are a number of concerns with the simple model used in the assessment relating to data, the robustness of the estimated relationship in the simple model and apparent errors in the simple model as presented by CGC Staff.

Data related concerns

<u>Expenses and subsidy data</u>

The quality of the expenses and subsidy data varies, as does the methods used to derive the regional level subsidy data. In addition, the explanation of the regional subsidy split is not very clear and the sources of underlying data are not made explicit for all data. The report notes that averages were used for subsidies / net expenses and populations used over 2008-09 to 2011-12 period <u>where available and appropriate</u>.

There are a number of assumptions made around data with no evidence base/rationale provided. For example, road/rail crossing data – the paper notes that actual data on length of road and rail waterway crossings was used where available, but where there was no length data available, the length of crossing was assumed to be 125 metres. This could be advantageous or disadvantageous, but nevertheless, means that areas with poorer data quality will be assessed differently to those where concerted efforts have been made to improve these data. Further, the length of crossings within a Significant Urban Area (SUA) but not included in an Urban Centre/Locality (UC/L) was NOT included in the assessment. Again, there is no rationale provided and this could impact differently across areas.

Estimated resident population data

Selection of the geographic units used in the CGC Staff models is based on unrebased estimated resident population data (ERP). The Australian Bureau of Statistics (ABS) has released a time series of updated ERP data recast and rebased against the 2011 Census. Preliminary sub-state estimates were released in 2012 while final sub-state estimates were released in August 2013. Use of these updated data is essential to determination of subsidies as the impact of rebasing and recasting varied from area to area.

The application of these final estimates to the methodology used in the paper identifies two additional SUA's with populations of over 20,000 people:

- Cessnock (NSW) has an average of 20,329 people
- Ocean Grove-Pont Lonsdale (Vic) has an average of 20,205 people.

CGC Staff's population estimates provided in the excel file show that Mount Isa SUA (QLD) also has an average population of over 20,000, however, it appears to be missing from both the simple and multivariate regression model. The multivariate model purports to include all urban centres with populations of 20,000 or more, whether or not these centres receive subsidies for public transport services. It is worth noting that SUAs in remote areas in other states are included in this model.

In relation to non-urban subsidies the paper notes that it is likely that the size of the subsidy depends not only on how large the non-urban population is, but how dispersed the population is. Queensland agrees that the current assessment does not capture the impact of population dispersion, but questions the Staff preference to use an existing measure of dispersion ($30 per capita) rather than investigate other methods mentioned i.e. rural road length etc. One proxy for measuring the dispersion of population by state and territory is to calculate the average distance to the nearest SUA[1] (ASGS 2011). Those living within an SUA were classed as having a distance of 0 kilometres. Using this measure, Table 1 shows the level of dispersion for each state and territory. The Northern Territory, Western Australia, Queensland and South Australia had higher levels of dispersion, relative to the national average.

Table 1: Dispersion of population by state and territory, 2012p

State/territory	Average distance from SUA (km)	Relative dispersion
New South Wales	6.4	0.64
Victoria	3.9	0.39
Queensland	13.7	1.37
South Australia	13.2	1.32
Western Australia	18.1	1.82
Tasmania	7.3	0.73
Northern Territory	109.5	10.95
Australian Capital Territory	0.0	0.00
Australia	**10.0**	**1.00**

p = preliminary
Source: ABS 3218.0

[1] A Significant Urban Area (SUA) has been defined by the ABS as an urban development with a population of 10,000 people or more.

Selection of Geography

While CGC Staff note that they believe that the alternative geography of UC/Ls contained within an SUA better captures the transport task, this argument does not apply in the Queensland case. The use of the ABS' SUA fails to include important UC/Ls in Queensland where transport relationships exist. For example, some UC/Ls that have a transport relationship with Brisbane appear to have been excluded from modelling due to the application of the SUA restriction. A number of UC/Ls with access to, or on, the rail line between Brisbane and the Sunshine Coast, including Maleny, Landsborough, Beerwah, Beerburrum and the Glasshouse Mountains, have not been included in the models base because they do not fall within the Sunshine Coast SUA boundary.

Table 2 shows the average population of the excluded UC/Ls.

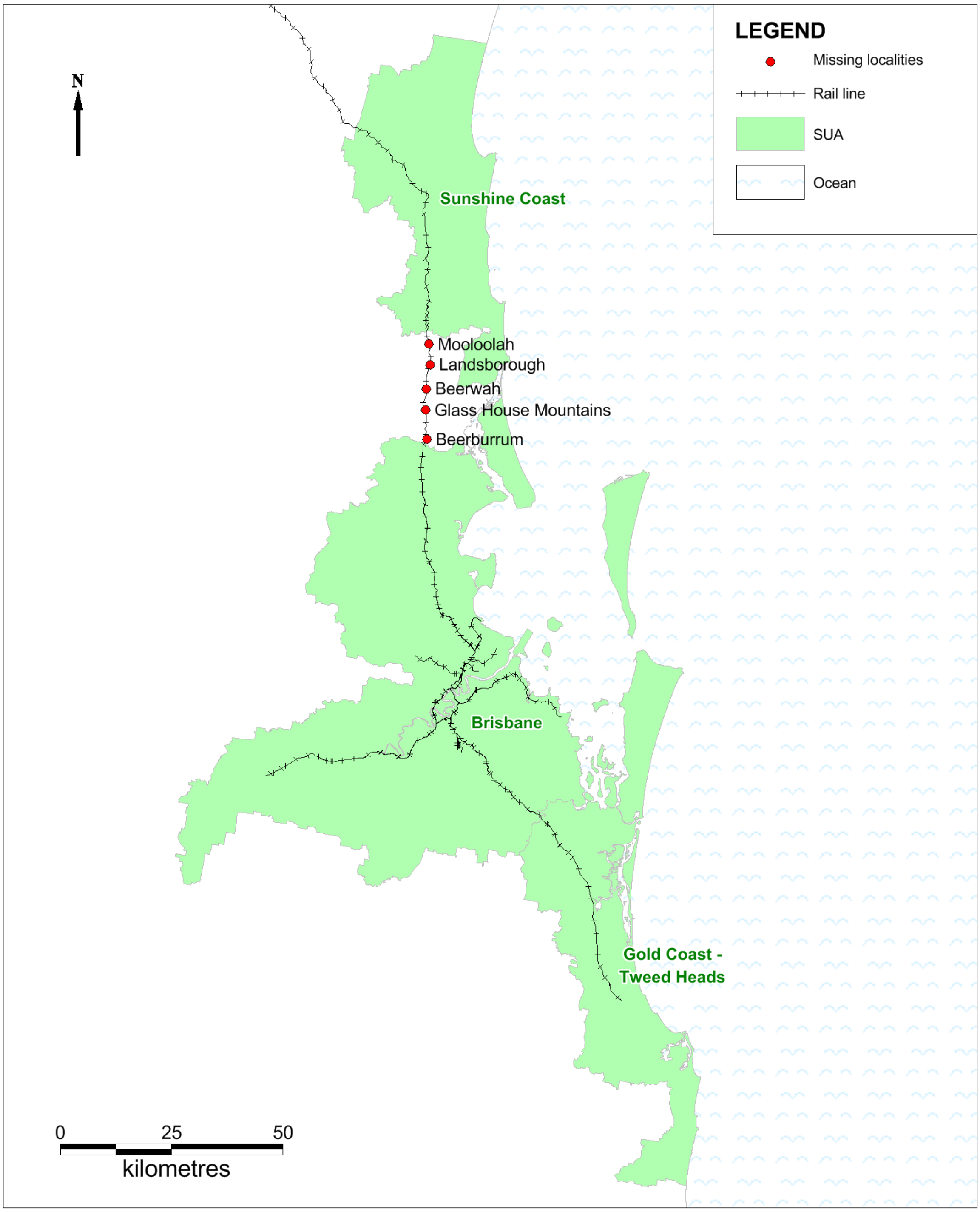
Table 2: Average estimated resident population, excluded UC/Ls, 2009-2012

UC/L	Average ERP
Beerburrum - North (L)	316
Beerburrum (L)	297
Beerwah	4,246
Flaxton (L)	914
Glass House Mountains	3,534
Glenview (L)	1,187
Kureelpa (L)	859
Landsborough	3,796
Maleny	2,565
Mapleton (L)	879
Mooloolah	2,926
Peachester (L)	483
Total	**22,002**

Source: ABS Estimated Resident Population, unpublished data

Figure 2 below shows the SUAs of Sunshine Coast and Brisbane with those excluded UC/Ls directly on the rail line shown in red. The UC/Ls in this missing region alone include a population of approximately 20,000.

Figure 2: Map of Sunshine Coast and Brisbane SUAs



Simple Model

Queensland concerns regarding the simple linear model are described below.

Inputs

The number of data points noted in Paragraph 17 of the paper (42), and model shown based on the new data $y = 260.35 + 61.48\ln(ERP)$, don't match those provided in the excel file; $n = 40, y = 242.87 + 61.655\ln(ERP)$.

Figure 19.2 of the CGC report appears to have a much higher average subsidy for Sydney (more than $600pc) compared with that provided in the data file ($494pc).

The array formula designed to read data into the set shown on the regression model spreadsheet fails to read in the Queensland component of Gold Coast – Tweed Heads SUA, meaning that Gold Coast – Tweed Heads subsidy and population data do not appear in the simple linear model shown on the following worksheet.

The multivariate model indicates that it includes SUAs with 0 subsidy, however, the simple linear model does not. The rationale for this approach is not stated.

Method

The simple linear model has been run in Excel by plotting the points as a scatter diagram and then requesting that excel run a logarithmic trend through the data. While this approach will produce the same regression equation that would result from running these data through a formal regression program in a statistical package, that is all it will do.

The Excel method does not supply any information about model fit, nor whether the assumptions of the linear modelling technique have been met.

The paper assumes that a high R^2 value implies that the model is a good fit. This is a misinterpretation of R^2. R^2 measures the proportion of the variance in data that is explained by model. It cannot determine whether the coefficient estimates and predictions are biased, which is why residual plots must be developed and examined. R^2 alone does not indicate whether a regression model is adequate.

Table 3 below presents the model output resulting from running the regression data, including the Gold Coast-Tweed heads (QLD) SUA, through Stata – a statistical package. The model regresses the average subsidy against the log of the average population, using the CGC provided ERPs for comparability.

Table 3: CGC Staff Simple Corrected for missing SUA and old ERPs

Variable	Coefficient	Standard error	Probability	Lower 95% Confidence limit	Upper 95% confidence limit
Log ERP	59.63	6.20	0.000	47.00	72.25
Constant	235.66	16.30	0.000	202.61	268.71
N=41	F(1,39)=91.2	Prob>F=0.000	R^2=0.71		

The relationship between average per capita subsidies and average population is not linear, however, transformation of average population on the log scale corrects this relationship to a large extent.

The above model results in Table 3 show that the average population is a significant predictor of average subsidies (not surprising given that the average per capita subsidies are derived from the average population), however:

- The standard error of 6.20 around the log population coefficient results in confidence limits that are quite wide at +/-21.2%.
- This means that predicted subsidies could vary quite widely from that derived from the regression equation developed by the Excel model. The standard errors around individual points should be used to develop the confidence limits around each predicted point. Figure 3 below shows these as grey bands around the fitted (predicted) values. The observed values are shown as dots. These bands are also presented in Table 4 below for the five largest SUAs.

Figure 3: Plot of fitted trend and observed average subsidy ($pc) against average population

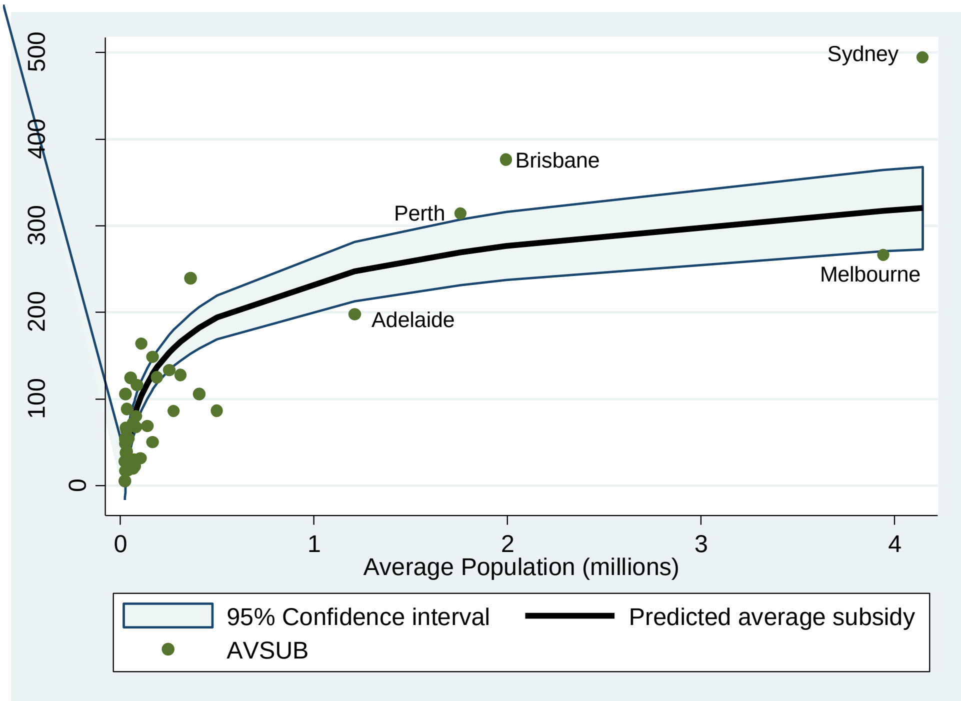


Table 4: Confidence Limits on Estimated Average Subsidy per Capita

State	SUA	Ave Subsidy $pc	Est pop	Predicted ave subsidy $pc	Lower 95% limit $pc	Upper 95% limit $pc
SA	Adelaide	197.32	1.21253	247.15	213.13	281.18
WA	Perth - Ellenbrook	313.70	1.7572	269.28	231.29	307.27
Qld	Brisbane	376.78	1.99227	276.76	237.41	316.12
Vic	Melbourne	265.97	3.94245	317.46	270.48	364.45
NSW	Sydney	494.02	4.14363	320.43	272.88	367.98

- Figure 3 and Table 4 show that the plausible predicted average subsidy for Sydney could range from $272.9 pc up to $368.0 pc. The observed value is substantially outside the upper limit.

- Further, these confidence intervals will be wider still if attempting to forecast subsidies using population data not within the sample, i.e. with population growth, predictions will become increasingly unreliable.

At a minimum, the distribution of the residuals should be examined to assess model fit. This does not appear to have been done in this case.

The residuals for each data point in Figure 4 have been plotted against their associated observed average subsidies. While the residuals are normally distributed overall it is clear from the figure that some systematic errors are made by the model.

Regression residuals should have a constant spread across all fitted values. These data exhibit heteroscedasticity or non-constant variance, as the fitted values get larger, so does the vertical spread of the residuals. Further, the residuals for subsidies between 100 and 200 ($pc) are randomly distributed around zero, while those at the very lower and upper ranges are not.

There are two main reasons this lack of random variation is a problem:

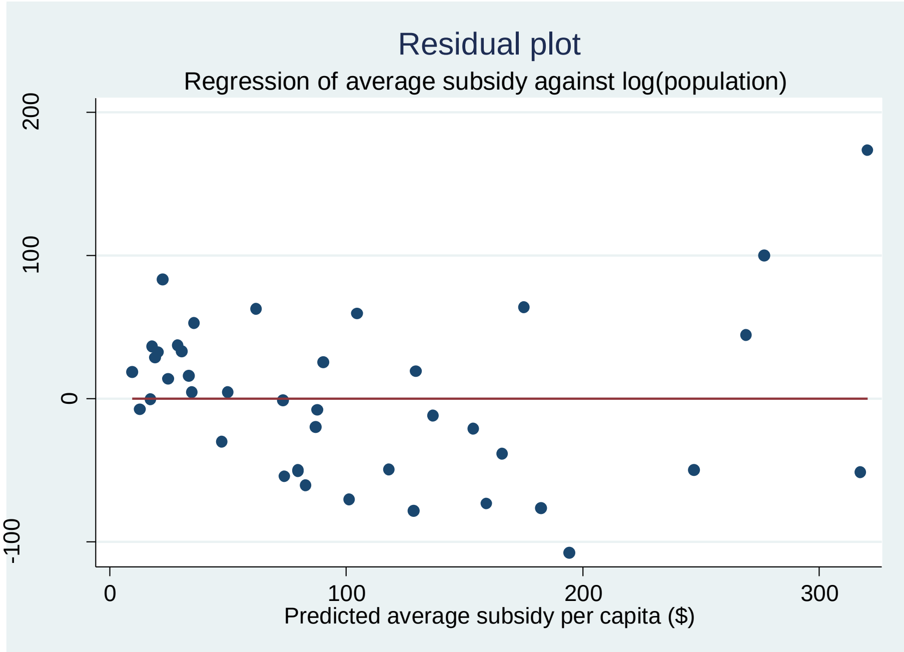
- The precision of the coefficient estimates is lower with non-constant variance.

- The p-values for the regression coefficients are based on satisfying the assumption of constant variance. Therefore, p-values, and the associated decisions about the statistical significance of predictors, can be incorrect if residuals have non-constant variance.

Studies such as this one are at a greater risk of exhibiting heteroscedasticity due to a greater disparity between the largest and smallest values of a predictor, e.g. small towns versus large cities.

A Breusch-Pagan / Cook-Weisberg test for this model showed very strong evidence of heteroscedasticity, refer to Figure 4.

Figure 4: Plot of residuals against predicted subsidies



In general, a model fits the data well if the differences between the observed values and the model's predicted values are small and unbiased.

The model data should also be examined for outliers and individual points that exert high leverage (influence) on the model prediction. This does not appear to have been done.

Post estimation model testing shows that Sydney exerts a high amount of influence on the model and is a notable outlier. Further, post estimation testing shows that the four largest population centres exert considerable leverage on the model. Table 5 presents the model results after excluding Sydney alone.

Table 5: Simple Model excluding Sydney

Variable	Coefficient	Standard error	Probability	Lower 95% Confidence limit	Upper 95% confidence limit
Log ERP	50.51	5.81	0.000	38.73	62.29
Constant	210.50	15.30	0.000	179.39	241.60
N=40	F(1,38)=91.2	Prob>F=0.000	R^2=0.6648		

Removing Sydney from the model results in increased predicted average subsidies for SUAs with less than 0.07 million, and decreased subsidies for larger areas. For example, the revised predicted subsidy for Melbourne is reduced to $279.8 per capita.

Further sensitivity analyses

Further sensitivity analyses were undertaken using the simple model, to examine its robustness.

- Firstly, the model was run using the updated estimated resident population data. This also meant recalculating the average subsidy data.
- Secondly, Brisbane, Sunshine Coast and Gold Coast were aggregated to create a comparable geography to that applied to Sydney and Perth. This was done with both the new and old populations. The results are shown in Table 6 below.
- Thirdly, the subsidies in monetary terms were calculated.

The results show both the impact of the new population estimates and the effect of aggregating South East Queensland (SEQ). The predicted subsidy modelling SEQ in aggregate is $804.9 million compared with the sum of the SUAs modelled separately of $687.2 million.

Table 6: Sensitivity Analyses on the Simple Model

State	SUA	Out dated population base	New population base	Out dated population base SEQ aggregated	New population base SEQ aggregated
		Subsidy based on predicted average subsidy ($ million)			
ACT	Canberra	63.67	63.86	63.50	63.67
NSW	Wollongong	44.22	44.21	44.17	44.16
NSW	Central Coast	51.65	51.87	51.56	51.77
NSW	Newcastle - Maitland	74.46	74.51	74.22	74.25
NSW	Sydney	1,327.75	1,331.83	1,314.86	1,318.63
NT	Alice Springs	0.62	0.60	0.69	0.66
NT	Darwin	11.60	11.54	11.69	11.63
Qld	Gladstone - Tannum Sands	2.01	1.97	2.09	2.05
Qld	Bundaberg	4.92	4.86	5.01	4.95
Qld	Rockhampton	5.84	5.76	5.93	5.85
Qld	Hervey Bay - Maryborough	5.84	5.79	5.93	5.88
Qld	Mackay	6.41	6.35	6.50	6.45
Qld	Toowoomba	10.66	10.60	10.75	10.69
Qld	Cairns	16.44	16.24	16.52	16.32
Qld	Townsville	21.27	21.06	21.33	21.13
Qld	Sunshine Coast	39.00	38.91	n.a.	n.a.
Qld	Gold Coast - Tweed Heads	97.00	96.74	n.a.	n.a.
Qld	Brisbane	551.39	551.52	n.a.	n.a.
Qld	**SEQ**	**687.39**	**687.17**	**804.92**	**804.79**
SA	Whyalla	0.21	0.19	0.27	0.25
SA	Victor Harbor - Goolwa	0.30	0.29	0.36	0.35
SA	Mount Gambier	0.44	0.42	0.51	0.49
SA	Adelaide	299.68	300.16	297.53	297.95
Tas	Burnie - Wynyard	0.46	0.44	0.53	0.50
Tas	Devonport	0.56	0.56	0.62	0.62
Tas	Launceston	7.20	7.20	7.30	7.30
Tas	Hobart	26.10	26.07	26.15	26.11
Vic	Warrnambool	0.90	0.88	0.97	0.95
Vic	Wodonga	1.12	1.09	1.19	1.17
Vic	Mildura - Wentworth	1.25	1.61	1.32	1.69
Vic	Shepparton - Mooroopna	2.22	2.19	2.30	2.27
Vic	Latrobe Valley	3.36	3.33	3.45	3.42
Vic	Bendigo	7.33	7.28	7.43	7.37
Vic	Ballarat	7.89	7.84	7.99	7.94
Vic	Geelong	21.71	21.74	21.78	21.80
Vic	Melbourne	1,251.59	1,253.16	1,239.53	1,240.84
WA	Busselton	0.51	0.50	0.57	0.57
WA	Albany	0.71	0.71	0.78	0.77
WA	Kalgoorlie - Boulder	0.97	0.95	1.04	1.02
WA	Geraldton	1.19	1.15	1.27	1.22
WA	Bunbury	4.81	4.81	4.90	4.90
WA	Perth - Ellenbrook	473.18	473.57	469.35	469.65
	Total	**4,448.44**	**4,454.36**	**4,536.79**	**4,542.02**

3. INTERSTATE WAGES ASSESSMENT

Background

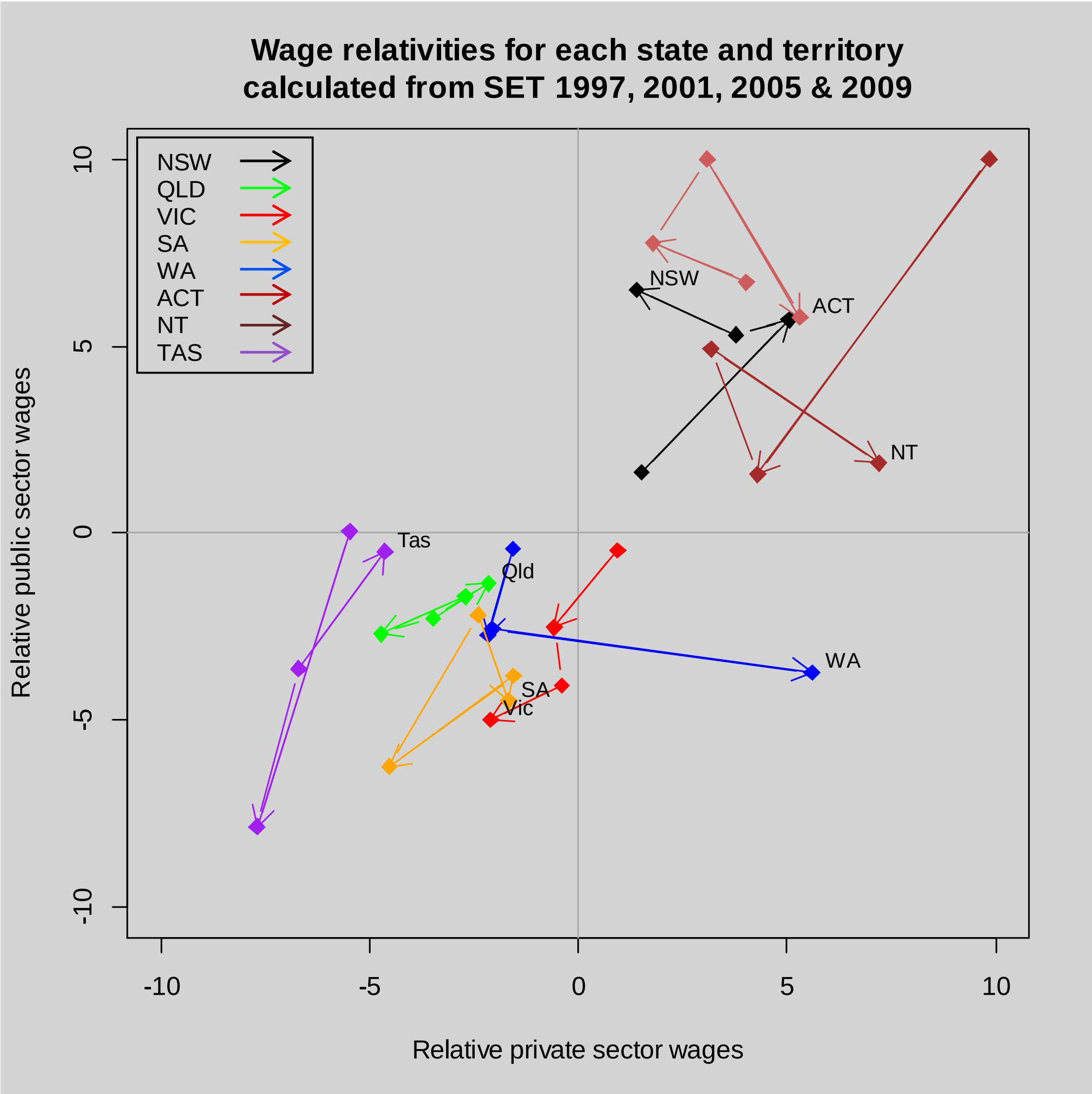
The objective of the Interstate Wages disability is to "consider if *differences in private sector wages apply pressure on public sector wage setting processes"* (Paragraph 116 of the paper). This assumption has been accepted by the Commonwealth Grants Commission (CGC) Staff and they have estimated the *differences between States in wages using an econometric model of wages of private sector employees* (Paragraph 113 of the paper).

Assessing the wages relationship with the Survey of Education and Training Methodology

Taking data from the ABS Survey of Education and Training (SET), the state-level relativities plotted in figure 28-2 of the CGC methodology review paper are derived from coefficients from a multiple regression that models the log of weekly wage against region (e.g. state or territory) controlling for a large number of person-level factors such as age, sex and occupation. The coefficients are transformed into relativities by taking exponentials. The figures vary about one, the Australian average. Numbers higher than one indicate wages higher than the Australian average and numbers below one, lower than average wages.

Contrary to the CGC argument in Paragraph 131 of the paper, the association between state level private and public sector wage relativities in the 1997, 2001 and 2005 SET data is relatively weak and has weakened further for the 2009 SET. Figure 5 below shows that survey-specific estimates have moved considerably from survey-to-survey. In particular, the 2009 estimates for Western Australia changed substantially between the 2005 and 2009 surveys and the 2009 relativity pair for Western Australia is clearly an outlier with respect to the distribution of state and territory pairs for previous SET data sets.

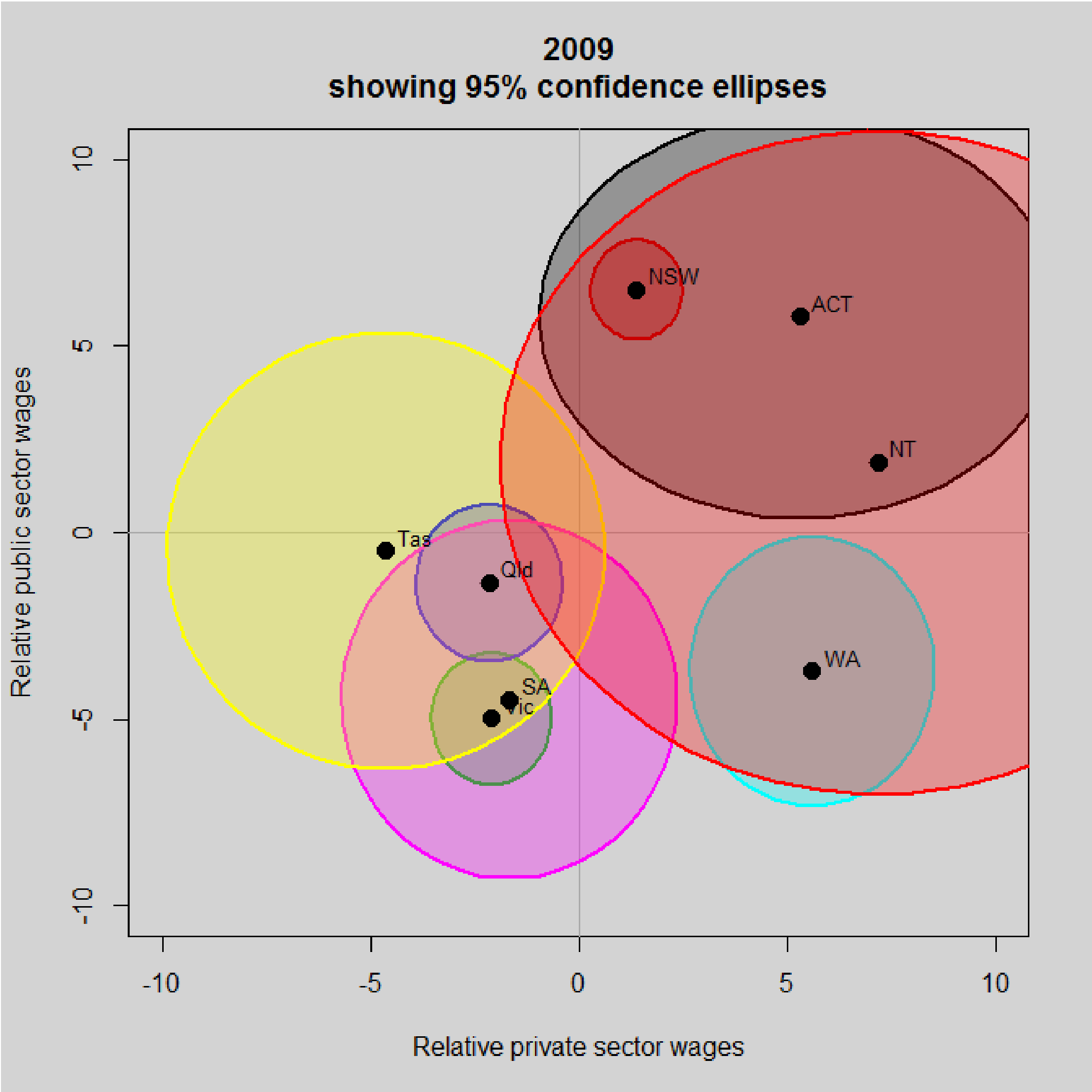
Figure 5: Movement in wage relativities since 1997



In addition to the variability between the surveys, the CGC analysis ignores the moderate to large amounts of measurement error associated with the private and public sector relativities which exists because the relativities are based on survey estimates each with a standard error (level of uncertainty).

Figure 6 shows approximate 95% confidence ellipses for the points plotted in fig 28-2 for the 2009 SET. This illustrates clearly the high level of uncertainty around the point estimates for states and territories put forward by the CGC.

Figure 6: 2009 SET Estimates Confidence Boundaries

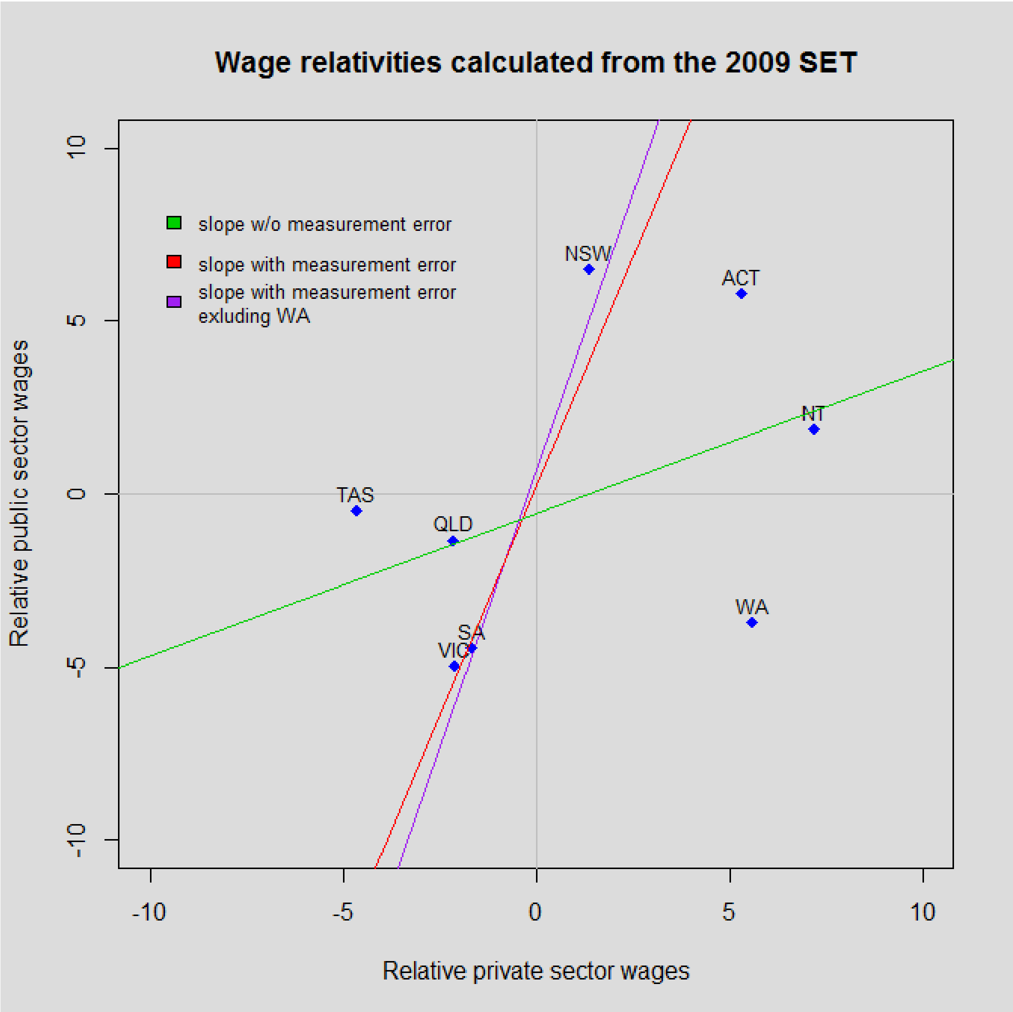


Repeating the simple liner regression for the 2009 SET model correcting for measurement error illustrates the impact in Figure 7 and further weakens the basis of the CGC assumption that public sector wages follow public sector wages.

A regression that correctly incorporates these standard errors[2] was employed to generate an estimated slope through the 2009 SET data points. This results in a coefficient that is substantially greater than the one obtained using simple regression (2.64 compared to 0.36).

[2] Generalised Deming regression was used to incorporate measurement error in the independent and dependent variables

Figure 7: SET Regression Correcting for Measurement error



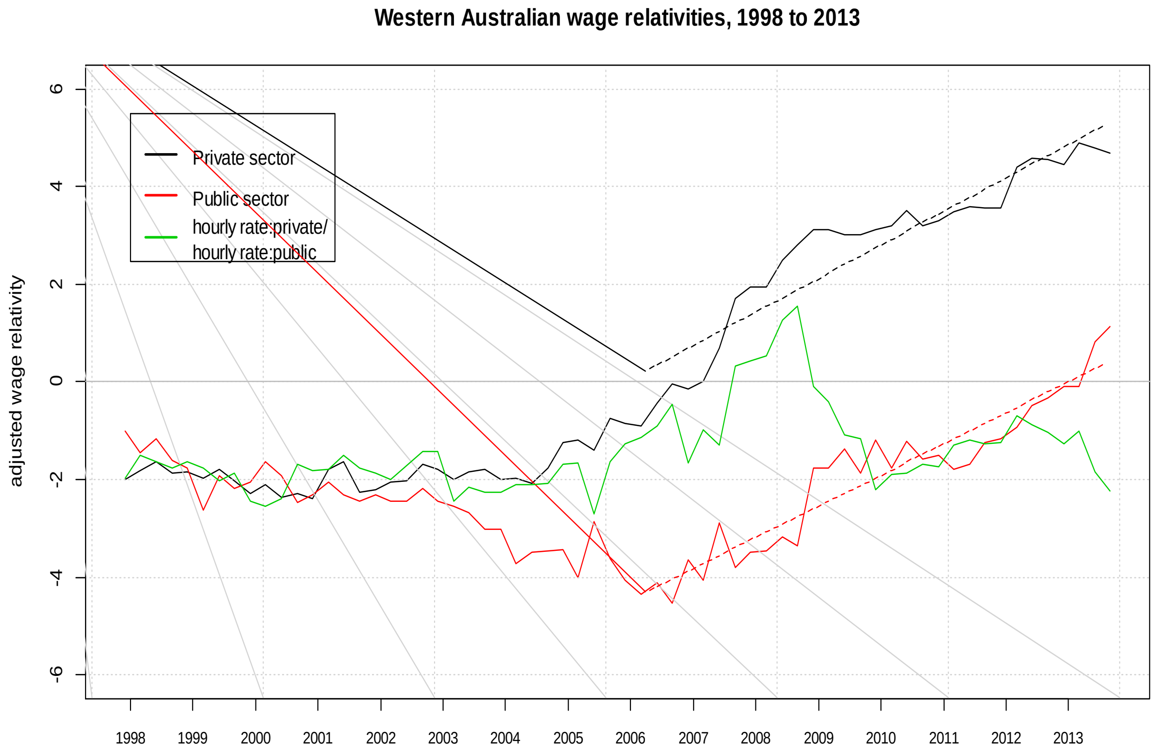
Removing Western Australia from the analysis, the slope coefficient for the linear regression, incorporating measurement error, increases to 3.2. As will be demonstrated below however, neither slope (with or without the WA point) is significantly different from zero.

Has Western Australia caused the deterioration in the SET model?

CGC Staff have formed the view that the wages experience in Western Australia has resulted in the deterioration of the relationship estimated from the 2009 SET presented in Figure 28-2. In the 2015 CGC Methodology Review, Figure 28-3 shows private sector growth in wages in Western Australia kept pace with Australian private sector wages without 'catching up' until mid-2004. Thereafter, Western Australian private sector wages grew faster relative to Australia. Public sector wages in Western Australia grew more slowly than those for Australia until around 2006 after which public sector wages, like private sector wages, grew faster than those for Australia.

Figure 8 shows WA wage relativities, regression lines and a plot of the ratio of private sector hourly wages to public sector hourly wages for the period 1997 – 2013. For almost the entire period, private sector wages have been lower than public sector wages except for a brief period between 2007 and 2009. During this period WA experienced private sector wage growth somewhat above the Australian rate. Public sector wages experienced a similar period of higher growth than the long term rate but lagged by about a year.

Figure 8: Trends in WA Wages Relativities



The almost linear trend in growth in WA public and private hourly wages relative to Australia appeared to begin around 2004 for private wages and from 2006 for public wages. A simple linear regression through estimates after 2006 for both public and private found gave similar and slopes (0.00174 vs 0.00188).

To test the CGC Staff assumption that Western Australian wage movements has affected the relationship estimated from the 2009 SET, the model was re-run removing Western Australia from the specification.

Dropping Western Australia from the 2009 SET data caused the slope estimate to increase from 0.39 to 0.61 and the R^2 value to rise from 0.15 to 0.37 (see Figures 9 and 10).

Figure 9: Relative Private and Public sector wages, from the 2009 SET (WA included)

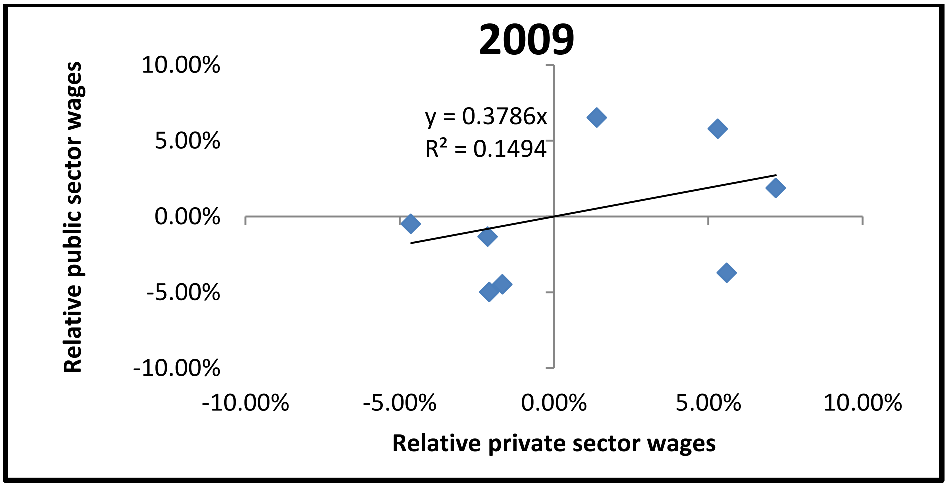
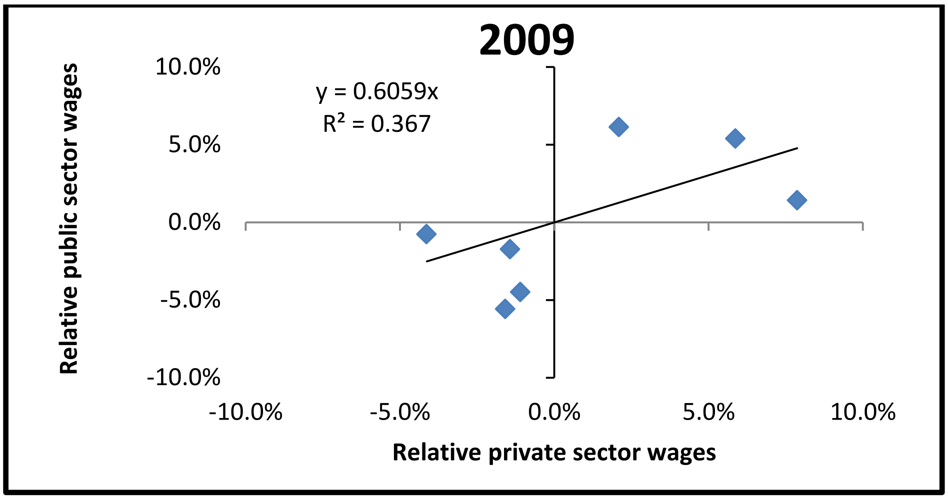
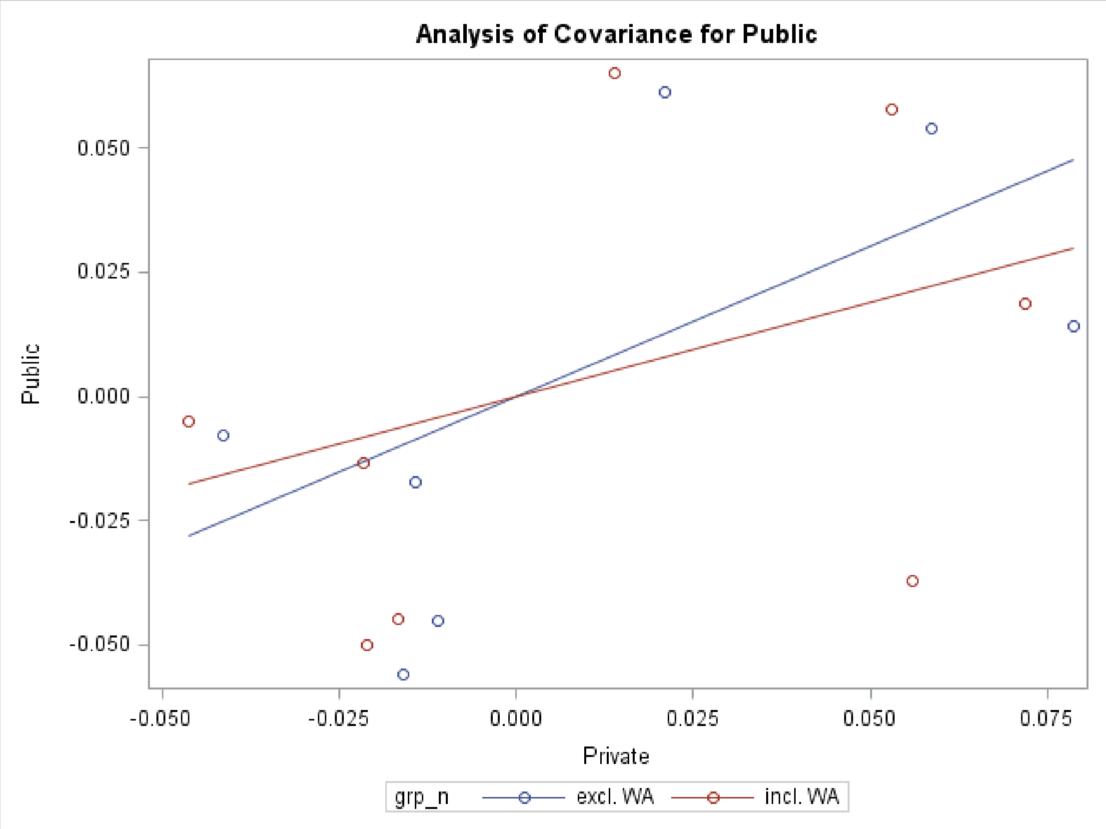


Figure 10: Relative Private and Public sector wages, from the 2009 SET (WA excluded)



At casual inspection the removal of WA from the regression analysis improves the estimated relationship. However, performing an analysis of covariance (ANCOVA) on the relationship between Public and Private sector wage relativities for the 2009 SET data, with and without Western Australia, produces the following results presented in Figure 11 and Table 7.

Figure 11: 2009 SET Regression – ANCOVA with and without WA



Although this does not take into account the standard errors for the estimates, some important results were obtained. The analysis showed that neither of these relationships were significantly different from 'zero' and that they were not significantly different from each other.

Table 7: ANCOVA RESULTS – 2009 SET Regression

Model	Estimate	P-value
Including WA	0.606	0.11
Excluding WA	0.379	0.26
Comparison	N/A	0.64

Using a standard approach by making judgement based on the P-value, the regression coefficient for the full model (i.e. including WA), 0.606, was not significantly different from zero (P-value 0.11). A similar result was obtained for the reduced model (i.e. excluding WA), with a high P-value of 0.26 showing that the regression coefficient of 0.379 is not significantly different from zero.

A comparison of the two models gives a high P-value of 0.64, which is a clear indication that the models are not significantly different from each other. It can be concluded therefore that Western Australia has not caused the deterioration in the relationship estimated from the 2009 SET presented by CGC Staff in Figure 28-2.

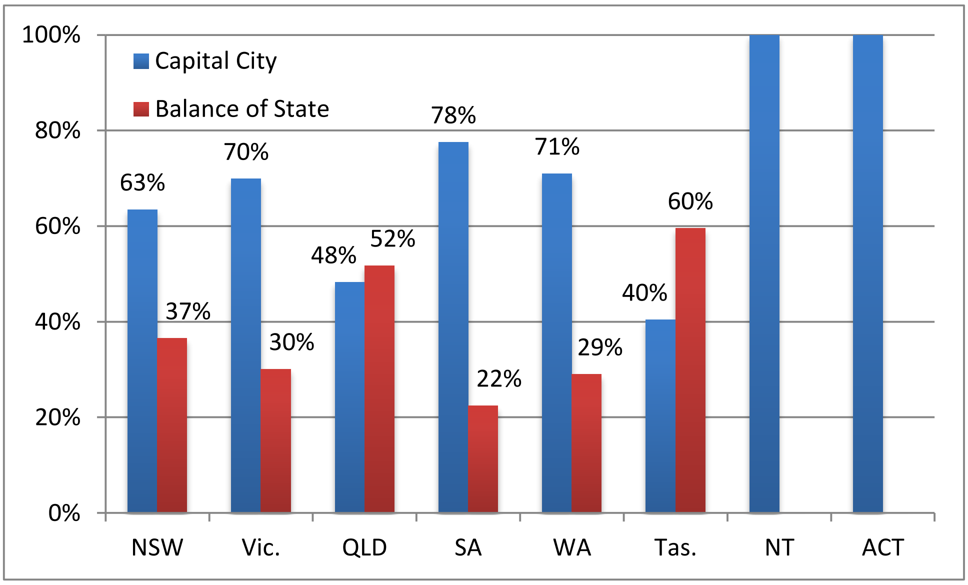
Using SET for Capital City v Whole of State

CGC Staff have put forward a suggestion to narrow the geographic scope of the wages assessment to a sub-state model. The analysis above has shown that at the state-level there is no statistically significant evidence to suggest a relationship exists between private and public sector wages as put forward in the wages assessment.

Leaving aside the fact that the CGC theory is not supported by evidence and therefore the suggestion to narrow the scope of the assessment to a concept of capital city, the geography employed by the CGC Staff is considered inappropriate for comparative purposes.

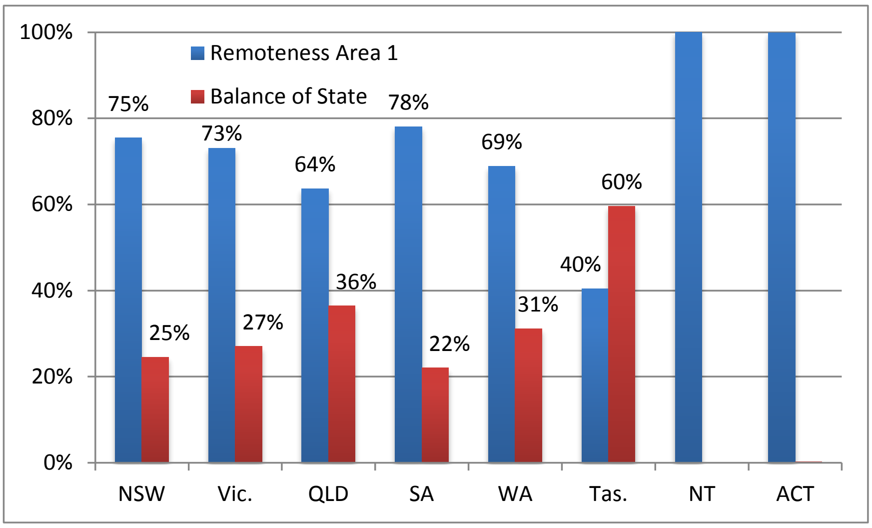
Figure 12 shows the ABS final sampling for Capital City/Balance of State for the 2009 SET. This shows the sampling proportions for Queensland are fundamentally different to other states owing to the ABS geography of Capital City excluding significant population centres within South East Queensland. The Major Cities Remoteness Area classification shown in Figure 13 presents a more uniform sampling across the states.

Figure 12: Sample population for Capital City and Balance of State



Source: ABS 6278.0

Figure 13: Sample population for Remoteness Area 1 and Balance of State



Source: ABS 6278.0

Table 8 presents the estimated resident population for the ABS geographic boundaries of Capital City Statistical Division and Major City Remoteness area. Figures 14 and 15 illustrate the differences in these boundaries.

Table 8: Estimated Resident Population, Capital City and Major City Remoteness Area

Region	Estimated Resident Population, 30 June 2012	Area	Density
	('000s)	(km²)	(persons/km²)
New South Wales			
Sydney Statistical Division	4,673	12,370.4	377.7
Major cities of NSW	5,366	4,860.7	1,104.0
Part of Sydney SD not within major cities	115	8,570.8	13.4
Victoria			
Melbourne Statistical Division	4,185	7,656.9	546.6
Major cities of Victoria	4,265	4,068.3	1,048.3
Part of Melbourne SD not within major cities	94	3,650.5	25.6
Queensland			
Brisbane Statistical Division	2,127	5,987.1	355.3
Major cities of Queensland	2,774	3,906.4	710.2
Part of Brisbane SD not within major cities	94	3,128.2	29.9
Western Australia			
Perth Statistical Division	1,809	5,389.8	335.6
Major cities of WA	1,735	2,076.6	835.3
Part of Perth SD not within major cities	74	2,771.7	26.8

Note: Population data based on Estimated Resident Population (ERP) as at 30 June 2012 where Statistical Area Level 1 (SA1) are within boundaries. For consistency purposes, the areas of these SA1s have also been used, and therefore area data in this table will not be equal to any published area data for Statistical Division or Remoteness Area.
Source: ABS 1216.0 (2006 and 2009 editions); ABS 1270.0 (2011 edition); ABS 3218.0 (unpublished data).

Figure 14: Capital City versus Major City, Sydney and Melbourne

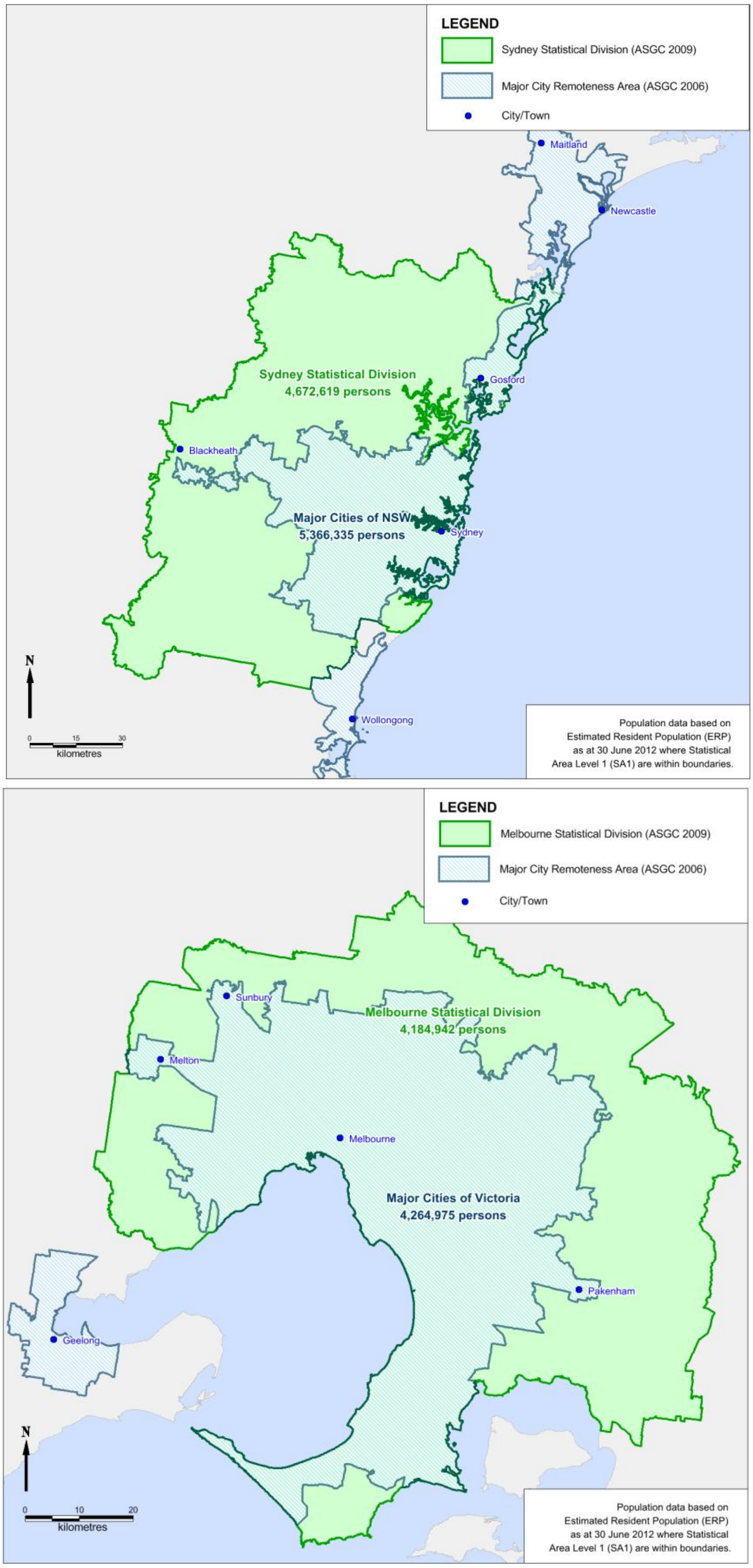
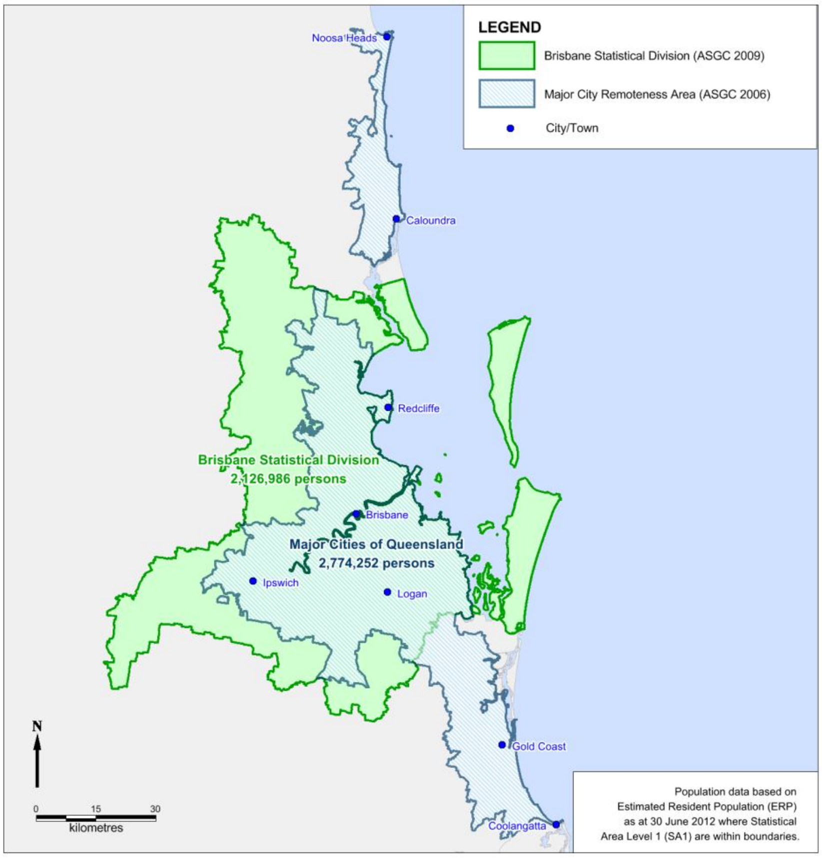
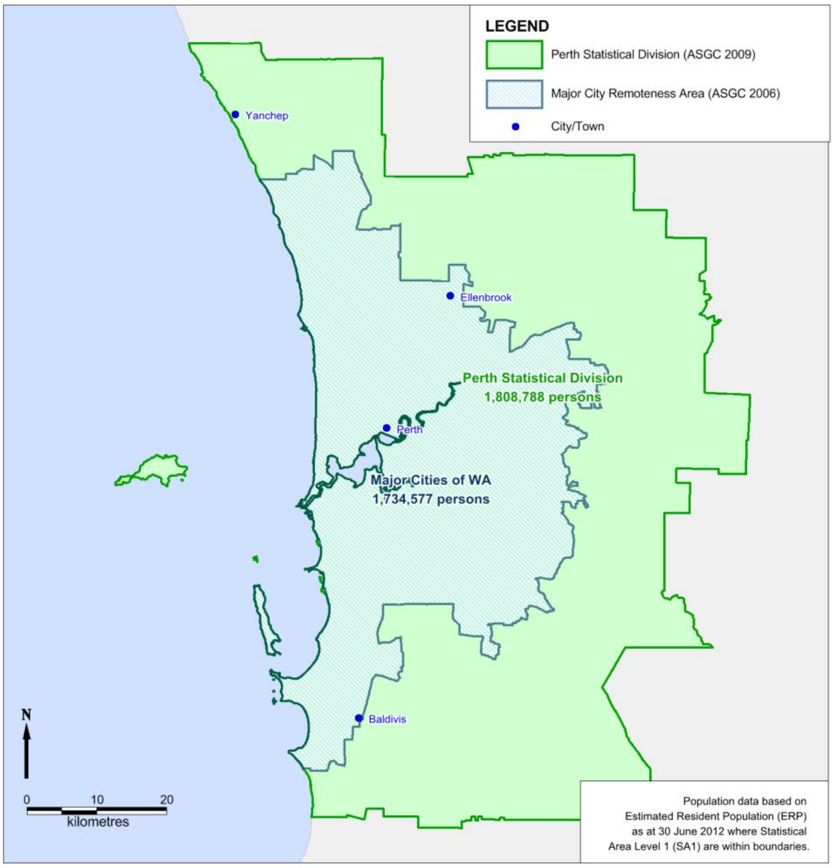


Figure 15: Capital City versus Major City, Brisbane and Perth





Taking the CGC Staff suggestion as presented, Figure 16 shows the effect of using Capital City and Remoteness Area RA1 (Major Cities) respectively instead of whole of state to calculate the relative private and public wages. In running these regressions it was found that slopes and R^2 values were very similar for all three sets of points.

Figure 16: 2009 SET Model Regression – Whole of State, Capital City, Major City

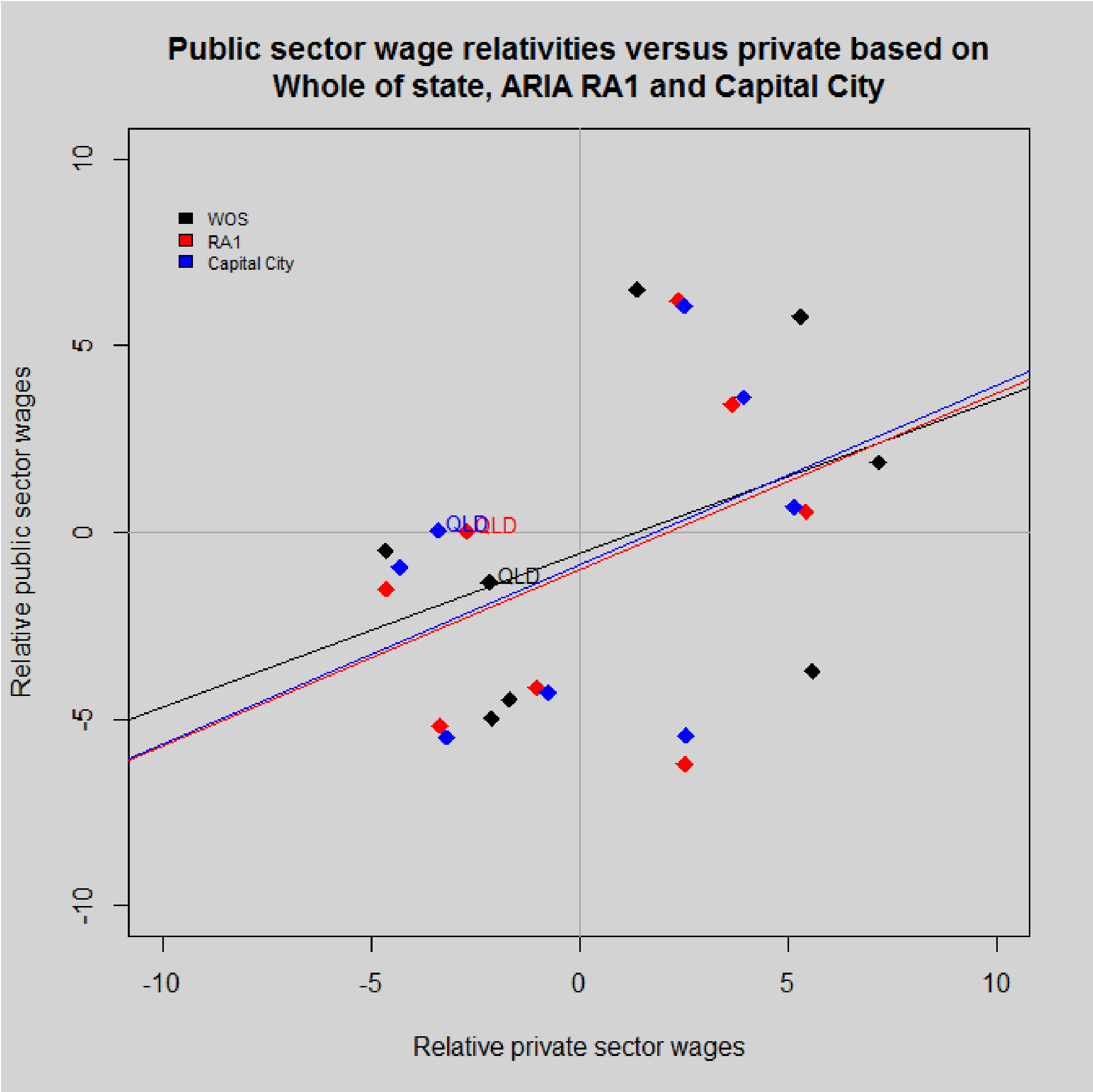


Figure 17: Relative private sector wages and 95% confidence intervals, by region, 2009

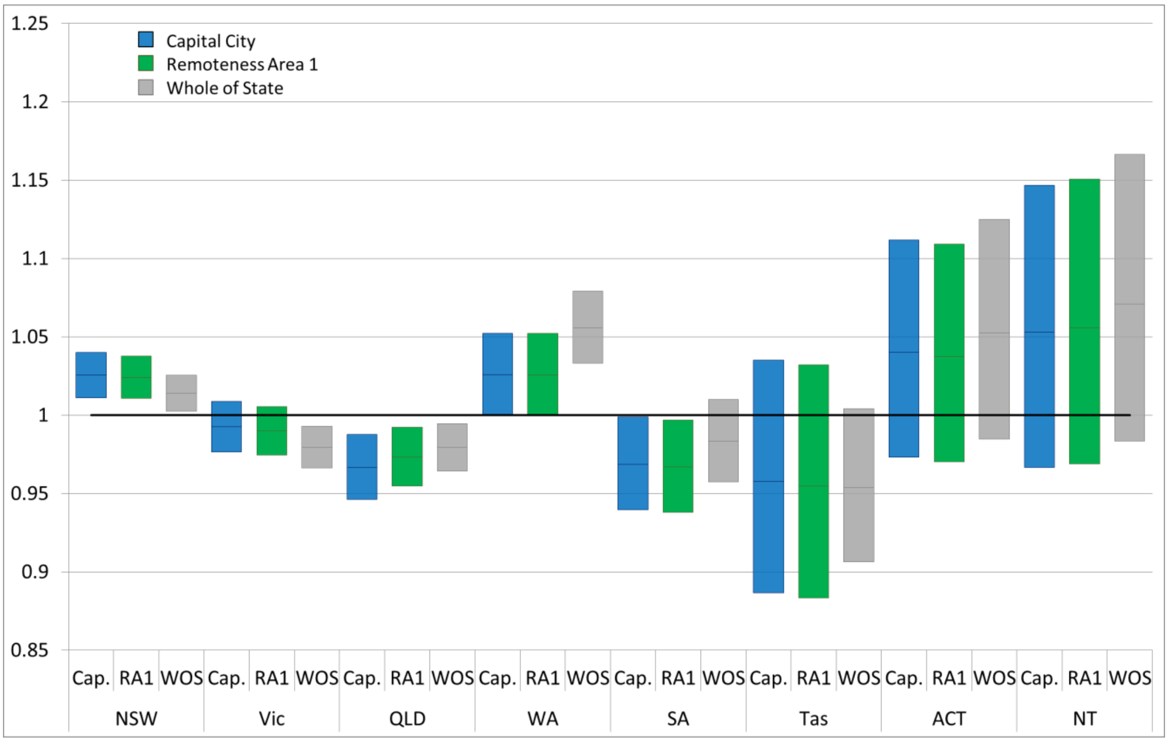


Table 9: Tests for significant differences between regression coefficients (p-values)

State	WOS vs CAP	WOS vs RA1	CAP vs RA1
NSW	0.22	0.26	0.89
VIC	0.22	0.32	0.82
QLD	0.34	0.62	0.65
WA	0.09	0.09	0.99
SA	0.47	0.42	0.94
ACT	0.81	0.76	0.95
NT	0.78	0.82	0.96

Testing the relationship with an alternative data set

As the CGC assessment is largely held to be true by assumption (i.e. not supported by evidence) this section attempts to "reality check" the CGC theory with an alternative dataset, the ABS, Census of Population and Housing, 2006 and 2011.

Usual resident population counts were extracted from both the 2006 and 2011 Census by state of usual residence, 2-digit occupation, public/private employer indicator, total personal income[3] for the employment type of employee not owning a business. Median incomes were derived by the Queensland Government Statistician's Office for each state and territory, occupation and sector cohort[4]. Occupations with very low person counts were excluded from this analysis, due to the inability to create a robust median.

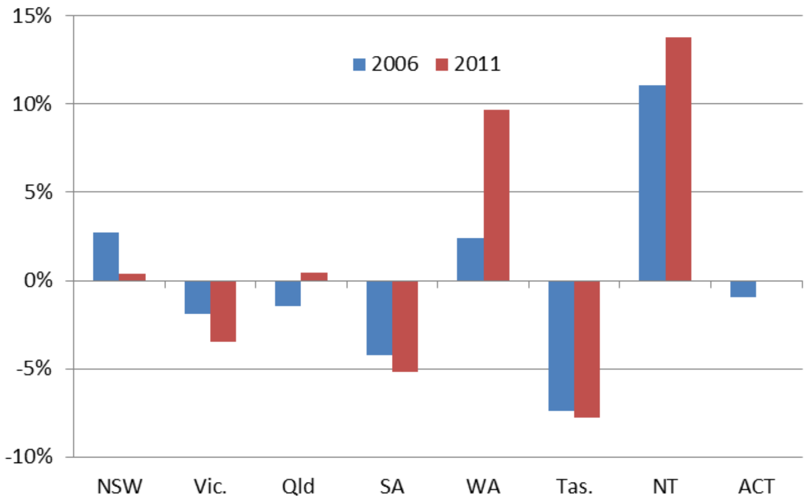
1. Does the conceptual case for a wages assessment continue to exist?

(i) Do private sector wage levels differ between States?

Relative differences in median income were calculated for private sector occupations between each state and territory and Australia, by 2-digit occupation. These differences were weighted to the Australian distribution of private sector employment for each state and territory 2-digit occupation. Results are shown in Figure 18.

Using Census 2006 and 2011 data, Figure 18 portrays a similar story to Figure 28-1 in the CGC review which used SET 2009 data. The only notable differences are that Queensland has a positive private sector wage relationship in the Census 2011 data (compared with a negative relationship from the 2009 CGC estimates) and the Australian Capital Territory has a negative private sector wage relationship in the Census 2011 data (compared with a positive relationship from the 2009 CGC estimates). These differences highlight the variability and standard errors that need to be considered when using sample data such as the SET 2009.

Figure 18: Standardised[(a)] private sector wage relativities compared to Australia, by state and territory, 2006 and 2011



(a) Standardised to the Australian 2-digit private sector occupation structure.
Source: ABS Census 2011

[3] Total personal income includes all wages/salaries, government benefits, pensions, allowances and other income the person usually receives. This differs slightly from the SET 2009 income variable of usual weekly earnings in current (main) job or business (employees).

[4] When dealing with income data, medians are a better descriptive measure to use than averages as income data are usually skewed to the higher incomes.

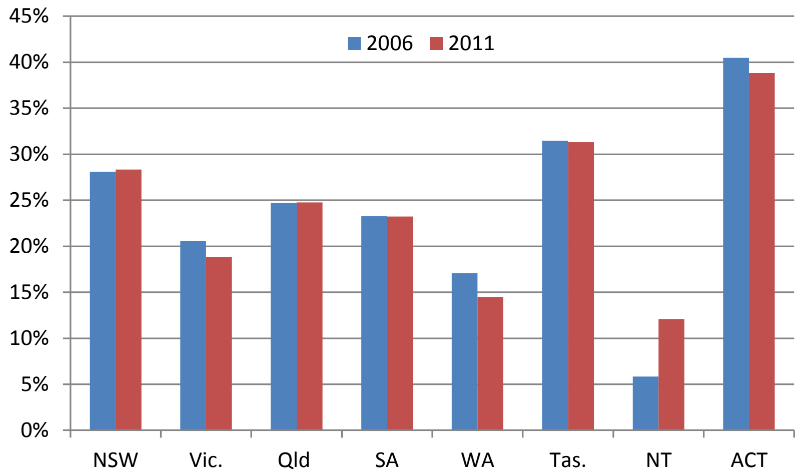
From Figure 18 it is apparent that a private sector wage level difference between state and territories does exist.

<u>(ii) Do the wage levels faced by the public sector reflect pressures in the private sector labour market?</u>

Relative differences in median income were calculated from Census 2006 and 2011 data for each state and territory between private and public sector 2-digit occupations. These differences were weighted to the Australian distribution of total (private and public) employment for each state and territory 2-digit occupation.

Figure 19 clearly shows for each state and territory the public sector wage relativities are at least 5% and up to 40% higher than private sector wages. It also shows for Western Australia (as well as Victoria, Tasmania and the Australian Capital Territory), the private sector wages relative to public sector wages increased between 2006 and 2011 (as indicated by the CGC Review in Figure 28-3).

Figure 19: Standardised[(a)] public to private sector wage relativities, 2006 and 2011

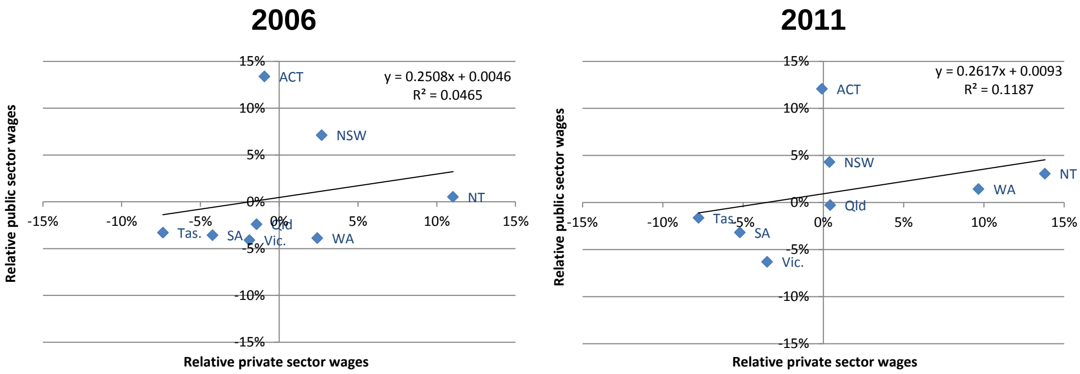


(a) Standardised to the Australian 2-digit total occupation structure.
Source: ABS Census 2011

Initial indications based on Figure 19 would suggest no causal link between private and public sector wages given public sector wages are higher than private sector wages.

To investigate this relationship further, Figure 28-2 in the CGC Review was reproduced using Census 2006 and 2011 data and can be seen in Figure 20.

Figure 20: Comparison of relative wage levels in public and private sector



Source: ABS, Census 2006 and 2011

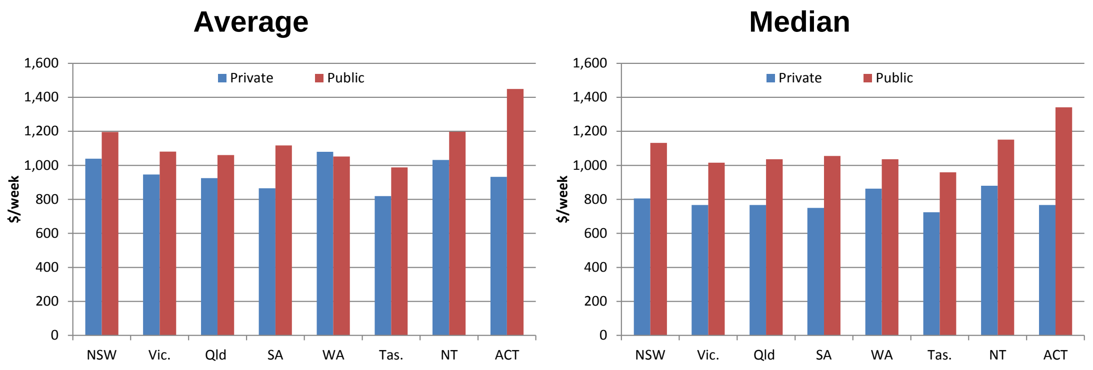
In both 2006 and 2011, the R^2 value was less than 0.15 and the linear line of best fit was not statistically significant; i.e. the p-value for the slope coefficient was not less than 0.05 and therefore cannot be assumed to be different from zero. Table 9 shows the details for the statistical regression analysis. This regression test also suggests there is no relationship between relative wages for the private and public sector.

Table 10: T-Test for linear relationship between relative private and public sector wages

	Coefficient	p-value
2006		
Intercept	0.0046	0.8545
X variable	0.2508	0.6082
2011		
Intercept	0.0093	0.6620
X variable	0.2617	0.4033

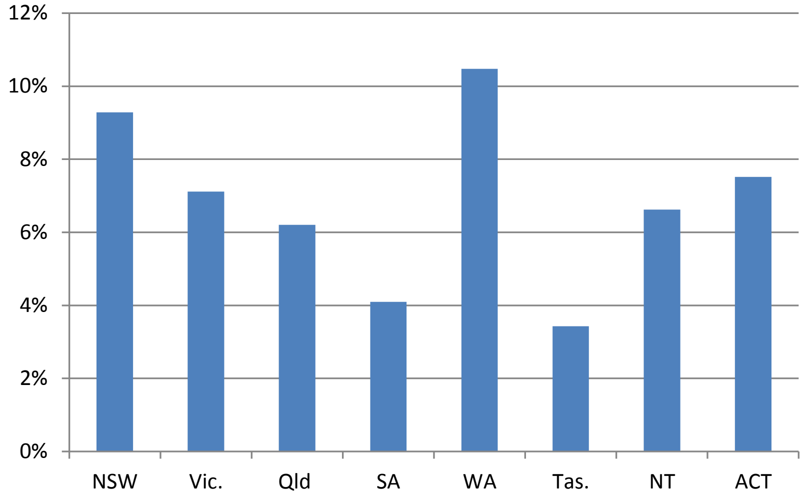
More testing was done on the relationship between private and public sector incomes, this time using the SET 2009 data set. The average and median usual weekly earnings in current (main) job or business, for employees were calculated for each state and territory (Figure 21). The average usual weekly earnings were higher for the public sector in all state and territories except for Western Australia, while the median usual weekly earnings were higher for public sector in all state and territories. For Western Australia, this suggests the usual weekly earnings for the private sector are more skewed towards higher incomes than other state and territories, as shown in Figure 22.

Figure 21: Average and median usual weekly earnings in current (main) job or business, employees, by state and territory, 2009



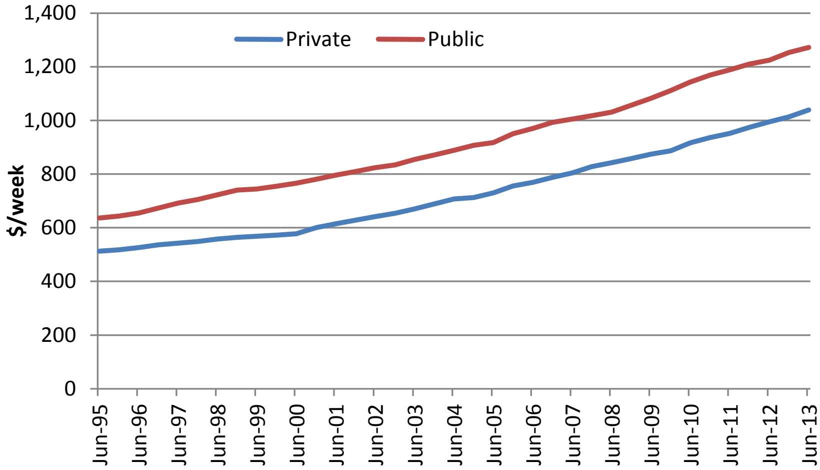
Source: ABS SET 2009

Figure 22: Percentage of employees with a usual weekly earning in current (main) job or business over $2,000 per week



One additional check comparing the private and public sector incomes was done using data from the ABS average weekly earnings (Figure 23). As with the other two data sets, this clearly shows the public sector receives a higher average income per week than the private sector.

Figure 23: Average weekly earnings, private and public sectors, Australia, June 1995 to June 2013



Trend series for "persons, all employees, total earnings"
Source: ABS 6302.0, Average Weekly Earnings, Australia, May 2013

Based on the above analysis with an alternative dataset there is no evidence to suggest the wage levels faced by the public sector reflect pressures in the private sector labour market.