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2015 REVIEW

SIMPLIFYING THE INTERSTATE WAGES REGRESSION MODEL

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BACKGROUND

1 The Interstate wages regression model used in the 2010 Review aims to measure the relative differences in wage levels between the States. The model uses the Australian Bureau of Statistics (ABS) Survey of Education and Training (SET) to regress the log of private sector earnings on State of employment and other measurable labour market influences.

2 The SET allows for potentially dozens of variables to be included in the regression model. Currently the model includes 219 variables. Because the SET includes a relatively large number of observations, the standard errors for each variable are less sensitive to increases in the number of variables.[1] However, it is important to ensure each variable retains theoretical relevance and assists in explaining the variation in wages.

3 This paper examines how the regression model used in the 2010 Review can be simplified to include only those variables that have theoretical relevance and provide explanatory power. We also consider how some of the coding can be simplified. Attachment A gives the results of the simplified regression.

PROPOSED ADJUSTMENTS

4 We have identified a number of areas where the regression model can be simplified and made more transparent. In this section we discuss the impact of reducing the number of variables and how we can adjust how some variables are defined. The GST impacts of the proposed adjustments are shown in the next section (Table 1).

Remove effects coding and use simple dummy variables

5 In the 2010 Review, the Interstate wages assessment used effects coding, rather than simple dummy variables, as the method for estimating the variation in interstate wages. Both methods effectively produce the same results. However, the interpretation of results is very different. Unlike simple dummy variables, effects coding calculates the difference from the national average of each State within the regression model.[2] The dummy variable method calculates the difference of each State from a reference State (we have used Tasmania as the reference State). A process of standardisation is then used to calculate the deviation from the national average for each State outside the regression model.

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1 This number includes all dummy variables within each category and all female interaction variables.

2 Effects coding still requires a reference State to be excluded in the calculation.

6 The effects coding method was used in the 2010 Review because it was considered simpler to calculate the difference from the national average within the regression model. However, this adds complexity to the regression model and the interpretation of the results is not immediately obvious. For this reason we have decided to use the simple dummy variable approach. This approach produces the same outcome but removes a layer of complexity in the regression coding.[3]

Remove female interaction variables

7 Interaction variables are commonly used in regression analysis to measure the combined impact of two (or more) variables. For example, the current regression model uses an interaction variable by combining gender and education to test if an undergraduate degree increases wages more for males or females.

8 In fact, the current model includes a female interaction variable for every variable in the model. This nearly doubles the number of variables in the model from 115 to 219. While theoretically there may be differences in the relationship between productivity influences on wages for males and females we have found that the inclusion of female interaction variables only increases the explanatory power of the model by a small amount. The R squared increases from 0.783 to 0.790 when all 114 female interaction variables are included in the model. This suggests they do not explain much of the change in wages but add complexity and potentially decrease the precision of the model. Therefore, staff propose to remove the female interaction variables from the regression model.

Remove the variable of hours worked less than 15 hours and greater than 60 hours

9 Currently the model measures the impact of the number hours worked by including a variable that is the log of an employee's continuous number of hours worked per week. The model includes two additional variables that measure the impact of working less than 15 hours and more than 60 hours. We have found that neither of the additional hours worked variables add any explanatory power beyond the information included in the continuous hours worked variable. Therefore, staff propose to remove the less than 15 and more than 60 hours worked variables.

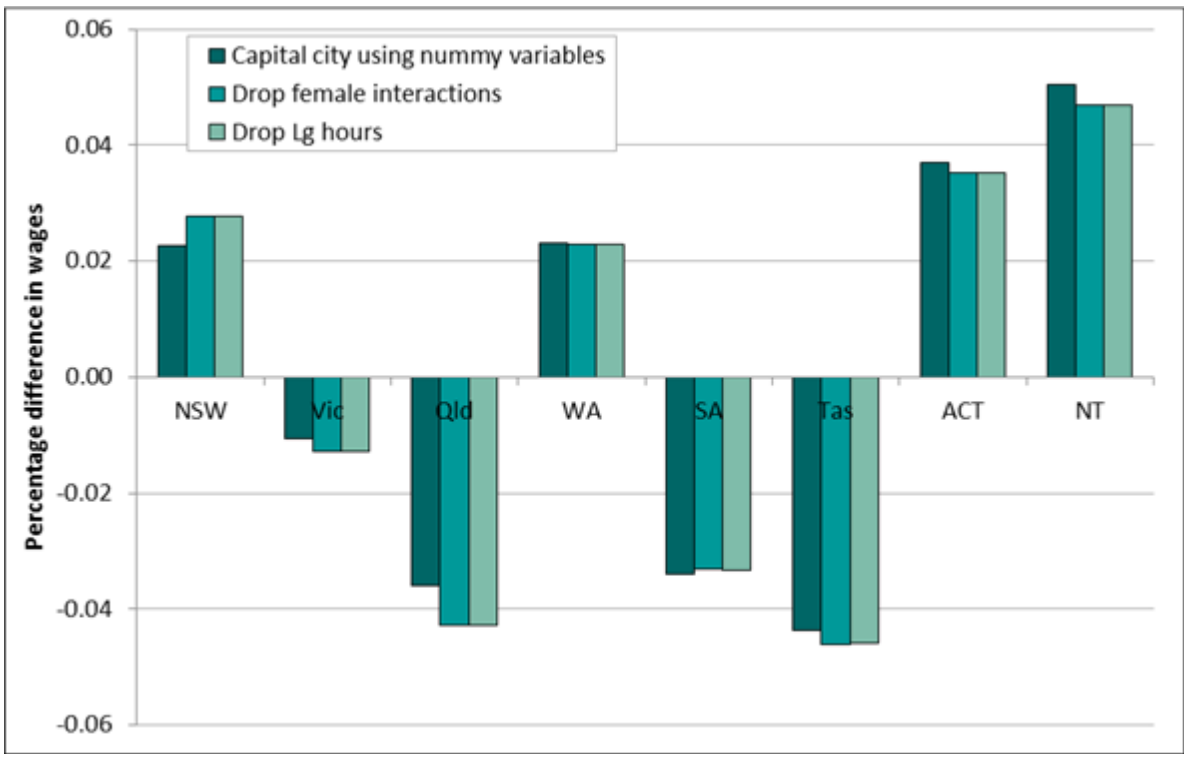
[3] The dummy variable approach produces different State coefficients but the relative differences are the same.

IMPACT OF PROPOSED ADJUSTMENTS

10 In the 2013 discussion papers to the States, staff proposed a change from using the whole of State wage to assess interstate wage relativities to using capital city wages. We have used capital city wages as the basis for this analysis.

11 Figure 1 shows how interstate relative wage levels change with each adjustment to the regression model. The adjustments were made progressively so that removing the under 15 and over 60 hours worked variables includes the impact of the previous adjustments.

Figure 1 Relative wage levels, SET 2009



Source: SET 2009.

12 Table 1 shows the impact from adjusting the model on the redistribution from EPC if the changes were applied in the 2014 Update. Changing to the dummy variable approach does not have an impact on the GST distribution. The proposed adjustments increase the impact of the Wages assessment by $7.6 per capita but do not have a material impact for any State.

Table 1 Impact from adjusting the model, redistribution from EPC, U2014 (a)

	NSW	Vic	Qld	WA	SA	Tas	ACT	NT	Redist.
	$pc	$pc	$pc	$pc	$pc	$pc	$pc	$pc	$pc
2014 Update assessment using capital city	101.9	-45.4	-143.7	160.0	-163.1	-173.7	166.2	287.1	55.8
Female interaction variables removed	126.2	-52.9	-172.6	160.1	-157.7	-182.7	159.8	272.7	63.3
Remove under 15 and over 60 hours worked logged variables	126.3	-52.8	-172.8	160.2	-158.2	-182.0	160.0	272.8	63.4
Difference from U2014 (b)	24.4	-7.4	-29.2	0.2	4.9	-8.2	-6.2	-14.3	7.6

(a) Adjustments were made progressively so that removing the under 15 and over 60 hours worked variables includes the impact of the previous adjustments.
(b) This is the difference between the 2014 Update Wages assessment using capital city and the combined impact from including all adjustments to the regression model.
Source: SET 2009.

CONCLUSIONS

13 Staff have found that the female interaction variables and the under 15 and over 60 hours worked variables do not add explanatory power to the model. By removing them, the regression model is significantly simplified. We have also found that using the dummy variable approach to measure interstate wage differences simplifies the coding but produces the same outcome.

14 Staff consider this simpler and more transparent model specification continues to produce a reliable estimation of interstate wage levels.

Staff propose to recommend the Commission:

- remove effects coding and use simple dummy variables
- remove the female interaction variables
- remove the variable hours worked less than 15 and greater than 60.

ATTACHMENT A – 2009 SET REGRESSION RESULTS

Table A - 1 2009 SET regression results including proposed adjustments

Description of variable	Parameter Estimate	Standard Error	t value	P > |t|
Intercept	2.44166	0.09632	25.35	<.0001
State of residence				
New South Wales	0.07441	0.04174	1.78	0.0747
Victoria	0.03414	0.04178	0.82	0.4139
Queensland	0.00313	0.0427	0.07	0.9416
Western Australia	0.06961	0.04288	1.62	0.1046
South Australia	0.01317	0.04373	0.3	0.7633
**Tasmania				
ACT	0.08169	0.05344	1.53	0.1264
Northern Territory	0.09278	0.06018	1.54	0.1232
Sex				
Female	-0.12196	0.01188	-10.27	<.0001
**Male				
Marital status				
Married	0.06129	0.01157	5.3	<.0001
**Not married				
Whether had any young children				
With children under 15 years old	-0.00346	0.01142	-0.3	0.7618
**Without children under 15 year old				
Whether permanent or casual				
Permanent with main period employer	0.05839	0.01474	3.96	<.0001
**Casual with main period employer				
Hours usually worked per week				
Log of Number of hours	0.96298	0.01294	74.41	<.0001
Migrant status				
Born in ESC lived in Australia >20 years	0.06057	0.02005	3.02	0.0025
Born in ESC, lived in Australia 10-20 years	0.12242	0.0343	3.57	0.0004
Born in ESC, lived in Australia < 10 years	0.0928	0.02623	3.54	0.0004
Born in NESC, lived in Australia more than 20 years	-0.06534	0.01739	-3.76	0.0002
Born in NESC lived in Australia between 10-20 years	-0.12963	0.02139	-6.06	<.0001
Born in NESC, lived in Australia less than 10 years	-0.13022	0.02057	-6.33	<.0001
**Born in Australia				
Size of firm (number of employees)				
Less than 20	-0.00856	0.03116	-0.27	0.7836
20-99	0.06395	0.03157	2.03	0.0428
100 and over	0.13485	0.03165	4.26	<.0001

Table A - 1 2009 SET regression results including proposed adjustments (continued)

Description of variable	Parameter Estimate	Standard Error	t value	P > |t|
**Number unknown				
Trade union membership				
Had trade union membership	0.01032	0.01431	0.72	0.4708
**Did not have trade union membership				
Detailed Occupation				
Managers nfd	0.54598	0.08032	6.8	<.0001
Chief Executives, General Managers and Legislators	0.87512	0.07785	11.24	<.0001
Farmers and Farm Managers	-0.07818	0.14308	-0.55	0.5848
Specialist Managers	0.45574	0.04342	10.5	<.0001
Hospitality, Retail and Service Managers	0.23431	0.04523	5.18	<.0001
Professionals nfd	0.31208	0.14613	2.14	0.0327
Arts and Media Professionals	0.27977	0.08364	3.35	0.0008
Business, Human Resource and Marketing Professionals	0.36927	0.04424	8.35	<.0001
Design, Engineering, Science and Transport Professionals	0.30609	0.04762	6.43	<.0001
Education Professionals	0.22145	0.06356	3.48	0.0005
Health Professionals	0.37253	0.05796	6.43	<.0001
ICT Professionals	0.39078	0.0505	7.74	<.0001
Legal, Social and Welfare Professionals	0.29574	0.06739	4.39	<.0001
Engineering, ICT and Science Technicians	0.22406	0.04912	4.56	<.0001
Automotive and Engineering Trades Workers	0.06358	0.04704	1.35	0.1766
Construction Trades Workers	0.02258	0.05486	0.41	0.6806
Electrotech and Telecommunications Trades Workers	0.09176	0.05124	1.79	0.0734
Food Trades Workers	-0.02728	0.05675	-0.48	0.6307
Skilled Animal and Horticultural Workers	-0.04719	0.07081	-0.67	0.5051
Other Technicians and Trades Workers	0.08243	0.05126	1.61	0.1079
Health and Welfare Support Workers	0.20196	0.0674	3	0.0027
Carers and Aides	0.0958	0.04978	1.92	0.0543
Hospitality Workers	0.1095	0.05096	2.15	0.0317
Protective Service Workers	0.17796	0.07329	2.43	0.0152
Sports and Personal Service Workers	0.22276	0.05488	4.06	<.0001
Office Managers and Program Administrators	0.31843	0.04802	6.63	<.0001
Personal Assistants and Secretaries	0.22579	0.0541	4.17	<.0001
General Clerical Workers	0.10692	0.05249	2.04	0.0417
Inquiry Clerks and Receptionists	0.10406	0.04632	2.25	0.0247
Numerical Clerks	0.0782	0.04563	1.71	0.0866
Clerical and Office Support Workers	-0.07475	0.07036	-1.06	0.288
Other Clerical and Administrative Workers	0.0702	0.04759	1.48	0.1402
Sales Representatives and Agents	0.19331	0.05131	3.77	0.0002
Sales Assistants and Salespersons	0.05321	0.0411	1.29	0.1955
Sales Support Workers	0.02986	0.04902	0.61	0.5424
Machinery Operators and Drivers nfd	-0.22509	0.16255	-1.38	0.1662

Table A - 1 2009 SET regression results including proposed adjustments (continued)

Description of variable	Parameter Estimate	Standard Error	t value	P > |t|
Machine and Stationary Plant Operators	0.06045	0.05331	1.13	0.2568
Mobile Plant Operators	0.05833	0.05332	1.09	0.274
Road and Rail Drivers	-0.05452	0.04943	-1.1	0.2701
Storepersons	-0.01096	0.05494	-0.2	0.8419
Cleaners and Laundry Workers	-0.06699	0.04936	-1.36	0.1748
Construction and Mining Labourers	0.16235	0.05754	2.82	0.0048
Factory Process Workers	-0.20878	0.04781	-4.37	<.0001
Farm, Forestry and Garden Workers	-0.05238	0.07832	-0.67	0.5036
Food Preparation Assistants	0.02245	0.05554	0.4	0.6861
Inadequately described	0.09871	0.09769	1.01	0.3123
Industry				
Agriculture, Forestry and Fishing	0.03081	0.06828	0.45	0.6518
Mining	0.46166	0.04755	9.71	<.0001
Manufacturing	0.16133	0.02865	5.63	<.0001
Electricity, Gas, Water and Waste Services	0.34303	0.04875	7.04	<.0001
Construction	0.18985	0.03369	5.64	<.0001
Wholesale trade	0.15398	0.03277	4.7	<.0001
Retail trade	0.08902	0.03047	2.92	0.0035
Accommodation and Food Services	0.04924	0.03611	1.36	0.1728
Transport, Postal and Warehousing	0.19385	0.03556	5.45	<.0001
Information Media and Telecommunications	0.18157	0.03933	4.62	<.0001
Financial and Insurance Services	0.24782	0.03295	7.52	<.0001
Rental, Hiring and Real Estate Services	0.14361	0.04451	3.23	0.0013
Professional, Scientific and Technical Services	0.17821	0.03074	5.8	<.0001
Administrative and Support Services	0.14317	0.03522	4.06	<.0001
Public Administration and Safety	0.04752	0.05556	0.86	0.3924
Education and Training	0.02758	0.04584	0.6	0.5475
Health Care and Social Assistance	0.04479	0.03217	1.39	0.1639
Arts and Recreation Services	0.06776	0.04959	1.37	0.1719
Inadequately described	-0.01378	0.11641	-0.12	0.9058
**Other Services				
Level of highest education attainment				
Higher degree	0.47845	0.05475	8.74	<.0001
Postgraduate diploma	0.41063	0.05761	7.13	<.0001
Bachelor degree	0.37277	0.05002	7.45	<.0001
Advanced diploma/diploma	0.18219	0.05011	3.64	0.0003
Certificate III or IV	0.16794	0.05042	3.33	0.0009
Certificate I or II	0.0001423	0.06756	0	0.9983
Certificate not defined	-0.02297	0.16561	-0.14	0.8897
Year 12	0.05655	0.01581	3.58	0.0004
**Did not complete year 12/unknown				

Table A - 1 2009 SET regression results including proposed adjustments (continued)

Description of variable	Parameter Estimate	Standard Error	t value	P > |t|
Main field of highest educational attainment				
Natural and physical sciences	-0.00353	0.03699	-0.1	0.9239
Information technology	-0.00262	0.03779	-0.07	0.9447
Engineering and related technologies	0.10686	0.02686	3.98	<.0001
Architecture and building	0.13148	0.04052	3.24	0.0012
Agriculture, environmental and related studies	-0.00304	0.0524	-0.06	0.9537
Health	0.07203	0.03614	1.99	0.0463
Education	0.03262	0.03979	0.82	0.4124
Management and commerce	0.0567	0.02282	2.48	0.013
Creative arts	-0.02978	0.03347	-0.89	0.3736
Food, hospitality and personal services	0.07194	0.03685	1.95	0.051
Mixed program or unknown	0.13552	0.05125	2.64	0.0082
**Society and culture				
Cumulative duration of employment				
Under 1 year	-0.06498	0.02534	-2.56	0.0104
1–4 years	-0.05741	0.02391	-2.4	0.0164
5–9 years	-0.01147	0.02441	-0.47	0.6384
10–19 years	0.01652	0.02536	0.65	0.5147
**20 years and over				
Estimated work experience (years)				
Experience	0.02535	0.00149	17	<.0001
Experience square	-0.0004589	3.12E-05	-14.71	<.0001
Note: Experience is calculated by first finding 'age-age left school'. Then we deduct the time spent in training beyond 12 yrs at school. For example, 5 years for post-graduate, 4 years for graduate diploma and so on.				

Note: ** is the reference variable.
Source: SET 2009.