SCHOOL OF ECONOMICS AND FINANCE

Discussion Paper 2010-05

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ISSN 1443-8593
ISBN 978-1-86295-585-1

ASSESSING THE IMPACT OF WORKER COMPENSATION PREMIUMS ON EMPLOYMENT IN TASMANIA*

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September 2009

Version 3.1

*The author is grateful to the board of Work Cover Tasmania, for allowing access to their data and for being able to reproduce the findings of a consultancy report conducted for them by the author.

ABSTRACT

The aim of this study is to obtain estimates of the impact of worker compensation premiums on employment in Tasmania. To do so it proposes a basic reduced form employment equation as a function of wages, output, time and lagged employment using lags and Australian output figures as instruments. Using quarterly time series an estimate of the wage elasticity of employment for Tasmania over 1984.3 to 2008.1 is obtained that is comparable to other Australian employment studies. It also estimates an annual panel model across 3-digit industries together with worker compensation premium data to obtain a direct estimate of the impact of worker compensation premium on employment across Tasmania and also at a 1-digit industry level from 1992 to 2008.

Keywords: Wage Elasticity of Employment, Workers' Compensation Premiums

JEL Classification: J23, J32, J38

1. INTRODUCTION

In 2008 the Work Cover Tasmania Board approached the School of Economics and Finance at the University of Tasmania to investigate the effect of raising workers compensation premiums on employment[1]. Amongst other objectives the Work Cover Tasmania Board manages the workers compensation scheme and monitors the performance of scheme participants and provides advice to the Minister for Infrastructure, Resources, Planning and Workplace Relations on the policy, objectives and effectiveness of Tasmania's workers compensation and related legislation[2]. The Work Cover Tasmania Board wished to increase the scope and coverage of the workers compensation scheme but needed to increase premiums to do so. Before recommending this course of action to the Minister it wanted an estimate of the likely effects on employment in Tasmania. This paper is a similar study to that carried out by the author for Work Cover Tasmania Board for the above aim but also wishes to examine the effect of wages on employment.

Workers compensation premiums (WCP) together with employer superannuation contributions (ESC) and payroll taxes are frequently referred to as labour on-costs since they are applied on top of the direct wage cost of employing labour. Each of these labour on-costs should be treated differently when assessing their impact on employment, since they each have different levels of benefits to the employer and/or employee.

Superannuation for the employer is a marginal cost, and effects labour demand. For workers it is a form of deferred wages and so changes to superannuation levels may also alter the labour supply decisions of workers (or their labour effort choices). One could use the wage

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[1] It also commissioned the Tasmanian Chamber of Commerce and Industry to conduct a survey of its members to obtain an estimate of the effect of raising workers compensation premiums on Tasmanian Employment.

[2] For a full description of Work Cover Tasmania's objectives see their strategic plan at www.workcover.tas.gov.au.

elasticity of employment to estimate the effect of changing ESC, if the ESC were suitably discounted to the present.

Ignoring general equilibrium effects, payroll tax provides no benefit to neither the employer nor employees. Changes in payroll taxes would be a purely be a change in marginal cost for firms and effect labour demand. Using the wage elasticity of employment to assess the employment effects of changing payroll tax, could potentially lead to misleading results as it does not affect the labour supply or effort as wages may.

Most workers compensation schemes allow injured workers to either take the specified payment for the particular injury, but in doing so lose the right to pursue the matter through common law. Thus any increase in WCP that are used to fund either an increase in payments or an increase in the scope of injuries covered, is likely to reduce the chance of common law action against the employer. The common law action could potentially cost the employer a far greater amount than the WCP and so provide a benefit to the firm that would offset the rise in marginal costs form the higher on-costs. Employers may not perceive this benefit, in which case any increase in WCP would just be an increase in costs, the same as payroll tax increase. It is also possible that WCP may be increased to cover larger administrative costs of the scheme, which may provide little benefit to employers, although may lower their own administrative and communication costs.

The effect of increased WCP on employees is even more difficult to assess. If the increase in WCP were to increase the scope and coverage of payments and the probability and damage of a work place accident remained constant then the overall remuneration package to employees would have grown. However the increased size of payments may have come from a realisation that the damage to the individual worker of an accident has increased in lost work and leisure opportunities. Due to these uncertainties this study ignores any effect of increased WCP on workers labour supply or effort.

Public data on workers compensation premiums is quite limited. The ABS publishes an annual national index of on-costs including ESC, WCP, payroll tax, split between the public and private sector in the appendices of ABS 6345.0 Labour Price Index. More detailed state by 1-digit ANZSIC industry[3] based data is available from the ABS upon request and covers 2000-01 to 2007-08[4]. Using this data there would be scope for a panel data study of the effect of WCP on employment; however it is unlikely that any significant results would be obtainable at an industry level.

Without this or more detailed data, one is left to make inferences from the wage elasticity of employment about the impact of WCP on employment. Ignoring any benefits of wage rises on workers' effort or labour supply, the wage elasticity of employment can be used to provide an upper bound estimate of the effect of raising WCP by 1% of wages. This estimate would be appropriate if a dollar of WCP were considered by businesses as simply another dollar of costs such as payroll tax.

This study takes two approaches to assess the impact of rasing WCP on employment. The first is to estimate a reduced form equation for Tasmanian employment based on aggregate quarterly time series ABS data without WCP data. This allows the wage elasticity of employment (WEE) to be estimated and is comparable to other studies of the Australian

[3] ANZSIC = Australian and New Zealand Standard Industry Classification. The broad level (1-digit) industries are reported in Table A8.2.2 in the Appendix.

[4] This data is also available via the ABS Time Series Plus via the DX Database in tables 6345-15 and 6345-15 for ESC, 6345-17 and 6345-18 for Payroll Tax and 6345-19 and 6345-20 for WCP. This sources does not classify on-cost by industry and state, but rather one or the other.

labour market. This approach provides an upper bound on the estimate of raising WCP, but also allows the comparison of the Tasmanian WEE with the Australian WEE from previous studies.

The second approach is to make use of confidential data supplied by *Work Cover Tasmania* covering well over 400 disaggregated 2-digit ANZSIC industries annually from 1991-92 to 2007-08. The dataset includes: the no. of policies, WCP, no. of employees, wages, no. of claims, and total payouts. Together with other ABS data this provides a direct estimate of the WCP elasticity of employment (WCPEE) and also an estimate of the WEE for each broad level (1-digit) ANZSIC industry classification in Tasmania.

In Section 2 of the report, the past literature on the wage elasticity of employment and the effect of changing workers compensation premiums is reviewed. The data and methodology used in the report are explained in Sections 3 and 4, respectively. Section 5, follows, which presents the results and the conclusion, is made in Section 6. References are contained in Section 7 and additional information referred to in the report is contained in the section 8.

2. Previous Studies

While there have been only a few studies on the effect of changing workers compensation premiums, there have been numerous studies of the wage elasticity of employment. The wage elasticity of employment has received considerable attention in Australia, in order to evaluate the various forms of centralised wage fixing that have existed, or continue to exist today. In section 2.1 the two studies that consider the impact of changes in workers compensation premium in Australia are reviewed. Section 2.2 reviews the studies and estimates of the wage elasticity of employment in Australia.

2.1 Studies of the economic effect of changes in workers compensation premiums

Meagher and Parmenter (1986) use the ORANI-NAGA general equilibrium model to examine the effect of reducing workers' compensation premiums Australia wide. They found a moderate increase in output and employment would result and a net gain to the government from the increased tax base. Most of the expansion occurred in sectors of the economy subject to international trade that are very sensitive to cost changes.

Cerasani (1990) also used ORANI to model the complete removal of workers' compensation premiums as part of the total removal of labour on-costs. The Industry Commission (1994) felt this was an unrealistic policy option and so examined the long run effect of a 20 per cent fall in labour on-costs. In the long-run, it was assumed that the i) level of capital can change in response to changes in input costs; and ii) real wages vary to keep unemployment fixed at some 'natural' level, although the participation rate may vary.

Industry Commission (1994), Table A9, page A18

Table A9 Illustrative long-run effects of reduced workers' compensation costs (Percentage change)

Economy wide effects		*Sectoral effects*		
			Output	*Employment*
Real GDP	0.5	Agriculture	0.4	-0.1
Exports (volume)	0.7	Mining	0.8	0.2
Imports (volume)	0.2	Manufacturing	0.3	0.1
Real after-tax wage	0.5	Services	0.3	0.0
Real government expenditure	0.3			

Source: Industry Commission 1993, ORANI simulations

The Industry Commission (1994) states (without explaining their methodology) that the "…economy-wide effect of this efficiency improvement is that there is an increase in real

GDP of $1.75 for each dollar by which workers' compensation costs are reduced, while leaving workers as well off as before." It should be noted that the study simulation did not consider the indirect effects of reducing workers compensation premiums such as increased common law legal action, loss of safety and back to work initiatives by workers compensation bodies. These costs are likely to be sizeable although very difficult to quantify. In a similar fashion this study will not include any benefits from raising workers compensation premiums, in evaluating the effect of increasing them on employment.

The Industry Commission's (1994) results implies that a 20% rise in labour on-costs would result in the opposite effects to those in Table A9, that is a fall in employment of approximately 0.05% (an average of the industry effects) and a fall in economic output of 0.5%. To place this result in terms of increasing workers compensation premium by 1% of real wages this result should be divided by 3.33 (as explained in Appendix 8.1), resulting in a fall in employment of 0.015% and fall in output 0.15%.

The most comparable study to this one is Edmiston (2006) who examines the effect of workers compensation costs across 50 states of the US and the District of Columbia with comprehensive data from 1978 to 2000. Edmiston (2006) estimates a three equation system of employment, wages and workers compensation benefits (as a proxy for workers compensation costs) along with a range of other exogenous variables with LIML. Edmiston (2006) opts for a LIML rather than use 2SLS, due to the concern that the available instruments are weak. Edmiston (2006) find that the effects of workers compensation costs have a significant negative effect on employment but the effect was small relative to the negative effect of wages on employment. The wage elasticity of employment was estimated to be -0.211, while the elasticity of workers compensation costs estimate was -0.011.

2.2 Studies of the wage elasticity of employment

Most studies implicitly adopt a neoclassical economic framework for the formulation of the demand for labour and so it is assumed to be negatively related to wages and positively related to output. Typically a constant elasticity of substitution production function is assumed and the resulting 'demand for labour' is a linear in logarithms function. (See section 4 for more details). Total employment or total hours worked is normally specified as a function of wages, gross domestic product and a time trend as a proxy for technical progress. In practice, most studies take employment to be equal to the demand for labour.

Freebairn (1977), while not estimating any of his own parameters, concluded that the long-run elasticity of employment with respect to output was about 0.7 and with respect to real wages was about -0.5. Lewis and Kirby (1988) found that the Accord had brought about a shift in the supply curve for labour bringing about a 10 per cent fall in real wages and a rise in employment of 8 per cent implying an employment elasticity with respect to real wages of –0.8. Pissarides (1991) estimated an Australian employment real wage elasticity of -0.8.

Russell and Tease (1990) estimated the labour demand as a log Koyck model, where the impact of variables decays over time for quarterly Australian data from 1969:3 to 1987:4. They found that wages, economic output (GDP), employment lagged and a time trend where all significant and of the correct sign. In particular they found an impact wage elasticity of employed persons of -0.11 and -0.18 for hours decaying with coefficients of 0.82 and 0.76 respectively for lagged employment. The long run impact of rise in wages of 1% was a -0.61% for employed persons and -0.75% for employed hours.

Dungey and Pitchford (1998), using more recent data estimate an elasticity with respect to real wages of –0.4. Debelle and Vickery (1998), advocate employment elasticity with respect to real wages of –0.7 for the period 1969 to 1997 and lower at-0.4 from 1979. Bernie and

Downes (1999) suggest that the differences in estimates are due to variations in definitions, methodology and data. Their results from the TRYM model suggest an employment elasticity of about -0.6 with respect to real wages.

Lewis and McDonald (2002) outline a number of dissatisfactions with previous work on the wage elasticity of employment. They criticise i) the previous interpretation of the coefficient on wages as an output constant wage elasticity of employment, which they demonstrate is not the case for a CES production function; ii) that the endogeneity of wages is not considered and iii) previous economic and econometric models. They use an autoregressive distributed lag (ARDL) approach that models a long run relationship within an autoregressive error-correction model. They estimate that the elasticity of substitution between labour and capital is -0.45 and given a labour share of GDP of 0.6, translates to output constant wage elasticity of employment of (0.45 x (1 - 0.6)) = -0.2. However taking into the cost saving effect on output and assuming a elasticity of employment for output of 1 (unitary), results in a total wage elasticity of employment of – (0.2 + 0.6 x 1) = -0.8. Luckily this is close to previous estimates of the total wage elasticity of employment obtained from incorrectly interpreting results.

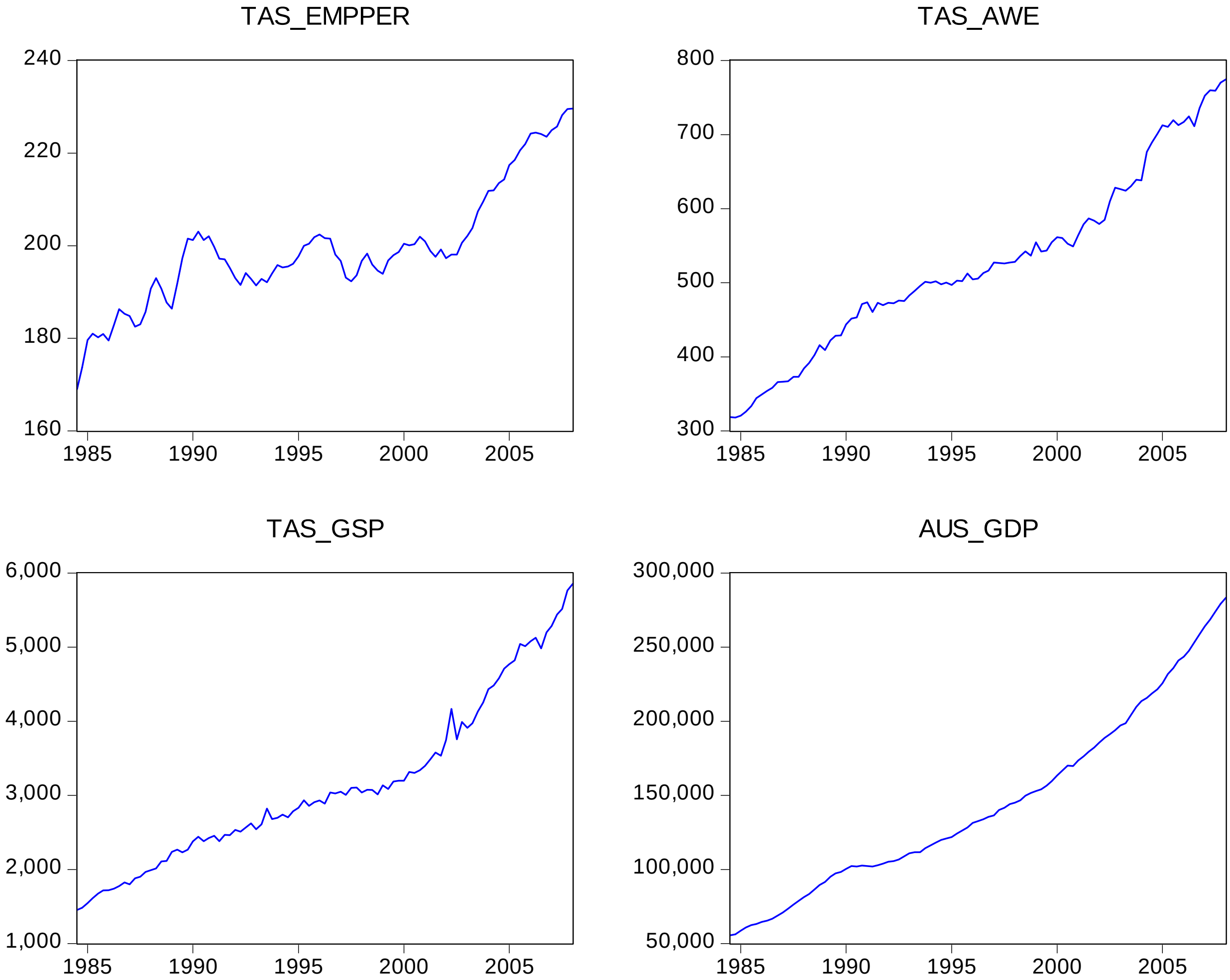
Dowrick and Wells (2004) explain that Lewis and McDonald (2002)'s interpretation is incorrect, and that the output constant elasticity of demand is simply the coefficient on log wages in an equation with log employment as the dependent variable.

In summary, the results for Australia suggest a wage elasticity of employment of about -0.4 to -0.8, which is higher than most other countries (see Hamermesh 1993). As previously stated, the wage elasticity of employment can be used as an estimate of raising workers compensation premiums by 1% of wages, particularly as the extreme case. The previous literature for Australia suggests that an increase in workers compensation premiums of 1% of wages will result in a -0.4% to -0.8% fall in employment.

3 DATA

For the aggregate time series study, seasonally adjusted quarterly data on the Employed Persons (L_t), nominal Average Weekly Earnings (W_t) and nominal Gross State Product (Q_t) for Tasmania together with data on the nominal Gross Domestic Product for Australia (G_t) was obtained from www.abs.gov.au. For more details on the source and nature of the time series data, see Table A8.2.1 in the Appendix. The data ranges from September 1984 to March 2008 and includes quarterly 95 observations in total. Figure 3.1 contains time series charts for Employed Persons (TAS_EMPPER) and nominal Average Weekly Earnings (TAS_AWE) and Gross State Product (TAS_GSP) for Tasmania and Australian Gross Domestic Product (AUS_GDP). Note the apparent correlation between E_t,W_t, and Q_t, especially in last decade.

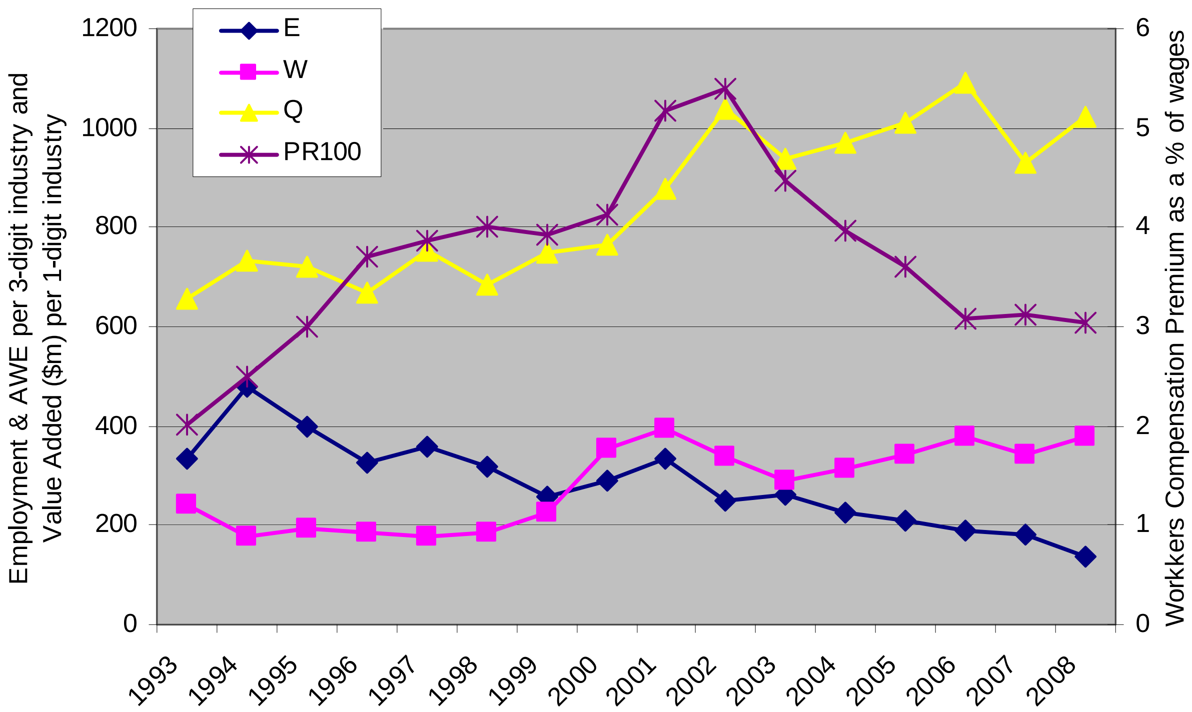
Figure 3.1 Quarterly Time Series Tasmanian Data Labour Function Data



For the annual panel study, data from Work Cover Tasmania was obtained for: the number of employees, premiums charged and wages paid for each 3-digit ANZSIC industry classification. This data was merged with data from ABS 5222.0 on nominal value added contribution to GSP for Tasmania and GDP for Australia (measures of output) attributable to each broad level (1-digit) ANZSIC industry.

The panel covers 455 3-digit ANZSIC industries, generally covering data from 1992 to 2008, but not for all industries (that is the panel is unbalanced). Observations for which the number of employees are equal to zero are removed, resulting in 7159 observations, consisting of 455 3-digit ANZSIC industries covering up to 17 years. Using variables lagged by up to two years, reduces the final sample used in estimation to 447 3-digit ANZSIC industries covering up to 15 years, which contain 6190 observations. The mean across 3-digit industries of the variables used in panel study are displayed in Figure 3.2 below and in Table A8.2.2 in the Appendix.

Figure 3.2 Panel Data – Average per 3-digit Tasmanian Industry



4 METHODOLOGY

Lewis and MacDonald (2002) illustrate that many estimated employment equations can be viewed as the first order condition for profit maximisation with respect to labour inputs within the neoclassical framework assuming a CES production function. Lewis and MacDonald warn that in this case, the coefficients estimates can not be directly interpreted as elasticities of employment.

This study uses a reduced form employment equation, representing the interaction of the demand and supply for labour. It does not make any explicit assumptions about the underlying production function that gives rise to the labour demand function nor the form of the labour supply function. This has the advantage that the wage elasticity of employment (WEE) can be directly obtained from the estimates.

The functional form chosen is largely the same as previous studies that have estimated employment equations, many were incorrectly labelled as “labour demand equations”. In each period t Employment (L_t) is modelled as a function of nominal wages (W_t), output (Q_t) and time (t). An infinite geometric lag model of log employment is chosen

$$\begin{aligned} \ln L_t = \alpha &+ \beta_W \ln W_t + \beta_W \lambda \ln W_{t-1} + \beta_W \lambda^2 \ln W_{t-2} + \ldots\ldots \\ &+ \beta_Q \ln Q_t + \beta_Q \lambda \ln Q_{t-1} + \beta_Q \lambda^2 \ln Q_{t-2} + \ldots\ldots \qquad (1) \\ &+ \gamma t + u_t \end{aligned}$$

where β_W is the instantaneous wage elasticity of employment,

β_Q is the instantaneous output elasticity of employment,

λ is the rate of decay in the wage and output elasticities overtime, $0 < \lambda < 1$,

γ is the change in employment holding output and wages constant,

α is the intercept term

$u_t \sim IID\left(0, \sigma_u^2\right)$ is the error term in period t .

The long run elasticities $\beta + \beta\lambda + \beta\lambda^2 + \beta\lambda^3 + \ldots$ can be simplified to $\beta/\left(1-\lambda\right)$ and the mean lag is given by $\lambda/\left(1-\lambda\right)$. By using the Koyck transformation it can be shown that (1) can be expressed as

$$\ln L_t = \beta_0 + \beta_W \ln W_t + \beta_Q \ln Q_t + \gamma\left(1-\lambda\right)t + \lambda \ln L_{t-1} + v_t \qquad (2)$$

where $\beta_0 = \alpha\left(1-\lambda\right) + \lambda\gamma$ and $v_t = u_t - \lambda u_{t-1}$.

Note that the error term is now a moving average and exhibits serial correlation $\text{cov}(v_t, v_{t-1}) \neq 0$ leading to inefficient estimates, unless it is taken into consideration in estimation. More importantly $\ln L_{t-1}$ is correlated with the error term, $\text{cov}(v_t, \ln L_{t-1}) \neq 0$, since $\ln L_{t-1}$ and v_t are both functions of u_{t-1}, leading to biased estimates. The other possible problem with equation (2) is that wages (W_t) and output (Q_t) are likely to be endogenously determined by employment (L_t) and each other. OLS estimation of (2) will result in biased estimates if the explanatory variables: $\ln L_{t-1}$, $\ln W_t$ and $\ln Q_t$, are correlated with the error term. Two Stage Least Squares (2SLS), where the troublesome variables are replaced with their estimates based on instrumental or exogenous variables, is used to counter this estimation problem.

4.1 Aggregate Tasmanian Employment Equation

For the aggregated Tasmanian quarterly time series model, the employment equation is specified

$$\ln L_t = \alpha_o + \alpha_1 \ln W_t + \alpha_2 \ln Q_t + \alpha_3 t + \alpha_4 \ln L_{t-1} + v_t \qquad (3)$$

where, $\ln L_t$ is the logarithm of employed persons in Tasmania in quarter *t*,

$\ln L_{t-1}$ is the logarithm of employed persons in Tasmania in quarter *t-1*,

$\ln W_t$ is the logarithm of nominal average weekly earnings in Tasmania in quarter *t*,

$\ln Q_t$ is the logarithm of Gross State Product in Tasmania in quarter *t*,

t is a time trend used to capture technical change, and

v_t is a moving average error term in period *t*, $v_t \sim \left(0, \left(1+\lambda^2\right)\sigma_u^2\right)$

While this study does not specify the structural relationship between employment, wages, and output it recognises that they are all endogenous to one another. For this reason 2SLS is used with instruments being: the logarithm of Australian GDP as well as its 1st and 2nd quarter lags, (i.e. $\ln G_t$, $\ln G_{t-1}$ and $\ln G_{t-2}$), the 2nd quarter lags of Tasmanian GSP, ($\ln Q_{t-2}$), the 2nd quarter lag of log employment ($\ln L_{t-2}$) and nominal wages, ($\ln W_{t-2}$). These exogenous variables ensure over-identification with six exogenous variables and four endogenous variables.

4.2 Tasmanian Employment Equation For Panel Data

For the panel data the generic employment equation to be estimated is

$$\ln L_{i,t} = \theta_0 + \theta_1 \ln W_{i,t} + \theta_2 \ln Q_{I,t} + \theta_3 t + \theta_4 \ln L_{i,t-1} + \theta_5 \ln P_{i,t} + \mu_i + v_{i,t} \qquad (4)$$

where, $\ln L_{i,t}$ is the logarithm of employed persons in Tasmania in year *t* in 3-digit industry *i*,

$\ln L_{i,t-1}$ is the logarithm of employed persons in Tasmania in year *t-1* in 3-digit industry *i,*

$\ln W_{i,t}$ is the logarithm of nominal wage in Tasmania in year *t* in 3-digit industry *i*,,

$\ln Q_{I,t}$ is the logarithm of the value added in Tasmania in year *t*, in each 1-digit industry *I,*

$\ln P_{i,t}$ is the logarithm of the premiums paid in year *t*, in each 3-digit industry *i,*

t is a time trend and t^2 a squared time trend

$\mu_i \sim IID\left(0, \sigma_\mu^2\right)$ is a random effect in each 3-digit industry *i*

$v_{i,t}$ is a moving average error term, serially correlated for a given *i*.

In order to allow for broad industry specific behaviour and to be able to obtain industry specific estimates of the effect of elasticity of employment w.r.t WCP and wages the panel model is also estimated with broad industry *I* varying coefficients on $\ln W_{i,t}$ ($\phi_{1,I}$) and $\ln P_{i,t}$ ($\phi_{6,I}$), for $I = A, B, \ldots Q$ as specified in (5) below with fixed effects

$$\ln L_{i,t} = \phi_{0,i} + \phi_{1,I} \ln W_{i,t} + \phi_2 \ln Q_{I,t} + \phi_5 \ln L_{i,t-1} + \phi_{6,I} \ln P_{i,t} + v_{it} \quad (5)$$

and also random effects

$$\ln L_{i,t} = \varphi_0 + \varphi_{1,I} \ln W_{i,t} + \varphi \ln Q_{I,t} + \varphi_5 \ln L_{i,t-1} + \varphi_{6,I} \ln P_{i,t} + \mu_i + v_{it} \quad (6)$$

Each 1-digit industry in *I* consists of a set of mutually exclusive 3-digit industries from *i*.

The variables used as instruments in the 2SLS panel estimation are the log of the Value Added in Australia in year *t*, *t*-1 and *t*-2, in each 1-digit industry *I,* (i.e. $\ln G_{I,t}$, $\ln G_{I,t-1}$ and $\ln G_{I,t-2}$), the 1st and 2nd quarter lags of the log of the Value Added in Tasmania in each 1-digit industry *I,* (i.e. $\ln Q_{I,t}$, $\ln Q_{I,t-1}$ and $\ln Q_{I,t-2}$), as well as lagged log nominal wages and the 2nd quarter lag of log employment in each 3-digit industry *i*, ($\ln W_{i,t-1}$ and $\ln L_{i,t-2}$, respectively).

5 RESULTS

5.1 Aggregate Tasmanian Employment Equation

Allowing for lags, the 2SLS was estimated over 92 quarterly observations with lags of the variables from the employment equation, Australian GDP and a time-trend being used as instruments. While all of the variables used in the estimation of equation (3) were non-stationary, the residuals from the 2SLS estimation are stationary (using an ADF test at the 1% level) providing evidence that the relationship is cointegrated. The inclusion of the moving-average term drastically improves the Durbin Watson statistic and removes most of the autocorrelation in the model. Any remaining affects of autocorrelation on the standard errors is mitigated with the Newey-West Correction. Table 5.1 contains the essential results of estimating equation (3) with EViews 6.0. The full results are contained in Table 8.3.1 in Appendix 8.3.

Table 5.1 2SLS Estimates of Tasmanian Employed Persons

Variable	C	$\ln W_t$	$\ln Q_t$	T	$\ln L_{t-1}$	MA(1)
Coefficient	1.7294	-0.1138	0.1894	-0.0010	0.7965	0.1313
P Value	[0.0555]	[0.0643]	[0.0720]	[0.1906]	[0.0000]	[0.5110]
	Dependent Variable $\ln E_t$			DW = 1.580	$R^2 = 0.973$	$\bar{R}^2 = 0.972$
	Newey-West HAC SE			IVs: $\ln Q_{t-2}$, $\ln G_t$, $\ln G_{t-1}$, $\ln G_{t-2}$, $\ln W_{t-2}$, $\ln E_{t-2}$,		

The results in Table 5.1 indicate that the model fits the data quite well, with a good R-squared and the coefficients of interest upon $\ln W_t$, $\ln Q_t$ and $\ln L_{t-1}$ are significant and of the correct sign. The coefficients on $\ln W_t$ and $\ln Q_t$ are the instantaneous wage and output elasticities of employment. The coefficient of 0.189 upon $\ln Q_t$ suggests a 10% rise in Tasmanian GSP would be associated with a 1.89% rise in employment. The coefficient of the time trend was negative, but very small and insignificant.

The estimated coefficient on $\ln W_t$ in Table 5.1 above, indicates that the initial impact on employment of 1% rise in wages would be a fall of 0.114%. The coefficient on lagged log employment of 0.796 indicates that in the next quarter this effect would be (0.796 x -0.114) = -0.091 suggesting that a 1% rise in wages would result in a fall of 0.091%. The following quarter the effect would be 0.796^2 x -0.114) = -0.072 a fall of 0.072% and so on. Leading eventually to a total long run (LR) impact of (1/(1-0.796) x -0.114) = -0.559, a fall in employment of 0.56% in response to a 1% rise in wages. The median lag for this Koyck model is 3 quarters[5], suggesting that half this long run effect of -0.56%, would be felt in a

[5] The median lag for the Koyck model is $-\ln 2/\ln \lambda$.

little under a year. The long run elasticity of -0.56 is in the range of previous Australian estimates of the wage elasticity of employment that vary from -0.4 to -0.8.

In March 2008 there 229,600 people employed in Tasmania, thus a coefficient of 0.114 on wages implies a 1% rise in wages would result in an initial decline 208 employed persons rising to 1,284 employed persons in the long run. This estimate can be considered the extreme case of workers compensation premiums being treated identical to all other labour costs including wages.

The equation (3) was also estimated replacing employed persons (*L*) with employed hours (*HRS*) and the results are contained in contained in Table 8.3.2 in Appendix 8.3. The results in that table show the model in this study can not explain the movements in hours worked in Tasmania as well as it can for employed persons with the R^2 of 0.513 and none of the variables significant other than the constant.

5.2 Tasmanian Employment Equation For Panel Data

An unbalanced panel of 442 fine-level industries from 1994 to 2008 providing 6047 observations was used to estimate an equation (4) for employment using 2SLS with random effects and cross-section weights applied to the standard errors. The variables used as instruments in the 2SLS panel estimation are the log of the Value Added in Australia in year *t*, *t*-1 and *t*-2, in each 1-digit industry *I,* (i.e. $\ln G_{I,t}$, $\ln G_{I,t-1}$ and $\ln G_{I,t-2}$), the 2nd quarter lag of the log of the Value Added in Tasmania in each 1-digit industry *I,* (i.e. $\ln Q_{I,t-2}$), as well as the 2nd quarter lags of log wages and log employment in each 3-digit industry *i*, ($\ln W_{i,t-2}$ and $\ln L_{i,t-2}$, respectively), a time trend and time trend squared for each 1-digit industry and a constant for each 3-digit industry.

On the whole, using both common and individual unit root tests available in EViews 6.0 for panels, ln$E_{i,t}$, *and* $PR100_{i,t}$ were stationary , ln$W_{i,t}$, was trend stationary, while ln$Q_{I,t}$, was non-stationary. However cointegration tests indicate that the variables in (4) are cointegrated. Moving average error terms are not permitted in EViews 6.0, thus the estimates may suffer from being inefficient however the Durbin Watson statistic indicates there is no problem with autocorrelation. Period SUR was used to adjust the standard errors.

Table 5.2 contains the essential results and the LR wage and WCP elasticities of employment for of estimating equation (4) using both random and fixed effects. The full results for the random and fixed effects models are contained in Table 8.3.3 and Table 8.3.4, respectively, in Appendix 8.3. As for the quarterly time series estimation, the results in Table 5.2 indicate that the fixed effects model fits the data quite well. In addition all the coefficients are significant at the 5% significance, except the coefficient on $\ln W_t$ which is significant at 10%. The random and fixed effects estimates are not dissimilar.

Concentrating on the fixed effects results the instantaneous wage elasticity of employment of -0.11964 suggest a 1% rise in average wages per week would be associated with a 0.112% fall in employment. The coefficient on lagged log employment of 0.7111 indicates that in the next year this effect would be (0.7111 x -0.11964) = -0.08494 suggesting that a 1% rise in wages would result in a fall of 0.085%. The total long run (LR) impact of (1/(1-0.7111) x -0.11964) = -0.4135, a fall in employment of 0.413% in response to a 1% rise in wages. The long run wage elasticity of employment estimate from the panel data of -0.41 is similar to the time series estimate of -0.56 and other previous Australian estimates. The median lag for this

Koyck model of 2 years[6] suggests that half the fall of 0.413% would occur in 2years seems appropriate.

Table 5.2 2SLS Estimates for Panel Data with Random Effects

	Random Effects	Fixed Effects
ϕ_W (coefficient on $\ln W_t$)	-0.0941 *	-0.1194*
ϕ_Q (coefficient on $\ln Q_t$)	0.0787 **	0.1046**
ϕ_L (coefficient on $\ln L_{t-1}$)	0.7241 **	0.7111**
ϕ_P (coefficient on $PR100_t$)	-0.0042 **	-0.0047**
ϕ_0 (constant)	1.3955 **	1.5071**
$\phi_W / 1-\phi_L$	-0.3410 *	-0.4135*
$\phi_P / 1-\phi_L$	-0.0153 **	-0.0162**
Adjusted R-squared	0.5404	0.9445
Durbin-Watson stat	1.9309	1.9134

Of note in Table 5.2 is that the impact of raising workers compensation premium rate (as a %) is much smaller about 4% the size and significant negative effect on employment. The coefficient on the WCP as a percentage of wages, *PR100*, suggests that an absolute rise of 1% in the premium rate, for example 1.2% to 2.2%, would lower employment by 0.005% in the current year. The total long run (LR) impact of (1/(1-0.7111) x -0.0047) = -0.0162, a fall in employment of 0.016% in response to an absolute rise of 1% in the premium rate.

Table 5.3 below, provides the 1-digit industry specific panel estimates with fixed effects of the long run impact on employment of raising wages by 1% and raising WCP by 1% of wages from estimating equation (5) using 2SLS and OLS[7]. Full results are contained in Table A8.3.5.

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[6] The median lag for the Koyck model is $-\ln 2/\ln\lambda$.

[7] Fixed effects estimation provided very similar estimates to those in Table 5.3.

Table 5.3 Panel Data with Fixed Effects Estimates of the LR Impact of raising Wages and Workers Compensation Premiums (WCP) by 1% of wages

Code	Industry	2SLS-FE				OLS-FE			
		Wages ↑1% of wages $\phi_{W,I}$		**WCP** ↑1% of wage $\frac{\phi_{P,I}}{1-\phi_L}$		**Wages** ↑1% of wages $\phi_{W,I}$		**WCP** ↑1% of wages $\phi_{P,I}$	
A	Agriculture, Forestry and Fishing	-0.1463		-0.0611		-0.7618	**	-0.0754	**
B	Mining	-1.5749	*	-0.0958		-0.8844	**	-0.0516	
C	Manufacturing	-1.0157	**	-0.0205	**	-0.4066	**	-0.0100	**
D	Electricity, Gas and Water Supply	2.5961	**	0.2323		0.8839	*	0.1148	
E	Construction	0.0181		-0.0728		-0.5078	*	-0.1018	*
F	Wholesale Trade	-0.1108		0.0728		-0.9065	**	0.0819	
G	Retail Trade	0.9092	**	0.1591	**	-0.0425		0.1475	
H	Accommodation, Cafes and Restaurants	-0.2513		-0.0837		-1.2050	**	-0.0170	
I	Transport and Storage	-0.3655		-0.1060	*	0.2425		-0.0576	*
J	Communication Services	0.2602		-0.0793		-0.7648		-0.1824	
K	Finance and Insurance	0.0239		-0.0321		-0.8600	**	-0.0789	
L	Property and Business Services	0.9433		0.1971	**	-0.0361		0.1157	**
M	Government Administration and Defence	-0.7480		-0.0467		0.4918		0.0517	
N	Education	-0.6178		0.2614	**	0.4594		0.3798	**
O	Health and Community Services	0.4601		-0.0220		0.3476		-0.0235	
P	Cultural and Recreational Services	-0.1521		-0.2086	**	-0.4370	*	-0.2551	**
Q	Personal and Other Services	0.4827		-0.0151		-0.6851	*	-0.0974	**
	ϕ_Q (coefficient on $\ln Q_t$)	0.0814	*			0.1130	**		
	ϕ_L (coefficient on $\ln L_{t-1}$)	0.6902	**			0.6993	**		
	ϕ_0 (constant)	1.4486	**			1.4527	**		
	Adjusted R-squared	0.9387				0.9408			
	Durbin-Watson Statistic	1.8606				1.9054			

** Indicates impact parameter is statistically significant from zero at the α = 5% level of significance.
* Indicates impact parameter is statistically significant from zero at the α = 10% level of significance.

The effect of the reduction in the degrees of freedom due to the inclusion of the 34 industry specific wage and WCP effect is evident in Table 5.3 with many parameters insignificant. The 2SLS long run wage elasticities results vary more widely than the OLS results, -1.6 to +2.6 for 2SLS compared to -1.2 to 0.88 for OLS and are on the whole less significant. Of course the OLS estimates will be biased and inconsistent if the regressors are correlated with the error term. An examination of the residuals and the sample regressors indicates that this is the case for wage variable and so the OLS will not be discussed further.

Table 5.3 shows only four of the 17 long run wage elasticities of employment are significant: -1.6 for Mining, -1.0 for Manufacturing, +0.9 for Retail Trade and +2.6 for Electricity, Gas and Water Supply. The standard errors of the impact wage elasticities estimates (not reported here) are less varied ranging from 0.06 to 0.18 and thus it is only the larger of the impact wage elasticities that are significant. While the positive estimates may implausible, it must be remembered that the equations in this study and equation (5) are reduced form employment equations and not labour demand equations. The range of estimates while large for some industries seems plausible when considering the average effect of -0.4 from estimating equation (4). The estimates of the WCP elasticity of employment in Table 5.3 also vary considerably from -0.20 and 0.26 and only 6 out of the 17 estimates are significant at 10%. This range also seems plausible given the estimate of -0.02 from estimating equation (4).

Table 5.3 shows only four of the 17 long run wage elasticities of employment are significant: -1.6 for Mining, -1.0 for Manufacturing, +0.9 for Retail Trade and +2.6 for Electricity, Gas and Water Supply. The standard errors of the impact wage elasticities estimates (not reported here) are less varied ranging from 0.06 to 0.18 and thus it is only the larger of the impact wage elasticities that are significant. While the positive estimates may implausible, it must be remembered that the equations in this study and equation (5) are reduced form employment equations and not labour demand equations. The range of estimates while large for some industries seems plausible when considering the average effect of -0.4 from estimating equation (4). The estimates of the WCP elasticity of employment in Table 5.3

also vary considerably from -0.20 and 0.20 and only 6 out of the 17 estimates are significant at 10%. This range also seems plausible given the estimate of -0.02 from estimating equation (4).

To facilitate a valid comparison of the magnitude of wage and WCP employment elasticities at a 1-digit level the Manufacturing will be examined further. The estimates in Table 5.3 suggest that a 1% rise in wages in Manufacturing would result in a 1.02% fall in employment, while a rise in WCP by 1% of wages would result in a fall of employment by 0.02%. These results that in manufacturing in Tasmania the effect is only about 1/50th , rather 1/1.2 = 0.83 as the 20% labour on-costs would imply if WCP had the same effect as wages. Thus it would appear that there are benefits of workers compensation to employers in manufacturing. This appears to be the case for most other industries with the WCP employment elasticity generally half or less that of the wage employment elasticity.

6 CONCLUSION

This study specifies a reduced form employment equation as a function of output, wages and lagged employment. Estimates of this equation using 2SLS on Tasmanian quarterly date found an initial wage elasticity of employment of -0.114 and a long run wage elasticity of employment of -0.559. This implies that that a rise in workers compensation premium by 1% of wages would at worse result in employment falling 0.56%, with half this effect to be felt over the first 3 quarters after the event.

The employment equation was re-specified to include workers compensation premiums and estimated over a final panel of 447 3-digit ANZSIC Tasmanian industries from 1994 to 2008. The panel data study found that across all industries, a 1% rise in wages implies an initial fall of employment by 0.12% in the first year and long run fall of 0.41% with half this effect to occur with in 2 years. More importantly this model and data allowed a direct estimate of impact of workers compensation premiums (WCP). The model implied that a rise in WCP by 1% of wages would lead to an initial fall of 0.005% in employment in the first year and a fall in employment of 0.02% in the long run. The impact of an increase in WCP of 1% of wages is estimated to be only 1/20th of the effect of raising wage by 1%. This suggests that employers believe that there are benefits to paying WCP, such as a reduced chance of common law legal action.

Attempting to estimate wage and WCP elasticities of employment for each 17 Tasmanian 1-digit industries within the panel began to stretch the capability of the sample size, with only about a quarter of estimates significant. What it did illustrate was that there was considerable variation in the estimates across industries. Wages elasticities of employment varied from -1.6 for Mining, to +2.6 for Electricity, Gas and Water. In addition to Mining, Manufacturing was also very responsive to wages with an elasticity of -1.0. WCP elasticities of employment varied from -0.20 Cultural and Recreational Services, to +0.26 for Education.

This study as found estimates for Tasmania that suggests the effect of raising workers compensation premiums by 1% of wages is considerably less than the effect of raising wages by 1% suggesting that employers believe that there are benefits to paying WCP and workers compensation schemes.

7 REFERENCES

Bernie, K. and Downes, P. (1999), 'The Macroeconomics of Unemployment in the Treasury Macroeconomic (TRYM) Model', TRYM Related Paper no. 20, paper presented in the RBA seminar series, 27 January, Reserve Bank of Australia, Sydney.

Cerasani, G. (1990), "Labour on-Cost: Who Bears the Burden?", *Labour Economics and Productivity*, no. 2, p27-45.

Dowrick and Wells (2004), 'Modelling Aggregate Demand for labour: A Critique of Lewis and MacDonald', *Economic Record*, vol. 80, no. 251, pp436-440.

Debelle, G. and J. Vickery (1998), 'The Macroeconomics of Australian Unemployment' in G. Debelle (ed.) *Unemployment and the Australian Labour Market: Proceedings of a Conference*, Reserve Bank of Australia and Centre for Economic Policy Research ANU.

Dungey, M. and J. Pitchford (1998) 'Prospects for Employment and Output Growth with Steady Inflation' in G. Debelle (ed) *Unemployment and the Australian Labour Market: Proceedings of a Conference*, Reserve Bank of Australia and Centre for Economic Policy Research ANU.

Edmiston, K. D. (2006), "Workers Compensation and State Employment Growth", *Journal of Regional Science*, vol. 46, no. 1, pp. 121-145.

Freebairn, J.W. (1977), 'Do Wages Matter? The Effect on Aggregate Employment', *Australian Economic Review*, no. 39, pp25-35.

Hamermesh, D. (1993), *Labor Demand*, Princeton University Press, New Jersey.

Lewis, P.E.T. and G. McDonald (2002), "The Elasticity of Demand for Labour in Australia", *Economic Record*, vol. 78, no. 1, pp18-30.

Meagher, G.A. and B.R. Parmenter (1986), "The economic effects of reductions in industries' costs associated with reforms to the workers' compensation system", Melbourne Institute of Applied Economic and Social Research Working Paper Series, 03/1986, University of Melbourne.

Industry Commission (1994), "Workers' Compensation in Australia", Commission Inquiry Report no. 36, Industry Commission, Canberra.

Pissarides, C. (1991), 'Real Wages and Unemployment in Australia', *Economica*, vol. 58, no. 229, pp. 35-55.

Productivity Commission (2004), "National Workers' Compensation and Occupational Health and Safety Frameworks", Productivity Commission Inquiry Report no. 27, Productivity Commission, Canberra.

Russell, B. and Tease, W. (1990), 'Employment, Output and Real Wages', *Economic Record*, 67(196), pp34-45.

Workplace Standards Tasmania (2008), *Work Cover Tasmania Strategic Plan 2008 – 2010*, www.workcover.tas.gov.au

8 APPENDICES

8.1 Converting Elasticities of Employment

8.1.1 Relationships between Total Labour Costs, Wages and Premiums

Labour On-Costs	=	Workers Compensation Premiums	+	Employer Superannuation Contributions	+	Pay Roll Tax
LOC	=	*WCP*	+	*ESC*	+	*PRT*

Total Labour Costs	=	Wages	+	Labour On-Costs
TLC	=	*W*	+	*LOC*

LOC	=	*WCP*	+	*ESC*	+	*PRT*
LOC / W	=	*WCP / W*	+	*ESC / W*	+	*PRT / W*
LOCR	=	*WCPR*	+	*ESCR*	+	*PRTR*

In which case TLC may be expressed

TLC	=	*W*	×	*(1+LOCR)*

8 APPENDICES

8.1 Converting Elasticities of Employment

8.1.2 Equivalent Changes in Labour Costs, Wages and Premiums

Starting with expression for Total Labour Costs

$$TLC = (1 + LOCR)W$$

$$dTLC = \frac{\partial TLC}{\partial W} dW + \frac{\partial TLC}{\partial LOCR} dLOCR$$

$$dTLC = (1 + LOCR) dW + WdLOCR$$

$$\frac{dTLC}{TLC} = \frac{(1 + LOCR) dW}{(1 + LOCR)W} + \frac{WdLOCR}{(1 + LOCR)W}$$

$$\%\Delta TLC = \%\Delta W + \%\Delta LOCR \frac{LOCR}{(1 + LOCR)}$$

Thus an equivalent percentage rise in the wage to a %rise in the LOCR is given by

$$\%\Delta W = \%\Delta LOCR \frac{LOCR}{(1 + LOCR)}$$

An example

Consider the case of the Industry Commission (1994) report where they considered a *20%* change in LOC from the current level *LOCR* of 20% of wages, then from the formulas above it can be seen that TLC have risen by 4%. An equivalent way of achieving this increase in *TLC* would be for wages to rise by 3.33% since it will be inflated by *LOCR* of 20%, so that a 3.33% ΔW x 1.20 = 4%ΔTLC

Or simply using equation () gives $\%\Delta W = 20\% \frac{20\%}{(1 + 20\%)} = 3.3\dot{3}\%$

Now also consider a possible increase in the WCPR

$$TLC = (1 + LOCR)W$$

$$dTLC = \frac{\partial TLC}{\partial W} dW + \frac{\partial TLC}{\partial LOCR} dLOCR + W \frac{\partial LOCR}{\partial WCPR} dWCPR$$

$$dTLC = (1 + LOCR) dW + WdLOCR + WdWCPR$$

$$\frac{dTLC}{TLC} = \frac{(1 + LOCR) dW}{(1 + LOCR)W} + \frac{WdLOCR}{(1 + LOCR)W} + \frac{WdWCPR}{(1 + LOCR)W}$$

$$\%\Delta TLC = \%\Delta W + \%\Delta LOCR \frac{LOCR}{(1 + LOCR)} + \frac{dWCPR}{(1 + LOCR)}$$

Another example

Consider the Industry Commission (1994) report again where they considered a *20%* change in LOC from the current level *LOCR* of 20% of wages, then from the formulas above it can be seen that TLC have risen by 4%. An equivalent way of achieving this increase in *TLC* would be for the WCPR to increase by 4% of wages (for example from 2% of wages to 6% of wages).

$$\begin{aligned} \%\Delta LOCR \; LOCR &= \Delta WCPR \\ 20\% \times 20\% &= \Delta WCPR\,\% \\ \Delta WCPR &= 4\% \end{aligned}$$

8.1.3 Wage Elasticity of Employment

$$WEE = e_w^L = \frac{\%\Delta L}{\%\Delta W} = \frac{\Delta L / L}{\Delta W / W}$$

8.2 Data Sources and Information

Table A8.2.1 Detailed Source of Time Series Data

Variable	Source	Details
Employment (L_t)	ABS 6202.0.55.001 Labour Force, Australia, Spreadsheets	Employed - total; Persons; Seasonally Adjusted month converted to quarterly.
Wages (W_t)	ABS 6302.0 Average Weekly Earnings	Seasonally Adjusted: AWE: Tasmanian: Persons: Total

		earnings: All employees $ /week
Output – GSP (Q_t)	ABS 5206.0 Australian National Accounts: National Income, Expenditure and Product Table 27. State Final Demand, Detailed Components: Tasmania.	Seasonally Adjusted Nominal GDP $m
Output – GDP (G_t)	ABS 5206.0 Australian National Accounts: National Income, Expenditure and Product Table 27. State Final Demand, Detailed Components: Tasmania.	Seasonally Adjusted Nominal GSP $m

Table A8.2.2 ANZSIC Industries at 1-Digit level

Code	1 Digit ANZSIC Industry
A	Agriculture, Forestry and Fishing
B	Mining
C	Manufacturing
D	Electricity, Gas and Water Supply
E	Construction
F	Wholesale Trade
G	Retail Trade
H	Accommodation, Cafes and Restaurants
I	Transport and Storage
J	Communication Services
K	Finance and Insurance
L	Property and Business Services
M	Government Administration and Defence
N	Education
O	Health and Community Services
P	Cultural and Recreational Services
Q	Personal and Other Services

Table 8.2.2 Means of the Panel Data variables across 3-digit Industries

YEAR	*L*	*W*	*Q*	*PR100*
1993	334	240.8	656	2.02
1994	481	177.8	732	2.50
1995	397	192.2	720	3.00
1996	328	185.6	667	3.70
1997	360	178.3	754	3.86
1998	319	185.9	685	4.00
1999	256	225.8	747	3.92
2000	291	356.2	767	4.13
2001	335	395	876	5.18
2002	250	339.9	1,037	5.39
2003	261	289.9	938	4.46
2004	225	312.2	971	3.96
2005	211	343.7	1,011	3.60
2006	189	378.7	1,091	3.09
2007	182	342.6	932	3.12
2008	138	378.6	1,023	3.05

8.3 Additional Results

Table A8.3.1 2SLS Estimates of Tasmania Employed Persons from Quarterly Time Series

Dependent Variable: LOG(E)
Method: Two-Stage Least Squares
Date: 30/07/09 Time: 04:55
Sample (adjusted): 1985Q2 2008Q1
Included observations: 92 after adjustments
Convergence achieved after 2 iterations
Newey-West HAC Standard Errors & Covariance (lag truncation=3)
MA Backcast: 1985Q1
Instrument list: TIME LOG(Q(-2)) LOG(G(-1)) LOG(G(-2)) LOG(G) T LOG(E(-2)) LOG(W(-2))
Lagged dependent variable & regressors added to instrument list

	Coefficient	Std. Error	t-Statistic	Prob.
LOG(W)	-0.113837	0.060728	-1.874528	0.0643
LOG(Q)	0.189353	0.103937	1.821797	0.0720
C	1.729355	0.890747	1.941466	0.0555
LOG(E(-1))	0.796512	0.112351	7.089475	0.0000
T	-0.000993	0.000753	-1.319320	0.1906
MA(1)	0.131330	0.198979	0.660022	0.5110

R-squared	0.973354	Mean dependent var	12.20454
Adjusted R-squared	0.971805	S.D. dependent var	0.059209
S.E. of regression	0.009942	Sum squared resid	0.008501
Durbin-Watson stat	1.580446	Second-Stage SSR	1.187805
Inverted MA Roots	-.13		

Table A8.3.2 2SLS Estimates of Tasmania Employed Hours from Quarterly Time Series

Dependent Variable: LOG(HRS)
Method: Two-Stage Least Squares
Date: 30/07/09 Time: 05:39
Sample (adjusted): 1985Q3 2008Q1
Included observations: 91 after adjustments
Convergence achieved after 3 iterations
Newey-West HAC Standard Errors & Covariance (lag truncation=3)
MA Backcast: 1985Q2
Instrument list: LOG(Q(-2)) LOG(G(-1)) LOG(G(-2)) LOG(G) LOG(HRS(-2)) LOG(W(-2)) T
Lagged dependent variable & regressors added to instrument list

	Coefficient	Std. Error	t-Statistic	Prob.
LOG(W)	-0.236868	0.296190	-0.799716	0.4261
LOG(Q)	0.594896	0.393594	1.511446	0.1344
C	5.986625	2.986876	2.004310	0.0482
LOG(HRS(-1))	-0.031733	0.484534	-0.065492	0.9479
T	-0.003832	0.002299	-1.666713	0.0993
MA(1)	0.002284	0.510228	0.004477	0.9964

R-squared	0.540061	Mean dependent var	8.804251
Adjusted R-squared	0.513006	S.D. dependent var	0.060193
S.E. of regression	0.042006	Sum squared resid	0.149981
F-statistic	20.25576	Durbin-Watson stat	2.025583
Prob(F-statistic)	0.000000	Second-Stage SSR	0.147385
Inverted MA Roots	-.00		

Table A8.3.3 2SLS Estimates for Panel Data with Random Effects

Dependent Variable: LOG(E)
Method: Panel Two-Stage EGLS (Cross-section random effects)
Date: 12/08/09 Time: 00:28
Sample: 1992 2008 IF E>1 AND E(-1)>1 AND E(-2)>1 AND AWE>1 AND AWE(-2)>1
Periods included: 15
Cross-sections included: 442
Total panel (unbalanced) observations: 6047
Swamy and Arora estimator of component variances
Period SUR (PCSE) standard errors & covariance (d.f. corrected)
Instrument list: C LOG(Q(-2)) LOG(G) LOG(G(-1)) LOG(G(-2)) LOG(E(-2)) PR100 LOG(AWE(-2)) T*@EXPAND(IND) T^2*@EXPAND(IND) @EXPAND(ANZSIC)

	Coefficient	Std. Error	t-Statistic	Prob.
LOG(AWE)	-0.094102	0.053519	-1.758299	0.0787
LOG(Q)	0.078673	0.036675	2.145124	0.0320
LOG(E(-1))	0.724072	0.012626	57.34869	0.0000
PR100	-0.004225	0.001567	-2.695472	0.0070
C	1.395511	0.205018	6.806784	0.0000

Effects Specification

	S.D.	Rho
Cross-section random	1.945246	0.9571
Idiosyncratic random	0.411616	0.0429

Weighted Statistics

R-squared	0.540381	Mean dependent var	0.278821
Adjusted R-squared	0.540076	S.D. dependent var	0.586758

S.E. of regression	0.397926	Sum squared resid	956.7209
F-statistic	682.4519	Durbin-Watson stat	1.930858
Prob(F-statistic)	0.000000	Second-Stage SSR	1433.767
Instrument rank	483.000000		

Unweighted Statistics

R-squared	0.862973	Mean dependent var	5.010690
Sum squared resid	2348.036	Durbin-Watson stat	0.786739
Second-Stage SSR	2825.082		

Table A8.3.4 2SLS Estimates for Panel Data with Fixed Effects

Dependent Variable: LOG(E)
Method: Panel Two-Stage Least Squares
Date: 12/08/09 Time: 00:23
Sample: 1992 2008 IF E>1 AND E(-1)>1 AND E(-2)>1 AND AWE>1 AND AWE(-2)>1
Periods included: 15
Cross-sections included: 442
Total panel (unbalanced) observations: 6047
Period SUR (PCSE) standard errors & covariance (d.f. corrected)
Instrument list: C LOG(Q(-2)) LOG(G) LOG(G(-1)) LOG(G(-2)) LOG(E(-2)) PR100 LOG(AWE(-2)) T*@EXPAND(IND) T^2*@EXPAND(IND) @EXPAND(ANZSIC)

	Coefficient	Std. Error	t-Statistic	Prob.
LOG(AWE)	-0.119446	0.064090	-1.863728	0.0624
LOG(Q)	0.104553	0.044148	2.368223	0.0179
LOG(E(-1))	0.711118	0.013993	50.82017	0.0000
PR100	-0.004694	0.001760	-2.667086	0.0077
C	1.507112	0.224928	6.700407	0.0000

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.944520	Mean dependent var	5.010690
Adjusted R-squared	0.940112	S.D. dependent var	1.683505
S.E. of regression	0.411989	Sum squared resid	950.6855
F-statistic	138.4998	Durbin-Watson stat	1.913435
Prob(F-statistic)	0.000000	Second-Stage SSR	1427.505
Instrument rank	483.000000		

Table A8.3.5 2SLS Estimates for Panel Data with Fixed Effects with Industry Specific Wage and Workers Compensation Premium Effects

Dependent Variable: LOG(E)

Method: Panel Two-Stage Least Squares
Date: 09/08/09 Time: 21:14
Sample: 1992 2008 IF E>1 AND E(-1)>1 AND E(-2)>1 AND AWE>1 AND AWE(-2)>1
Periods included: 15
Cross-sections included: 442
Total panel (unbalanced) observations: 6047
Cross-section SUR (PCSE) standard errors & covariance (d.f. corrected)
Instrument list: C LOG(Q(-2)) LOG(G) LOG(G(-1)) LOG(G(-2)) LOG(E(-2)) PR100*@EXPAND(IND) LOG(AWE(-2))*@EXPAND(IND) T *@EXPAND(IND) T^2*@EXPAND(IND) @EXPAND(ANZSIC)

	Coefficient	Std. Error	t-Statistic	Prob.
C	1.448587	0.292585	4.950995	0.0000
LOG(AWE)*(IND="A")	-0.045330	0.081662	-0.555101	0.5788
LOG(AWE)*(IND="B")	-0.487972	0.260827	-1.870867	0.0614
LOG(AWE)*(IND="C")	-0.314722	0.083612	-3.764092	0.0002
LOG(AWE)*(IND="D")	0.804405	0.232850	3.454605	0.0006
LOG(AWE)*(IND="E")	0.005615	0.157987	0.035540	0.9717
LOG(AWE)*(IND="F")	-0.034341	0.073256	-0.468780	0.6392
LOG(AWE)*(IND="G")	0.281708	0.123823	2.275095	0.0229
LOG(AWE)*(IND="H")	-0.077860	0.179880	-0.432843	0.6651
LOG(AWE)*(IND="I")	-0.113262	0.211074	-0.536602	0.5916
LOG(AWE)*(IND="J")	0.080628	0.306731	0.262861	0.7927
LOG(AWE)*(IND="K")	0.007405	0.137950	0.053680	0.9572
LOG(AWE)*(IND="L")	0.292274	0.177743	1.644358	0.1002
LOG(AWE)*(IND="M")	-0.231774	0.322806	-0.717999	0.4728
LOG(AWE)*(IND="N")	-0.191414	0.178743	-1.070888	0.2843
LOG(AWE)*(IND="O")	0.142557	0.146849	0.970776	0.3317
LOG(AWE)*(IND="P")	-0.047116	0.106377	-0.442912	0.6578
LOG(AWE)*(IND="Q")	0.149554	0.146943	1.017770	0.3088
LOG(Q)	0.081384	0.048438	1.680171	0.0930
LOG(E(-1))	0.690151	0.055848	12.35772	0.0000
PR100*(IND="A")	-0.018936	0.011670	-1.622582	0.1047
PR100*(IND="B")	-0.029689	0.026179	-1.134057	0.2568
PR100*(IND="C")	-0.006365	0.001846	-3.447470	0.0006
PR100*(IND="D")	0.071966	0.056563	1.272312	0.2033
PR100*(IND="E")	-0.022562	0.020403	-1.105823	0.2689
PR100*(IND="F")	0.022545	0.033636	0.670269	0.5027
PR100*(IND="G")	0.049287	0.024469	2.014262	0.0440
PR100*(IND="H")	-0.025924	0.034545	-0.750425	0.4530
PR100*(IND="I")	-0.032840	0.018725	-1.753771	0.0795
PR100*(IND="J")	-0.024571	0.072179	-0.340419	0.7336
PR100*(IND="K")	-0.009948	0.034858	-0.285375	0.7754
PR100*(IND="L")	0.061079	0.024943	2.448732	0.0144
PR100*(IND="M")	-0.014462	0.031367	-0.461060	0.6448
PR100*(IND="N")	0.081006	0.032463	2.495347	0.0126
PR100*(IND="O")	-0.006821	0.027133	-0.251407	0.8015
PR100*(IND="P")	-0.064644	0.026285	-2.459379	0.0139
PR100*(IND="Q")	-0.004672	0.013817	-0.338128	0.7353

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.943571	Mean dependent var	5.010690
Adjusted R-squared	0.938738	S.D. dependent var	1.683505
S.E. of regression	0.416687	Sum squared resid	966.9336
F-statistic	130.9560	Durbin-Watson stat	1.860598
Prob(F-statistic)	0.000000	Second-Stage SSR	1402.626
Instrument rank	515.000000		

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