CHAPTER 15

Modelling the Impact of the Accord on Wage Inflation

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Introduction

In 1972, Australia's inflation rate was 6.2 per cent, but following the first OPEC oil shock in 1974, aided by some large wage increases, the inflation rate reached 17 per cent in 1975. By the end of the 1970s, despite a period of subdued activity and rising unemployment, the inflation rate was still high in relation to our trading partners at 9.2 per cent. The wage increases that followed the breakdown of the period of wage indexation in the early 1980s pushed the inflation rate, once again above 10.4 per cent, and provided the background to the introduction of the Accord in 1983. At that time, the unemployment rate and the inflation rate were at around 10 per cent due to the sluggish economy.

The Accord period in Australia was associated with strong employment and GDP growth from 1983-84 to 1989-90 (with the help of an expansionist Labour Government), negative growth during the recession, and then a strengthening recovery after 1993-94. For the period 1984-85 to 1994-95, Australia's total employment growth per annum averaged 2.19 per cent, while the corresponding growth per annum for the OECD countries in total was 1.05 per cent. For the 1984-85 to 1989-90 period of expansion, the Australian figure was 3.43 per cent compared to 1.65 per cent for the OECD. Over the recession of 1990-91 to 1994-95, Australia's employment growth was 0.70 per cent per annum compared to the OECD outcome of 0.33 per cent per annum.

Mitchell (1987) found that there were constraining effects on wages growth in Australia as a result of imposing wage fixing guidelines. Watts and Mitchell (1990) updated and extended this study to estimate the effects of the first three stages of the Accord (up until the third quarter of 1988). They found (1990, p. 160) 'that the different eras of wage-fixing guidelines can be statistically differentiated and are robust across different specifications. Except for the third and fourth phases of the guidelines … which signalled the end of centralised wage fixation in 1981, incomes policy successfully imposed a negative trend on the growth of real earnings …'.

They also found no evidence of the 'existence of a conventional Phillips Curve relating inflation to unemployment ... the annual growth of real weekly earnings is largely independent of conventional excess demand proxies and is strongly influenced by the prevailing institutional arrangements for wage fixing' (p. 161).

Chapman and Gruen (1990) compare all the empirical work to that time which estimated the impacts of the Accord on wage inflation. They concluded that on balance the Accord had reduced the growth of nominal wage inflation.

With the Accord now history, this chapter updates the econometric modelling to assess the extent to which it influenced the path of wage and price inflation. A model is estimated to test for cointegration as the first stage in modelling an error-correction representation of the wage-setting dynamics. This is an advance on the work of Watts and Mitchell (1990) and Mitchell (1987) in that the modelling explicitly considers the possibility of integrated data.

In Australian wage setting, the period 1968(3) to 1996(1) has been dominated by incomes policy with several distinct phases of wage fixation. Table 15.1 describes the phases and the specification of the econometric variables.

Table 15.1: Wage Setting Phases in Australia, 1968 Q3 to 1996 Q1

Wage setting regime	Model Variable	Impact Dates
Decentralised Collective Bargaining	No variable	1968 Q3 to 1975 Q1
Full Indexation	IP1	1975 Q2 to 1976 Q2
Plateau Indexation	IP2	1976 Q3 to 1978 Q2
Partial Indexation	IP3	1978 Q3 to 1979 Q3
Partial Indexation	IP4	1979 Q4 to 1981 Q2
Decentralised Collective Bargaining	No variable	1981 Q3 to 1982 Q4
Wages Pause	Wage Pause	1983 Q1 to 1983 Q2
Accord		
Full Indexation	Mark I	1983 Q3 to 1985 Q1
Partial Indexation	Mark II	1985 Q2 to 1987 Q1
Restructuring and Efficiency Principle	Mark III	1987 Q2 to 1988 Q3
Structural Efficiency Principle	Mark IV	1988 Q4 to 1989 Q1
Structural Efficiency Principle	Mark V	1989 Q2 to 1990 Q1
Structural Efficiency	Mark VI	1990 Q2 to 1993 Q2
Enterprise Bargaining and Safety Net	Mark VII	1993 Q2 to 1995 Q3
Enterprise Bargaining and Safety Net	Mark VIII	1995 Q4 to 1996 Q2

It is also useful to compare the relationship between price inflation and unemployment in Australia (Figure 16.1) with the relationship between wage

inflation and unemployment over the same period (Figure 15.2). All data are described in Appendix B. There are two periods of instability evident in both Figures: the mid 1970s following the first OPEC oil shock and again in the early 1980s. An additional feature which emerges (comparing Figures 15.1 and 15.2) is that the instability in the mid 1970s implicated both wage and price inflation, but although there was some large wage rises in the early 1980s, the wage inflation quickly diminished around the time the Accord was initiated, but the surge in price inflation persisted for two more years. This behaviour supports the hypothesis that significant wage moderation accompanied the introduction of the Accord.

Figure 15.1: Australia Phillips Curve – Unemployment Rate and Inflation, 1970-1995

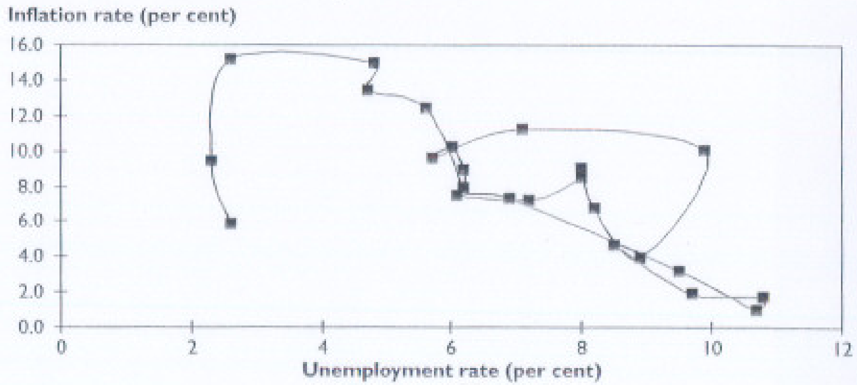
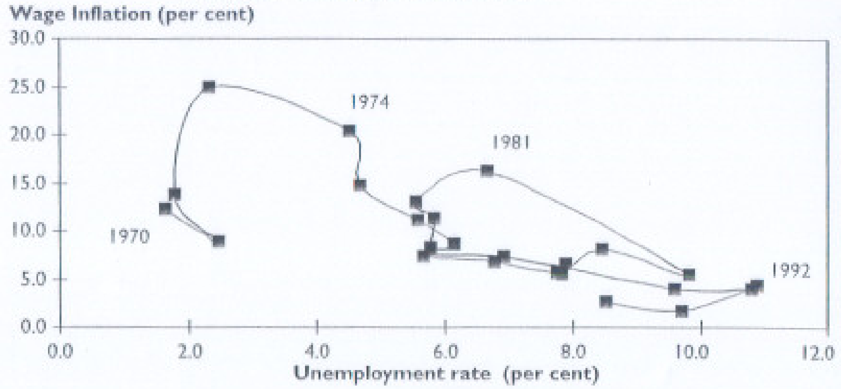


Figure 15.2: Australia Phillips Curve – Unemployment Rate and Annual Percentage Change in Average Weekly Earnings, 1970-1995



Modelling the Accord

Time series properties of data

The data is quarterly and is filtered for deterministic seasonality. All analysis is in terms of the logarithm. Appendix 15.B describes the data.

Table 15.2 displays the sample autocorrelations for all the data in levels, seasonal differences, and the first-difference of the seasonal difference. They are a preliminary guide to assist our interpretation of the more formal unit root tests.

Table 15.2: Sample Autocorrelation Functions for 1966(3)-1996(1)+

Series	Lag									
	1	2	3	4	5	6	7	8	9	10
LAWE	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Δ_4LAWE	0.91	0.80	0.67	0.58	0.56	0.52	0.48	0.40	0.34	0.28
$\Delta\Delta_4$LAWE	0.11	0.08	-0.16	-0.43	0.09	0.02	0.17	-0.07	-0.01	-0.16
LP	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Δ_4LP	0.96	0.90	0.83	0.73	0.66	0.59	0.52	0.47	0.43	0.39
$\Delta\Delta_4$LP	0.21	0.15	0.27	-0.29	-0.11	-0.03	-0.22	-0.08	-0.05	-0.03
LGUT	0.84	0.73	0.62	0.49	0.33	0.21	0.08	-0.01	-0.10	-0.12
Δ_4LGUT	0.69	0.49	0.30	-0.05	-0.10	-0.19	-0.30	0.30	-0.30	-0.27
LUR	0.99	0.98	0.96	0.94	0.92	0.91	0.89	0.88	0.87	0.87
Δ_4LUR	0.85	0.61	0.30	-0.03	-0.22	-0.32	-0.32	-0.21	-0.07	0.03
$\Delta\Delta_4$LUR	0.28	0.26	0.09	-0.49	-0.32	-0.31	-0.34	-0.07	0.12	0.08
LPROD	0.99	0.99	0.99	0.99	0.99	0.99	0.98	0.98	0.98	0.97
Δ_4LPROD	0.59	0.39	0.22	0.01	0.11	0.15	0.07	-0.01	-0.09	-0.18
$\Delta\Delta_4$LPROD	-0.24	-0.06	0.05	-0.37	0.06	0.15	0.00	0.00	0.00	-0.25

Note: + sample is for the level and is appropriately shortened to take into account the differencing.

There is considerable variation in the sample correlations shown. The price variables (LAWE and LP) reveal similar patterns, with the level of each showing very pronounced inertia. The ACF of a random walk exhibits behaviour similar to this (see Nelson and Plosser, 1982, p. 147). The seasonal difference for both variables also decay slowly and it is not until this difference is first-differenced do the lags drop off rapidly and resemble a stationary series. All the levels of the other variables appear to be non-stationarity. However, it seems that seasonal differencing results in ACFs which decay fairly quickly.

We now turn to more formal analysis using unit root testing (Appendix 15.B outlines the testing framework). To capture the successive wage and price adjustment patterns of the Australian wage setting system, four-quarter log

changes are preferred *a priori*. This raises the issue of seasonal integration. We test whether there are seasonal roots in the time series using the Dickey-Hasza-Fuller (1984) test and the critical values available in their Table 7. If we cannot reject the hypothesis of seasonal integration we then whether the seasonal difference (for example, $\Delta_4 w = w_t - w_{t-4}$) is stationary, that is, that the levels are $SI_4(0, 1)$. If that hypothesis is rejected, we proceed to test whether the first-difference of the seasonal difference (defined as $\Delta\ \Delta_4 w = [w_t - w_{t-4}] - [w_{t-1} - w_{t-5}]$) is stationary, that is, that the levels are $SI_4(0, 1)$. The last two tests employ the standard Augmented Dickey-Fuller test.

Table 15.3 reports the test statistics. The hypothesis that the series in levels are $SI_4(0, 0)$ is rejected in all cases, except there is conflicting evidence relating to LP. On balance, LP is assumed to be non-stationary. The critical value for the DHF for 80 observations is -4.11 at the 5 per cent level. Further testing suggests that we reject the $SI_4(0, 1)$ hypothesis for LAWE and LP but accept it for LGUT, LUR and LPROD. After first-differencing the annual difference, we can then accept the hypothesis that the levels of LAWE and LP are $SI_4(1, 1)$.

Table 15.3: Unit Root Statistics

Variable	T+	DHF[1]	ADFSI[2]	ADF[3]					Conclusion
				no constant or trend	k	with constant and trend	k	with constant	
LAWE	111	0.35	1.513		5	-0.65	5	-2.41	
Δ_4LAWE				-1.954	5	-2.94	5	-1.93	
$\Delta\Delta_4$LAWE				-5.09	4	-5.06	4	-5.07	**
LP	108	-5.76	-2.47		4	-1.07	4	-2.07	
Δ_4LP				-0.77	4	-2.36	4	-1.72	
$\Delta\Delta_4$LP				-5.16	3	-5.98	3	-5.86	**
LGUT	108	-3.87	-1.91		4	-3.14	0	-2.85	
Δ_4LGUT				-4.11	4	-4.13	4	-4.10	**
$\Delta\Delta_4$LGUT				-6.36					
LUR	108	0.92	1.46		2	-2.27	2	-1.97	
Δ_4LUR				-3.23	4	-3.69	4	-3.49	**
$\Delta\Delta_4$LUR				-7.70					
LPROD	108	-3.48	-3.37		1	-1.32	1	-1.96	
Δ_4LPROD				-2.23	4	-3.63	4	-3.17	**
$\Delta\Delta_4$LPROD				-7.71					

Notes: 1. DHF is the Dickey-Hasza-Fuller (1984) test outlined in Appendix 15.B.
2. ADFSI is the Augmented Dickey-Fuller Seasonal Integration test outlined in Appendix 15.B.
3. ADF is the Augmented Dickey-Fuller test.
+ sample is 1969(2)-1996(1) for all variables. ** indicates stationary

This means that a cointegration relationship can be explored between Δ_4LAWE, Δ_4LP, LGUT, LPROD and LUR. This is interesting because it means that the cointegration regression will be estimating an equilibrium or steady-state wage inflation model rather than the level of average weekly earnings.

The Model

Given that that LAWE and LP were found to be $SI_4(1, 1)$ and the activity variables and productivity were $SI_4(0, 1)$, the cointegration regression, following Engle-Granger (1987),[1] is specified as:

$$\Delta_4 LAWE_t = \beta_0 + \beta_1 \Delta_4 LP_t + \sum_{j=0}^{m} \beta_{2j} LZ_{j_t} + \sum_{j=1}^{13} \rho_j IP_j + \varepsilon_{1t}$$

where $\Delta_4 LAWE$ is the seasonal-difference of the log of average weekly earnings, $\Delta_4 LP$ is the seasonal-difference of the log of the consumer price index, LZ_j is the log of the j[th] variable which may impact on wage inflation (including LGUT – the log of capacity utilisation and LPROD – the log of non-farm GDP per hour worked by non-farm wage and salary earners), IP_j is the j[th] dummy variable designed to capture the periods of incomes policy in Australia.

The dynamic error correction model which corresponds to the cointegration model is specified as:

$$\Delta\Delta_4 LAWE = \beta_0 + \sum_{j=1}^{k} \beta_{1j} \Delta\Delta_4 LAWE_{t-j} + \sum_{j=0}^{k} \beta_{2j} \Delta\Delta_4 LP_{t-j} + \sum_{j=0}^{k} \beta_{3j} \Delta_4 LZ_{t-j}$$
$$+ \sum_{j=1}^{13} \rho_j IP_j + \delta ECM_{t-1} + \varepsilon_{2t}$$

where $\Delta\Delta_4 LAWE$ is the first-difference of the four-quarter change in average weekly earnings, $\Delta\Delta_4 LP$ is the corresponding change in the consumer price index, and ECM is the error-correction term derived from the residuals of the Cointegrating regression and δ is the adjustment parameter. All other variables and changes are self explanatory.

1. Johansen (1988) ML procedure was employed given the possibility that wage inflation and price inflation would form a system with more than one cointegrating relation. The results could not reject the hypothesis that there were two cointegrating vectors, using the maximal eigenvalue test. However, one of the vectors made no economic sense and so it was concluded that one distinct vector exists.

Cointegration Tests

Several variables were considered as possible candidates for the vector Z – the unemployment rate, the vacancy rate, and the rate of overtime, in addition to productivity and capacity utilisation (see Mitchell, 1987; and Watts and Mitchell, 1990 for a discussion). Significantly, no cointegrating relationship could be found between the wage and price inflation variables and the log of the unemployment rate, even when other variables were added.

Table 15.4 presents the final estimates with $\Delta_4 LAWE$ as the normalising variable:

Table 15.4: Cointegration Regression Estimates

Variable	Parameter Estimate	t-statistic
Constant	0.327	2.08
D4LP	0.857	8.60
IP1	-0.015	1.21
IP2	-0.043	4.08
IP3	-0.057	4.34
IP4	-0.035	2.92
Wage Pause	-0.053	2.55
Mark I	-0.048	3.16
Mark II	-0.082	5.71
Mark III	-0.080	4.99
Mark IV	-0.065	2.97
Mark V	-0.082	4.67
Mark VI	-0.048	2.89
Mark VII	-0.081	3.92
Mark VIII	-0.087	3.88
LGUT	0.372	2.24
LPROD	0.070	1.73
TD1	0.067	2.72

Sample 1967 Q3 to 1996 Q1

$R^2 = 0.82$ s.e. = 0.02 DW = 0.99

Table 15.5 shows the results of the ADF tests on the residuals of this equation and confirm that they are stationary at the 1 per cent level of significance. The results were unaffected when the trend and constant were deleted from the auxiliary regression.

Table 15.5: ADF Tests on Cointegration Residuals

Lag in Augmented Dickey-Fuller Regression	t-statistic in ADF
5	4.2612
4	4.7392
3	6.4652
2	6.9216
1	6.3908
0	5.8484

Critical values: 1 per cent = -4.044
A constant and trend were included.

The estimates from the cointegrating regression are biased but super consistent. The extent of the small-sample bias is related to (1 - R^2) of the cointegrating regression, which suggests that in our case the bias is not large (Banerjee *et al*., 1986). However, following Engle and Yoo (1989), we know that that the distribution of the estimators of the cointegrating vector are usually non-normal and this prevents inferences being drawn about the significance of the parameters.

Given our objective is to determine whether the introduction of incomes policies in Australia moderated wage inflation and to see if there is a difference in the impact of the various regimes specified, we have to wait until the dynamic error-correction model is estimated, before we perform a correction to the parameters in the cointegrating vector which will allow inference.

Dynamic Error Correction Model

A general-to-specific modelling approach was employed. In the general model, k was set at 4 for all variables. The initial model was estimated over the period 1969(1) to 1996(1) and satisfied the requirement that the residuals were white noise. The general model therefore serves as an appropriate benchmark for further simplification.[2]

The first simplification took the form of 24 zero restrictions. Testing the reduction restrictions yielded an F(24, 74) = 0.823, making the simplification

2. The F(5, 69) test for first to fifth-order autocorrelation was 1.48, the F(4, 66) for fourth-order ARCH was 0.28, the Normality Chi^2(2) was 0.65, and the RESET F(1, 73) was 0.57.

valid. The model now looked like:

$$\Delta\Delta_4 LAWE_t = \alpha_1 + \alpha_2 \Delta\Delta_4 LAWE_{t-2} + \alpha_3 \Delta\Delta_4 LAWE_{t-4} + \alpha_4 \Delta\Delta_4 LP_t + \alpha_5 \Delta_4 LGUT_t + \alpha_6 \Delta_4 LGUT_{t-1} + \alpha_7 \Delta_4 LPROD_{t-4} + \alpha_8 IP2 + \alpha_9 WagePause + \alpha_{10} TD1 + \delta ECM_{t-1} + u_t$$

Estimates from this model then suggested the following restrictions which would allow further simplification in accord with economic sense:

$\alpha 2 = -\alpha 3$
$\alpha 5 = -\alpha 6$
$\alpha 7 = 0$

The restrictions were imposed and accepted F(27, 74) = 0.766 (in comparison with the general model).

The final restricted form is (absolute t statistics in parentheses):

Sample: 1969 Q1 to 1996 Q1

$\Delta\Delta_4$LAWE	= 0.00	+ 0.288$\Delta_2\Delta\Delta_4$LAW(-2)	+ 0.355$\Delta\Delta_4$LP	+ 0.227$\Delta\Delta_4$LGUT
	(0.56)	(6.65)	(2.99)	(3.07)
		– 0.491ECM(-1)	– 0.011IP2	– 0.039Wage Pause
		(8.59)	(2.25)	(4.33)
		+ 0.073TD1		
		(5.74)		

R^2 = 0.66 s.e. = 0.012 RSS = 0.016

Test for first to fifth-order serial correlation: F(5, 96) = 1.89
Test for fourth-order ARCH: F(4, 93) = 0.81
Test for Normality: $\chi^2(2)$ = 1.51
RESET: F(1,100) = 1.65
Predictive Failure: F(4, 97) = 0.79
Predictive Failure: F(8, 93) = 0.71

The dynamic model contains a strong error-correction component. All the signs are meaningful and the magnitudes of the parameters are plausible. Diagnostically, the equation performs very well, exhibiting no problems of serial correlation, heteroscedasticity, or functional form mis-specification. Two predictive failure tests were performed (4 forecast periods, and 8 forecast periods) and the F statistics from Chow indicate no instability.

We might be concerned about the independence (or in fact, lack of correlation) of the regressors, $\Delta\Delta_4$LP and $\Delta\Delta_4$LGUT and the disturbance term in the dynamic model. A Hausman-Wu test was performed for each (using two lags of each as instruments in the relevant auxiliary regression) and the LM test statistic was insignificant [F(2, 99) = 0.069] indicating that we can consider $\Delta\Delta_4$LP and $\Delta\Delta_4$LGUT to be weakly exogenous.

In choosing AWE as the measure of earnings it is acknowledged in Appendix 15.A that a more appropriate measure of unit labour cost would be average hourly earnings (AHE) which is the ratio of AWE to average weekly hours. Its use raises the possibility, however, that variation in the pressure variable might influence AHE, not directly through moderating wage demands but indirectly due to inertia of AWE in response to quantity adjustments by firms (that is, variations in hours worked). Accordingly, an added variable test was performed by adding $\Delta\Delta_4$AWH. The insignificant t-statistic confirms the predominance of quantity adjustments over price adjustments (see Okun, 1981).

In summary, the dynamic model shows that the fluctuations in wage inflation around the conditional steady-state wage inflation rate is heavily conditioned by the error-correction mechanism. The incomes policy variables do not, in general, impact on the quarterly variation in the annual wage inflation rate. Their role seems confined to the annual change in wage inflation.

Correcting the First Stage Estimates

We follow the method set out by Engle and Yoo (1989) to correct the parameter estimates from the first stage cointegration regression. While the method was proposed for an unrestricted multivariate system, it can be applied to advantage in the case of a single cointegrating vector. The third step follows the estimation of the dynamic error-correction model. The final second-stage model is:

$$\Delta\Delta_4 LAWE_t = \alpha_1 + \alpha_2\Delta_2\Delta\Delta_4 LAWE_{t-2} + \alpha_3\Delta\Delta_4 LP_t + \alpha_4\Delta\Delta_4 LGUT_t + \alpha_5 IP2 + \alpha_6 WagePause + \alpha_7 TD1 + \delta ECM_{t-1} + e_{2t}$$

We form an auxiliary regression by multiplying all the conditioning variables in the first-stage cointegrating regression (X_t) by $-\delta$ and regress them on the residuals from the second-stage model, e_{2t}. The coefficients from the auxiliary regression are the corrections to the parameter estimates and the standard errors are the appropriate standard errors for inference. This allows us to test whether the income policy parameters are significantly negative.

The corrected parameter estimates are calculated by adding the original parameters on the conditioning variables to the parameters on the new variables ($-\delta X_t$) in the third-stage regression. The correct t-statistics are calculated from the standard errors in the third-stage regression in relation to the corrected parameter estimates. Table 15.6 reports the results and provides the corrected t-statistics.

Table 15.6: Corrected parameter estimates and t statistics

Variable	First Stage Parameter Estimates	Third Stage Parameter Estimates	Corrected Parameter Estimates	Third Stage Standard Errors	Corrected t-statistics
Constant	0.327460	0.0952260	0.422686	0.100260	4.22
D4LP	0.857440	-0.1365500	0.720890	0.113900	6.33
IP1	-0.146940	-0.0047944	-0.151734	0.013696	11.08
IP2	-0.042676	-0.0003441	-0.043020	0.011763	3.66
IP3	-0.056640	-0.0130700	-0.069710	0.014816	4.71
IP4	-0.035049	-0.0006863	-0.035735	0.013824	2.59
Wage Pause	-0.053124	0.0031676	-0.049956	0.023475	2.13
Mark I	-0.048461	-0.0170090	-0.065470	0.017428	3.76
Mark II	-0.082058	-0.0147690	-0.096827	0.016868	5.74
Mark III	-0.080008	-0.0181640	-0.098172	0.019141	5.13
Mark IV	-0.065382	0.0050966	-0.060285	0.026117	2.31
Mark V	-0.082330	-0.0280450	-0.110375	0.021587	5.11
Mark VI	-0.048417	-0.0219930	-0.070410	0.019420	3.63
Mark VII	-0.080763	-0.0353560	-0.116119	0.024775	4.69
Mark VIII	-0.087459	-0.1729900	-0.260449	0.027114	9.61
LGUT	0.371730	0.1664800	0.538210	0.209430	2.57
LPROD	0.070117	0.0472690	0.117386	0.053030	2.21
TD1	0.067293	0.0072768	0.074570	0.027804	2.68

The incomes policy variables are all highly significant and negative. In general, the Accord period exerted a much stronger downward influence on annual wages growth than the earlier period of incomes policy. The different phases are all robustly defined.

Conclusion – The Way Ahead

The experience for Australia is that incomes policy exert a strong moderating influence on the annual wages growth and insofar as this pushes against inflation, it provides more 'room' for governments to stimulate their economies. The only thing stopping governments is the will to do it.

But the way ahead is not so simple. One can no longer assume that a solution to the inflation constraint and a revival of social democratic budgetary ideals will allow sustainable low levels of unemployment to be achieved. A new set of constraints has become apparent in the last few decades although it is out of the realm of orthodox economic analysis.

A strong case can be made to support the argument that environmental constraints are now so relevant that the global economy cannot support levels of aggregate demand sufficient to fully employ the available workforces. This is the challenge that governments will have to face.

The solution appears however to lie in the role of the government as an employer. The capitalist system has cast aside the long-term unemployed and rendered then 'valueless' in terms of their contribution to production. The social costs of this are enormous and threatening. The role of the government given the environmental constraint has to lie in getting 'value' out of the long-term unemployed via government employment schemes which will be in harmony with the natural environment.

This will require considerable re-orientation of the way we think about employment and government. Unfortunately, we are some way from that change.

Appendix 15.A – Data Description and Discussion

Data is drawn from two main sources. The DX Data base (principally the ABS NIF-10 Databank) and the OECD Main Economic Indicators and country-specific data sources.

In terms of the regression model:

LAWE	log of average weekly earnings of non-farm wage and salary earners.
LP	log of consumer price index weighted average of 8 capital cities.
LGUT	log of capacity utilisation.
LPROD	log of real non-farm gross domestic product per unit of hours worked by non-farm wage and salary earners.

The choice of average weekly earnings as the dependent variable is discussed in Mitchell (1987) and Watts and Mitchell (1990). To focus on unit labour costs and hence the price level, it would be natural to use the growth in earnings per hour as the dependent variable. This would overcome the problem noted by Gregory (1986, s.73) of spurious correlation between average weekly earnings and labour utilisation rates within the firm.

Using average weekly earnings however, overcomes several difficulties that are encountered when the earnings per hour variable is used. Notable among these is that the dependent variable then becomes a ratio of two variables, each of which may be positively correlated with the excess demand pressures. As a result, the sign of the pressure variable in an hourly earnings equation is ambiguous. The homogeneity of earnings with respect to hours worked is a separate issue, not without interest, as it allows insights into the relative price and quantity adjustments that firms might employ as economic activity changes, the possible direct and indirect influences of variations in activity on inflation need to be more explicitly estimated. For these reasons, the quantity/price trade-offs are estimated by including average weekly hours as an added variable in the model.

The chosen form for the dependent variable, $\Delta_4 x_t = x_t - x_{t-4}$ is also discussed in Mitchell (1987) and Watts and Mitchell (1990). The form is preferred *a priori* because this pattern more adequately captures the successive wage and price adjustment patterns of the Australian wage setting system. The claim that this form introduces serial correlation is an econometric issue and should not necessarily guide the appropriate specification prior to testing. The model should attempt to capture the known characteristics of the data generating process.

The use of the $D_4 x_t$ raises interesting issues for unit root testing and cointegration modelling. Given that the variance for a fourth difference is larger than the variance for the first difference, the Dickey-Fuller procedure has to be modified to test for unit roots in this case. The literature on seasonal and non-seasonal unit roots is relevant here (see Dickey, Hasza, Fuller, 1984; Hylleberg *et al*, 1990).

Appendix 15.B – Testing the Orders of Integration

The preferred specification of the wage adjustment and price adjustment models takes the form of annual changes using quarterly data. The Dickey-Hasza-Fuller (1984) Testing Models:

To test H_0: $x_t \sim SI(0, 1)$ against
H_1: $x_t \sim SI(0, 0)$

We test for significant negativity in δ in the following model:

$$\Delta_4 x_t = \delta z_{t-4} + \sum_{i=1}^{k} \alpha_i \Delta_4 x_{t-i} + \varepsilon_t$$

where $z_t = x_t - \sum_{i=1}^{k} \phi_i x_{t-i}$

and f_i is the i^{th} coefficient in a regression of $D_4 x_t$ on its k lagged values.

An alternative approximate test is to use an Augmented Dickey-Fuller model like:

$$\Delta_4 x_t = \delta x_{t-4} + \sum_{i=1}^{k} \alpha_i \Delta_4 x_{t-i} + \varepsilon_t$$

and test for significant negativity in d.

To test H_0: $x_t \sim SI(1, 1)$ against
H_1: $x_t \sim SI(0, 1)$

We test for significant negativity in δ in the following model using an ADF criteria:

$$\Delta\Delta_4 x_t = \delta \Delta z_{t-1} + \sum_{i=1}^{k} \alpha_i \Delta\Delta_4 x_{t-i} + \varepsilon_t$$

If stationarity is not found at this stage, the next step is to test:

H_0: $x_t \sim SI(2, 1)$ against
H_1: $x_t \sim SI(1, 1)$

The ADF model then becomes:

$$\Delta\Delta\Delta_4 x_t = \delta \Delta\Delta z_{t-1} + \sum_{i=1}^{k} \alpha_i \Delta\Delta_4 x_{t-i} + \varepsilon_t$$