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The Accord and Strikes: An International Perspective

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Abstract

This exploratory paper examines the relationship between Australian and world strike activity between 1960 and 1998. Appropriate indices are constructed for which evidence of a long-run equilibrium relation is found between Australian and world strike activity. The evidence suggests Australian and world strike rate indices are cointegrated with a breakpoint in that relation occurring sometime in the very late 1960s or early 1970s. No breakpoints are in evidence before, during or after the period (1983-96) of the Accord. This result is consistent with the view that the decline in strike activity in Australia during the period of the Accord was not a singularly Australian experience.

1. Introduction

Australian studies of strike activity have traditionally focused on the relationship between working days lost due to strikes per worker and variables linked to changes in the domestic economy such as price level changes, measures of labour market demand, union density, profits and a range of shift (dummy) variables for various 'special events' (see, for example, Oxnam (1953), Bentley and Hughes (1971), Perry (1980), Beggs and Chapman (1987a) and Morris and Wilson (1994, 1995, 1999 and 2000)).

One important 'special event' was the Accord which was in place in Australia from 1983 to 1996 and involved a series of agreements between the government and the trade union movement on general wage setting practices.[1] An early study by Beggs and Chapman (1987b) estimated an approximate 60 per cent reduction in strikes attributable to the Accord while Chapman and Gruen (1990) estimated a 70 per cent reduction. Morris and Wilson (1999) argue that the Accord was associated with an approximate 40 per cent drop in the strike rate.[2] According to Morris and Wilson (1999) this drop in the strike rate appeared to continue beyond the period of the Accord, which raises the question of whether the shift effect that their study picked up was related to the Accord or to some other set of circumstances. Morris and Wilson (1999) and Chapman (1998) seem to favour the view that the sustained post-Accord decline in strike activity is attributable to '... a landscape or cultural transformation in Australian industrial relations ...' (Chapman, 1998, p.636), which was ushered in by the 13 years of the Accord.

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[1] For a review of the Accord and a selection of papers dealing with issues arising from the Accord see Wilson, Bradford and Fitzpatrick (2000).

[2] See also Morris and Wilson (1994, 1995, 2000). Morris and Wilson (2000) report results for the period 1959-96, while Morris and Wilson (1999) report results for the period 1959-97. Thus we treat Morris and Wilson (1999) to be the latest treatment of the Accord. The results of the two papers do not significantly differ.

One criticism sometimes levelled against studies that focus on local explanatory variables to explain local strikes is that international influences on local strikes are overlooked (see Moore, 1989). Beggs and Chapman (1987a and 1987c) and later Chapman and Gruen (1990) suggested the influence of international forces was not sufficient to explain the decline in strike activity in Australia.[3] However, none of these studies benefited from the inclusion of 1990s data and those studies that have employed 1990s data have not tested for an Accord effect in the presence of a relevant international variable or set of variables (see, for example, Morris and Wilson (1999). The issue of the influence of international forces is, therefore, one that warrants further attention.

The purpose of this paper is to analyse the relation, if any, between local (Australian) strike activity and world strike activity. In section 2 we establish a framework for testing the presence or otherwise of a long-term equilibrium relation between local and world strike activity drawing on, in particular, the methodology of Zivot and Andrews (1992) and Gregory and Hansen (1996a, 1996b). Section 3 applies local and world strike data to the framework established in section 2. These methodologies essentially involve techniques for sequentially testing for breakpoints in the stationarity properties of time series data. It will be seen that the tests carried out suggest the presence of a long-term equilibrium relation between local and world strike activity, as well as the presence of structural changes in that relationship. Finally, conclusions are drawn in section 4.

2. Towards a Testing Framework

International Linkages

In this paper we depart from the practice of explaining strikes in terms of domestic economic variables and assorted dummy variables. Instead we hypothesise that the dominating influence on local strike activity is world strike activity. We concede that local strike activity appears to be influenced by 'local' factors such as price changes and labour demand, particularly in the short run. However, we hypothesise that in the longer run the role of international influences overwhelm the influence of 'purely' domestic influences. An important reason for this is that apparent domestic factors such as price changes and labour demand are, we contend, largely governed by international influences, particularly in the long run.

The basis for our view on the dominating long-term influence of international factors involves recognition of all of the following considerations:

1. The local economy is relatively small, about 5 per cent the size of the world's largest economy, the US. The local economy draws heavily on international economies for its technology, cultural values and managerial practices.
2. The local economy has a well-known sensitivity to changes in the international economic climate (as well as the political and social climate). A major world recession is invariably mirrored in Australia. A major international supply shock (e.g. a 1970s-style energy shock) is similarly mirrored locally.

[3] Beggs and Chapman (1987c) found in a fourteen-country study for the period 1960-85 that, after controlling for inflation and unemployment rates, there was no statistically significant evidence of a worldwide decline in strike activity from 1983 to 1985. The Australian experience of declining strike activity during the period of the accord seemed unique until Chapman and Gruen (1990) updated Beggs and Chapman's (1987a, and 1987c) work. They extended the period of the study to 1987 and found that there was now evidence of a statistically significant decline in worldwide strike activity from 1983. However, the reduction in Australia was about twice as large as the worldwide decline, a result attributed to the Accord.

3. The local economy is strongly influenced by the practices of international corporations that play a major role locally and by locally owned international corporations that generally emulate the behaviour of international rivals.
4. The local economy is directly affected by a generalised 'demonstration' or 'role-model' effect from the global economy. This implies a small local economy will tend, over time, to emulate international practices; especially those practices that are perceived to be leading edge and worthy of copying locally.

We postulate that economies worldwide learn from the experiences, i.e. the successes and failures, of one and other. As a consequence, there is a tendency for the policies and performances of economic variables to move along broadly similar paths. In the long run, the numerous cultural, political, economic and other links between countries will ensure that the overall direction of change for countries will be, to a greater or lesser extent, comparable. Of course, some economies move in a closer relation to one another than others. Thus, for example, the USA and Canada move in a much closer relation to one another than, say, China and the USA. Larger and leading-edge economies, as well as leading-edge technologies in themselves, are major determinants of the paths all economies take in the long run.

What does all this have to do with trends in Australian strike activity? We envisage the mechanism linking Australian strike activity to overseas strike activity to be a small component of a much larger mechanism that ties all economies to one another in the longer term. Therefore, we postulate that over a long period of time (i.e. over several decades) local strike activity will tend to move along a broadly parallel path to that of world strike activity. Different world economies will be more influential than others at different times. The British economy was relatively influential during the earlier stages of the twentieth century. The US economy became more influential during the second half of the twentieth century. East Asian economies have become increasing important in recent decades. There may be occasional shifts in the relation between Australian and world strike activity as short-term forces ebb and flow, but in the long run, we contend that domestic strike activity will move in a broadly parallel fashion to some appropriately constructed indicator of world strike activity.[4]

Strike Activity and Dependency

Strike activity is defined in this paper to be the natural log of the published number of working days lost due to strikes per 10,000 employees (S). Correspondingly, the variable SA refers to strike activity (as defined) in Australia and *SW* refers to strike activity in the world. We hypothesise a long-term relation between *SA* and *SW*, with *SA* as the dependent variable. The existence or otherwise of a long-term relation between *SA* and *SW* can be established by testing to see if the two variables are cointegrated.

[4] We argue that most short-term shifts, when considered over a long time frame, turn out to be temporary disturbances. Thus, a series of strikes associated with a change in, say, government policy on medical insurance might register as an important disturbance in the short-run relation between domestic and international strike activity, but over a broader sweep of years, they would come to appear to be merely transitory disturbances.

On the other hand, if a country were to change from pursuing policies that produced world-comparable inflation rates to relatively high inflation *for a sustained period*, we might expect this policy change to generate a structural break (of one sort or another) in the relation between domestic and world strike activity - though the general relation itself would still hold.

However, we would further argue that global forces would eventually pressure the relatively high inflation economy to pursue policies that generate world-comparable inflation. In other words, we contend that the ability and inclination to pursue significantly different policies *for a sustained period* is limited. Eventually the forces that drive convergence and conformity will prevail. This hypothesised tendency for *generalised* convergence of economic behaviour over time, deals with broader issues we plan to explore further in the future.

The results of two cointegration methodologies are reported in this paper. One is the standard methodology associated with the Dickey-Fuller unit root test. The second methodology we employ is that developed by Zivot and Andrews (1992) and refined by Gregory and Hansen (1996a,b). The second methodology is used to test for the presence of breakpoints in the individual series (*SA* and *SW*) as well as the cointegrated series. In this regard, we are particularly interested in testing to determine whether the individual strike activity series had a unit root in the presence of structural breaks with unknown timing, and whether there is then any cointegrated relation between Australian and world strike activity once these breaks have been taken into consideration.

Zivot and Andrews Methodology

It is well established that the existence of cointegration between two (or more) data series implies the existence of some long-run equilibrium relationship between (amongst) these series. For instance, if SA_t and SW_t are cointegrated, then this will imply:

$$P_t = \alpha + \beta E_t + \varepsilon_t \quad \text{for } t = 1, \ldots\ldots, T \tag{1}$$

where ε_t is a stationary error process [i.e. I (0)]. Cointegration of markets, either domestically or internationally, implies the existence of common factors.

Before tests of cointegration can be undertaken it is essential to test if all variables are integrated to the same order - i.e. require the same degree of differencing so as to achieve stationarity [most economic time series are I (1)]. The most common means of testing a series for stationarity is to apply the following conventional Augmented Dickey-Fuller (ADF) regression to the data series[5]:

$$\Delta y_t = \alpha_0 + \alpha_1 y_{(t-1)} + \alpha_2 t + \sum_{j=1}^{k} \gamma_j \Delta y_{(t-j)} + \varepsilon_t \tag{2}$$

Where: *y* is the variable of interest, *t* is a trend variable, the *k* lagged differences are included to ensure a white noise error series and the number of lags is determined by a test of significance on the coefficient γ_j.

The coefficient of interest is α_1. If $\alpha_1 = 0$, then the above equation is entirely in first differences and so has a unit root. The finding of a unit root in a time series indicates non-stationarity and differencing is required to achieve a stationary series. For cointegration tests to be valid each series in a cointegrating regression should be integrated to the same order (and for cointegration to exist, a linear combination of any two series should exist which is integrated to a lower order than the individual series). The unit root hypothesis can be rejected (and the series is found to be stationary) if the test statistic is smaller than the appropriate MacKinnon (1991) critical value. A difficulty with a conventional unit root test is that, if there are structural breaks in the series, the critical value is too small (in an absolute sense) thereby resulting in the null hypothesis of a unit root being rejected too often (biasing the result).

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[5] This is the usual regression that is run for unit root tests. Note that the following two equations are equivalent expressions:

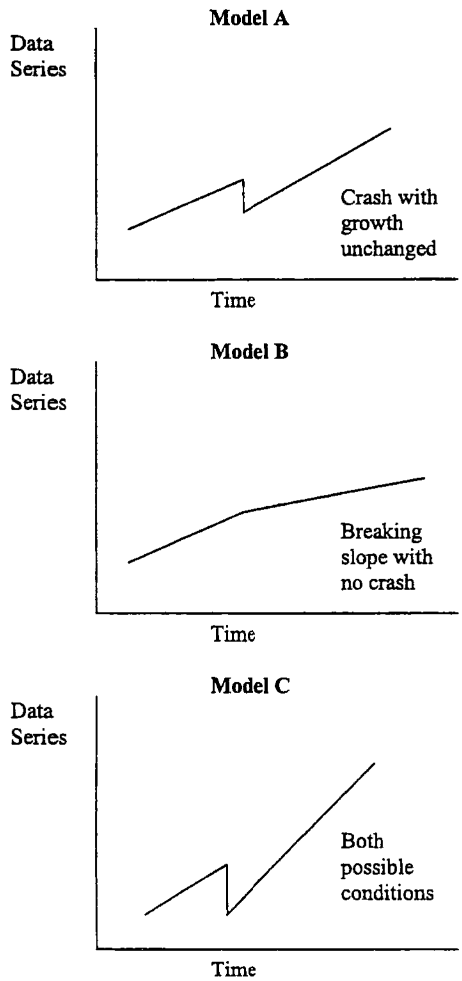
$$y_t = \alpha_1 y_{t-1} + \varepsilon_t$$
$$\Delta y_t = \gamma y_{t-1} + \varepsilon_t$$

The second equation is obtained by subtracting y_{t-1} from each side of the first equation. Thus $\gamma = (\alpha - 1)$. Testing for $\alpha = 1$ in the first equation is equivalent to testing for $\gamma = 0$ in the second. The difference between the DF and the ADF unit root test is the extension from a first-order to a k^{th} order autoregression. The ADF test is run in preference to the DF test when the residuals in the DF regression do not appear to be white noise. The order of the ADF regression is determined by the significance of the last included lag.

The Zivot and Andrews (Z-A) methodology was developed to address this problem of structural changes in time series generating misleading inferences about the stationarity of time series data. An earlier study by Perron (1989) showed that allowing for known breakpoints in time series could change the stationarity properties of a series. Essentially, many time series that were originally tested (see Nelson and Plosser, 1982) as being non-stationary were found to be stationary when allowance was made for the presence of a breakpoint or a number of breakpoints in the series. However Z-A developed the Perron approach a step further by allowing the data themselves to indicate breakpoints rather than imposing a breakpoint from outside the system. The advantage of the Z-A approach is that it does not rely on arbitrary *a priori* judgements as to the relative importance of various shocks.

The Z-A methodology followed Perron in considering three possible types of structural break in a series, these were simply designated Models A (a 'crash' model with no change in growth), B (change in growth, but no change in level), and C (the most general model permitting both occurrences). A visual impression of these model types is presented in figure 1 below.

Figure 1



In the Z-A methodology, the null hypothesis is that the series y_t is integrated without an exogenous structural break against the alternative that the series y_t can be represented by a trend-stationary process with a once only breakpoint occurring at some unknown time (to test for multiple breakpoints the procedure is re-run commencing from each identified breakpoint). The aim of the Zivot-Andrews procedure is to sequentially test breakpoint candidates and select that which gives the most weight to the trend-stationary alternative. That is, the breakpoint DU_t is chosen as the minimum t-value on α^i (i = A, B, C) for sequential tests of the breakpoint occurring at time $1<T_B<T$ in the following augmented regressions:

Model A

$$y_t = \hat{\mu}^A + \hat{\theta}^A DU_t(\hat{\lambda}) + \hat{\beta}^A t + \hat{\alpha}^A y_{t-1} + \sum_{j=1}^{k} \hat{c}_j^A \Delta y_{(t-j)} + \hat{e}_t \tag{3}$$

Model B

$$y_t = \hat{\mu}^B + \hat{\beta}^B t + \hat{\gamma}^B DT_t^*(\hat{\lambda}) + \hat{\alpha}^B y_{t-1} + \sum_{j=1}^{k} \hat{c}_j^B \Delta y_{(t-j)} + \hat{e}_t \tag{4}$$

Model C

$$y_t = \hat{\mu}^C + \hat{\theta}^C DU_t(\hat{\lambda}) + \hat{\beta}^C t + \hat{\gamma}^C DT_t^*(\hat{\lambda}) + \hat{\alpha}^C y_{t-1} + \sum_{j=1}^{k} \hat{c}_j^C \Delta y_{(t-j)} + \hat{e}_t \tag{5}$$

where λ is the break fraction; $DU_t(\lambda) = 1$ if $t>T\lambda$, and 0 otherwise; $DT^*_t(\lambda) = t-T\lambda$ if $t>T\lambda$ and 0 otherwise.

To test the unit root hypothesis, the smallest t-values are compared with a set of critical values estimated by Zivot and Andrews. Because the Zivot-Andrews methodology is not conditional on the prior selection of the breakpoint (all points are considered potential breakpoints) the critical values are larger (in an absolute sense) than the conventional ADF critical values. Consequently, it is more difficult to reject the null hypothesis of a unit root.[6] Table 1 shows that for the Zivot-Andrews techniques there was only a moderate difference between the asymptotic critical values and the small sample critical values. For instance, the Zivot-Andrews asymptotic model A at the 5 per cent level had an asymptotic critical value of -4.80, whereas for a finite sample size of 111, the critical value was -5.14 and for a sample size 62, the critical value was -5.32 (see footnote 7, for a discussion of the derivation of the Z-A sample sizes). That is, the sample size of 111 had a critical value about 7 per cent smaller than the asymptotic value, with the sample size of 62 being a further 3 per cent lower. This indicates that, in some instances, the asymptotic critical values may be too liberal in that these values may permit rejection of the unit root hypothesis too often. Therefore, in this analysis, we will present both asymptotic critical values along with the smallest finite sample critical values from the work of Zivot and Andrews.

[6] We should note that the Zivot and Andrews procedure was not aimed at testing for structural change *per se*, but rather was oriented towards the issue of testing for a unit root in the presence of an unknown structural break.

Table 1 Percentage Points for the Asymptotic and Small Sample Distribution of t-values on 'α' for Model Types A, B and C

Model Type			*1%*	*2.5%*	*5%*	*10%*	*90%*	*95%*	*97.5%*	*99%*
Asymptotic		A	-5.34	-5.02	-4.80	-4.48	-2.99	-2.77	-2.56	-2.32
Critical		B	-4.93	-4.67	-4.42	-4.11	-2.48	-2.31	-2.17	-1.97
Values		C	-5.57	-5.30	-5.08	-4.82	-3.25	-3.06	-2.91	-2.72
Finite Sample Critical Values[7]										
Size =	62	A	-6.03	-5.63	-5.32	-5.01	-2.92	-2.52	-2.23	-1.62
	111	A	-5.73	-5.41	-5.14	-4.86	-3.01	-2.74	-2.52	-2.15
	159	B	-5.40	-5.14	-4.84	-4.57	-2.70	-2.49	-2.32	-2.20
	71	C	-6.25	-5.92	-5.68	-5.38	-3.36	-3.04	-2.81	-2.57
	100	C	-6.30	-5.93	-5.63	-5.31	-3.30	-3.09	-2.85	-2.64

Source: Zivot and Andrews (1992)

3. Results

In this section we test for the presence of a cointegrated relation between Australian strike activity and world strike activity using quarterly data for the period 1960Q1 to 1998Q4. In addition, we test for the presence of any breaks in the relation between the variables.

Australian strike activity (*SA*) is defined as the natural log of the published number of working days lost due to strikes each quarter per 10,000 employees for Australia.[8] Three measures of world strike activity are analysed. The first is *SW1*. This is defined as the natural log of the published number of working days lost due to strikes each quarter per 10,000 employees for the world. 'The world' is proxied by the trade-weighted number of strikes per 10,000 employees for the following countries: USA, Canada, Japan, UK, New Zealand, France, Italy, Korea, Philippines, Singapore, Indonesia, Malaysia, Hong Kong, Taiwan, Germany and China. The trade weights are calculated as a fraction of the sum of the three-year moving average of Australian exports (fob) and imports (cif) for countries that make up the index.

The second measure of world strike activity is *SW2*. This is the same as *SW1* except it is adjusted to exclude the one-off effect of the extraordinary level of strike activity in France during the second quarter of 1968. During this particular quarter, the activities of French students and workers produced an exceptional level of disputes, such that for that particular quarter 240 per cent more strikes occurred worldwide than in any other quarter between 1960 and 1998. Arguably, this single event might best be treated as an outlier.

[7] The small sample critical values are estimated from Monte Carlo simulations based on sample sizes that Zivot and Andrews actually encountered in the original series. Zivot and Andrews fitted ARMA (p,q) models to the individual data series and then treated the optimal ARMA (p,q) model as the true data generating processes for the errors of each of the series. They then constructed a pseudo sample of size equal to the actual size of the series using the optimal ARMA (p,q) models and obtained breakpoints, lags and estimated t-values as described in the body of their paper. This was repeated 5,000 times to obtain the critical values. Zivot and Andrews found that the critical values differed little across the different ARMA (p,q) model specifications and finite sample sizes. For instance, at the 5 per cent level with similar ARMA (1,0) model specifications the critical value was -5.32 for a sample size of 62 and -4.84 for a sample size of 159. With an ARMA (1,0) specification for a sample size of 62 the critical value was -5.32 while for an ARMA (0,1) specification and sample size of 100 the critical value was -5.63.

[8] See the Appendix for further details on definitions and data sources.

The third measure of world strike activity is *SW3*. This measure is *SW2* adjusted to allow for the major change that occurred in the collection of USA strikes data in 1982. As from the first quarter 1982, the definition of strike activity in the USA changed from work stoppages involving six workers to work stoppages involving 1000 workers. This effectively meant the number of reported working days lost due to stoppages fell by an estimated 38 per cent from 1982 onwards. Based on the ratio of the average value of the old-definition data to the new-definition data for the five years immediately preceding the year (1982) when the new definition took over from the old definition, we magnified the data for the later period so as to give an estimated or synthetic series somewhat more harmonised with the original series in place prior to the change in definition.[9]

The various world strike indicators used in this paper are all subject to an important and well-known limitation, namely the limitation of data comparability. Although most countries follow broad ILO (International Labour Organisation) guidelines on the compilation of labour statistics, differences do exist. For example, in their aggregate tally of strikes, some countries include political strikes, like Australia, while others, like Japan, do not. Australia records strikes of 10 or more working days lost, while Japan records strikes of more than half a day. The USA, as we have noted, records since 1982, only strikes that involve more than 1000 workers. Like other studies that make international comparisons (see Beggs and Chapman, 1987a and Chapman and Gruen, 1990), we acknowledge that this is a limitation on the analysis, and we accordingly advise the reader to be mindful of this limitation. Nevertheless, it is argued that on the whole, while somewhat imperfect, the available data are reasonably indicative of trends in worldwide strike activity. Certainly, there are no superior sources of information available. Also, it is worth pointing out that, to the extent that economic agents respond to events *actually* reported and published, there is considerable information content in such data.

Finally, a word of explanation regarding the construction of the 'world' index is warranted. The various countries that make up the index are aggregated according to their trade weights. Thus major trading partners like the USA and Japan have a relatively strong influence. Increasingly important South Korea has a rising influence, while Britain a declining influence. Allowing for the waxing and waning of influence of different countries is considered to be important, and explains why a trade-weighted index has been employed to capture these changes.

Table 2 presents the results from conventional ADF unit root tests applied to the full series without any attention to the possibility of structural breaks in the data. From this table we see that all the series (*SA*, *SW1*, *SW2* and *SW3*) are I(1) or first difference stationary. Conventional Augmented Dickey-Fuller (ADF) cointegration tests for our three versions of world strike activity assuming no breaks are shown in table 3.

[9] The US Department of Labor backdated the new-definition data on an annual basis (though not a quarterly basis) for the period 1947 to 1981. Thus comparisons can be made between old-definition and new-definition data for the overlap period, 1947 to 1981. While the new-definition data necessarily records a smaller number of working days lost due to strikes, the correlation coefficient for the two series was 0.98. Given the strength of the correlation between the old-definition and new-definition data, the grossing up of the new-definition data from 1982 onwards by a constant proportion seems to be reasonable procedure. Also, given the pre-eminence of the US economy worldwide, it is important to include a reasonably consistent indicator of working days lost due to strikes in the USA in any aggregate indicator of 'world' strike activity.

Table 2 Conventional ADF Unit Root Tests on Strike Activity Series without Breaks being Identified

Series	*Levels*	*Lags*	*First Differences*	*Lags*
SA	-1.76	8	-3.72	12
SW1	-1.68	8	-4.78	8
SW2	-1.61	8	-5.97	7
SW3	-2.35	4	-6.99	5
MacKinnon CV:*		*MacKinnon CV:*		
Levels	5% -3.41 10% -3.13	*Levels*	5% -3.44 10% -3.14	
Differences	5% -2.86 10% - 2.57	*Differences*	5% - 2.88 10% - 2.58	

*CV = Critical Value. Period: 1960Q1 to 1998Q4.

Table 3 Conventional ADF Cointegration Tests

Series	t-value on Residuals	Lags
SA and SW1	-3.81	3
SA and SW2	-3.60	6
SA and SW3	-3.90	3
MacKinnon CV:	5% - 3.78 10% - 3.50	

Table 3 shows that all world series are cointegrated at the 10 per cent level of significance while *SW1* and *SW3* are cointegrated with *SA* at the 5 per cent level. These conventional ADF test results are more or less confirmed if we employ the Johansen procedure for determining the presence of a cointegrated relation. Table 4 below suggests the presence of a cointegrated equation at the 1 per cent level of significance for *SA* and *SW1* and *SA* and *SW3*, and a cointegrated equation for *SA* and *SW2* at the 5 per cent level of significance. (Recall that these results, confirming the likely presence of cointegration, do not allow for any breakpoints in the relation.)

Table 4 Cointegration Tests Using the Johansen Procedure

	Likelihood Ratio	*5 per cent*	*1 per cent*	*Hypothesised Number and Cointegrating Equations (CE)*
SA and SW1*	31.7533	25.32	30.45	None
	6.18172	12.25	16.26	At most one
SA and SW2**	29.9848	25.32	30.45	None
	5.9332	12.25	16.26	At most one
SA and SW3***	30.8537	25.32	30.45	None
	6.026	12.25	16.26	At most one

*LR (trace statistic) indicates one CE (cointegrating equation) at both 1 *per cent* and 5 *per cent* levels
**LR indicates one CE at 5 *per cent* level
***LR indicates one CE at both 1 *per cent* and 5 *per cent* levels

Testing for Breakpoints

We next test for cointegration between Australian strike activity and world strike activity in the presence of breakpoints (or regime changes) in the individual series. The methodology we have employed is as follows. First, we test each of the individual series (*SA*, *SW*1, *SW*2 and *SW*3) for a unit root in the presence of breakpoints with unknown timing as per the Zivot and Andrews methodology described earlier. The results of these tests are reported in table 5.

Next we apply these identified breakpoints (i.e. the breakpoints in the individual series reported in table 5) when testing for cointegration between Australian strike activity and the various world strike activity series along the lines suggested by Gregory and Hansen (1996a, 1996b). Gregory and Hansen modify equation 1 to permit tests for cointegration in the presence of structural breaks as follows. First these authors define a dummy variable to incorporate potential series breaks in a somewhat similar manner to that undertaken by Zivot and Andrews viz. let:

$$\varphi_{t\tau} = \left\{ \frac{0 \quad = \quad if \quad t \le (T\tau)}{1 \quad = \quad if \quad t > (T\tau)} \right\}$$

where $\tau \in (0, 1)$ denotes the relative timing of the break. The three potential models (A, B, C) for cointegrated series can then be defined as below.

The level shift model[10]

$$SA_{t\tau} = \alpha_1 + \alpha_2 \varphi_{t\tau} + \beta SW_{t\tau} + \varepsilon_{t\tau} \quad \text{for t = 1,....,T} \tag{6}$$

where α_1 represents the intercept before the shift and α_2 represents the change in the intercept at the time of the shift.

The slope change model

$$SA_{t\tau} = \alpha + \beta_1 SW_{t\tau} + \beta_2 SW_{t\tau} \varphi_{t\tau} + \varepsilon_{t\tau} \quad \text{for t = 1,....,T} \tag{7}$$

where β_1 denotes the cointegrating slope coefficient before the shift and β_2 denotes the change in slope after the shift.

The most general change model

$$SA_{t\tau} = \alpha_1 + \alpha_2 \varphi_{t\tau} + \beta_1 SW_{t\tau} + \beta_2 SW_{t\tau} \varphi_{t\tau} + \varepsilon_{t\tau} \quad \text{for t = 1,....,T} \tag{8}$$

with the coefficients as defined earlier.

Gregory and Hansen (1996a) point out that, for each of these models, if the timing of the shift is known *a priori* then a conventional unit root test can be applied to the regression errors. For the series in question, the Zivot and Andrews methodology is used to identify the timing of potential shifts, which are then superimposed on the models represented by equations 6 through 8. These models are then subjected to conventional cointegration tests.

[10] Which Gregory and Hansen (1996a) specify both with and without trend.

A number of observations can be made in reference to the results in table 5. First, recall that there are three models of regime shift being tested. Model A tests for a shift in the intercept value of the stationarity-testing equation. Model B tests for a shift in the time-sensitivity of the stationarity-testing equation. Lastly, Model C tests for a simultaneous shift in both the intercept value and in the time-sensitivity of the stationarity-testing equation.

Table 5 Zivot and Andrews Unit Root Tests with Unknown Breakpoints

Series and Model		*Minimum 't'Statistic and Period in which Break Occurred*			
SA	C	-11.20 1973Q1	-10.08 1978Q1	-9.90 1981Q4	-10.50 1991Q4
	B	-11.04 1975Q1	-9.35 1980Q1	-9.17 1983Q4	-7.48 1994Q1
	A	-9.68 1973Q1	-9.93 1979Q1	-9.87 1982Q1	-10.31 1991Q4
SW1	C	-10.25 1969Q3			
	B	-6.51 1970Q2	-7.26 1989Q2	-7.77 1991Q2	
	A	-4.91 1967Q1	-9.87 1991Q3		
SW2	C	-9.87 1969Q2	-8.53 1995Q3		
	B	-4.48 1971Q1	-7.77 1992Q2		
	A	-9.05 1970Q1	-4.91 1991Q2		
SW3	C	-9.91 1969Q2	-5.41 1992Q4		
	B	-4.47 1971Q1	-4.18 1989Q3	-7.77 1992Q3	
	A	-9.10 1970Q1	-5.16 1991Q2		
5 *per cent* Critical Values					
Asymptotic		Model A = -4.8 Model B = -4.42 Model C = -5.08			
Finite Sample		Model A = -5.14 Model B = -4.84 Model C = -5.63			

A second observation is that the shifts identified in table 5 include shifts that are significant relative to the asymptotic critical value estimates (which strictly speaking are relevant only when testing for very large samples). In other words, we have not, at this stage, confined our list of possible breakpoints (regime shifts) to those compatible with the small-sample critical value estimates reported at the bottom of table 5. These are included to allow for the largest reasonable number of potential breakpoints to be tested in the cointegration-testing equation.

A third observation is that, while the Zivot and Andrews methodology is not *directly* designed to identify breakpoints in a series, it does indirectly identify such breakpoints via the process of testing data series for changes in their unit-root properties.

Finally, attention should be drawn to one breakpoint that is of particular interest in this study. Model B for Australian strike activity (*SA*) shows evidence of a shift in 1983Q4 (*t*-test for a unit root significant at the 5 per cent level), which approximates to the effective beginning of the Accord period. This shift is not mirrored by any comparable shift in the various world indices.

The next step is to check for cointegration between Australian strike activity and the various world strike-activity proxies in the presence of possible breakpoints. Here, an approach similar to that developed by Gregory and Hansen (1996a,b) is employed. Gregory and Hansen argue that if breakpoints are known *a priori*, then a conventional ADF approach (including the application of conventional ADF critical values) can be applied. We treat the breakpoints identified by the Zivot and Andrews unit root testing procedure of the individual series (in table 5) as being our *a priori* known breakpoints. Applying these known breakpoints to the models shown in equations 6 through 8 generates the results reported in table 6.

Table 6 Gregory and Hansen Cointegration Procedure Applied to *a priori* Known Breakpoints[11]

Variables in Cointegration Regression	*Model*	*Breakpoint*	*t-value*
SA & SW1	C	1969Q3	-4.356
	B	1971Q1	-4.852
	A	1973Q1	-4.236
SA & SW2	C	1969Q2	-4.141
	B	1971Q1	-4.370
	A	1973Q1	-4.297
SA & SW3	C	1969Q2	-4.477
	B	1971Q1	-4.352
	A	1970Q1	-4.505
	A	1973Q1	-4.431
5 per cent CV *Models A and B		-3.74	
5 per cent CV Model C		-4.10	

*MacKinnon Critical Value

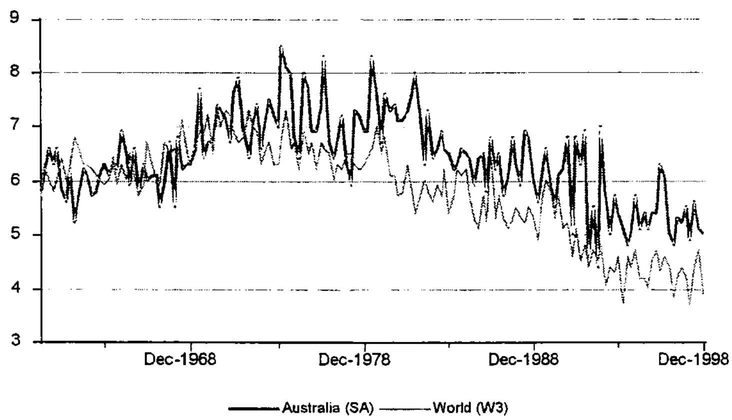
Table 6 reports only those breakpoints in tests of a cointegrated relation between Australian and world strike activity that are statistically significant. A number of observations can be made in reference to the results in table 6. First, all of the pairs of strike activity series show evidence of a break in the cointegrating relation at some of the breakpoints identified by tests on the individual series. Most models indicate a break in the cointegrating relation somewhere in the late 1960s or early 1970s. Second, there is no evidence of a break in the cointegrating relation between Australian and world strike activity immediately before, during, or after the period of the Accord. This outcome is consistent with a view that the Accord had no discernible effect on Australian strike activity (as defined). The relatively low incidence of strikes in Australia during and after the Accord is consistent with a similar low incidence of strikes experienced worldwide.

[11] If the breakpoints are not known *a priori* but need to be identified through a sequential testing procedure for the smallest t-value in an ADF regression on the residual series the critical values are higher. Gregory and Hansen provide approximate asymptotic 5 per cent critical values of -4.61 for Model A, and -4.95 for Model C.

Interpreting Results

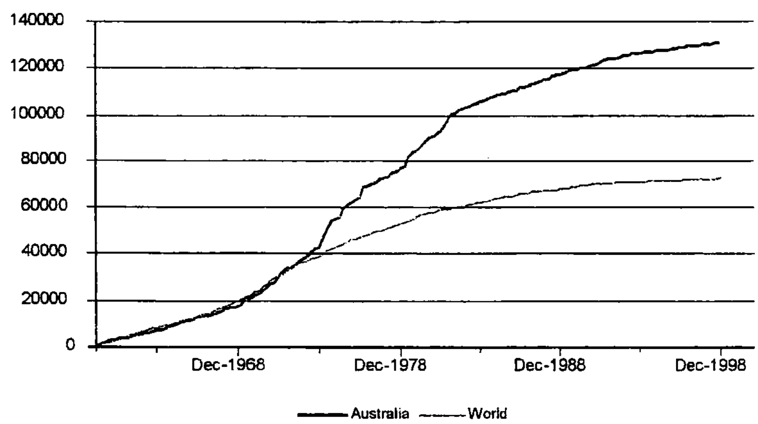
What then is the broad picture that emerges from this comparative analysis? There is evidence of a considerable degree of comparability in Australian and worldwide strike activity during the period (1960-98) under review. The Australian and world series are cointegrated, though with evidence of a permanent shift in the relation from around 1969 to 1973. This regime shift can be detected visually, albeit rather loosely, in figures 2 and 3. Figure 2 charts the series *SA* and *SW3* between 1960 and 1998. Note the general decline in worldwide strike activity from around the early 1970s and the somewhat delayed but still similar decline in Australia. Note also the parting of the ways of the two series around the early 1970s. The world series fall somewhat more sharply on average than does the Australian series.

Figure 2 Australian and World Strike Activity Natural Log of WDL per 10,000 Employees



WDL = Working Days Lost due to Strikes

Figure 3 Cumulative value of WDL per 10,000 Employees Australian and World Series



WDL = Working Days Lost due to Strikes

Another way of visualising the break in the cointegrated relation between Australian and world strike activity around the early 1970s is to look at the cumulative value of strikes per employee in Australia and worldwide. Figure 3 illustrates these two series. Note how these aggregated series part company somewhere in the early 1970s. The Australian series grows more rapidly than the world series from around the early 1970s. The series in figure 3 are simple I(2) transformations of the I(1) cointegrated series, but they arguably illustrate the sort of changes that the regime-shift results in Table 6 are registering.

What might have caused the regime shift in the cointegrated variables? A number of events during the late 1960s and early 1970s might be rationalised as being of importance. Changes in government, energy crises, labour market changes, exogenous changes in union militancy and / or employer resistance and so on. We do not pretend in this paper to have an answer to the question as to why strike activity became somewhat higher in Australia than elsewhere. At this stage we simply report the change.

Finally, a comment on the effect of the Accord on Strike activity. If the Accord was responsible for the decline in strike activity above and beyond the average downward trend experienced internationally, it might be expected that this would be registered with a shift in the relation between domestic and international strike activity. This has not occurred for the variables we have tested. Thus the results are consistent with the view that the Accord had little, if any, independent effect on strikes. Figures 2 and 3 give a visual representation to this contention. There is barely a wobble in the kindred shapes of the series charted in Figure 2 during the period of the Accord. Similarly, in figure 2 the decline in strike activity during the period of the Accord is no more dramatic than that which occurred internationally.

It should be noted that the Accord was not a monolithic framework. It did change over the period of its operation [see Chapman (1998) and Wilson, Bradford and Fitzpatrick (2000)]. Moreover, the various goals driving the Accord, such as moderation in wage growth as a means of managing inflation, were similarly sought worldwide. Perhaps the Accord can be viewed as a particularly Australian arrangement designed to achieve the same sort of goals other economies sought worldwide. Whatever the case, the evidence presented here does not indicate that the decline in strike activity in Australia during the period of the Accord was anything extraordinary.

4. Concluding Comments

This paper has sought to examine the long-term relation between strike activity in Australia and the world. It has been argued that Australian economic activity in general and strike activity in particular are subject to direct and indirect international influences that dominate perceived local-only influences. As a consequence, it is argued that there is a cointegrated relation between domestic strike activity and an appropriate measure of international strike activity.

To test for the presence or otherwise of a cointegrated relation, we use methodologies developed by Zivot and Andrews and further refined by Gregory and Hansen that allows for structural breaks in time series. Using these methodologies generates a number of interesting results. First, there is evidence of cointegration, which is consistent with the view that there has been, for the period of the study, a long-term equilibrium relation between local and international strike activity. Second, there is evidence of a structural break in the cointegrated relation sometime in the very late 1960s or early 1970s.

The break suggests that, though the form of the relation changed (ie parameter values changed), the relation itself did not. And third, the tests revealed no evidence of a break in the relation between Australian and world strike activity just before, during or after the period (1983-1996) of the Accord. This last result is consistent with a view that the decline in the strike rate in Australia over the last couple of decades is broadly compatible with a comparable decline worldwide.

Appendix

Data Sources

The strike rate is defined the number of working days lost due to strikes per 10,000 employees. Sources: OECD, Main Economic Indicators Historical Statistics and Economic Outlook; ILO Yearbook of Labour Statistics; B. R. Mitchell, International Historical Statistics Africa, Asia and Oceania 1750-1993, Third Ed. (Macmillan, 1998) and Directorate-General of Budget, Accounting and Statistics, Executive Yuan, Statistical Yearbook of the Republic of China and Monthly Bulletin of Statistics. Certain refinements and updates were communicated directly to the authors via direct correspondence with respective national statistical collection agencies (e.g. Japan, USA, Korea and Thailand). Employee series were centred and smoothed. Where employee series were incomplete, interpolations and or estimates based on labour force estimates were employed. Where strike data were available only on an annual basis, annual data were apportioned on a quarterly basis.

The trade weights are calculated as a fraction of the sum of the three-year moving average of Australian exports (fob) and imports (cif) for countries that make up the index. Sources: Australian Bureau of Statistics, International Merchandise Trade, 5422.0 and Commonwealth Bureau of Census and Statistics, Overseas Trade, Bulletin No. 56

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