



Institute of Actuaries of Australia

4th Financial Services Forum

Innovation in Financial Markets

19 and 20 May 2008 – Melbourne

Morbidity Experience & Economic Environment Correlations

Rod Berry & James Collier



AGENDA

- **Previous Australian Study**
- International Experience
- Analysis - KPMG Group Life & TPD Statistics
- Analysis - Workers Compensation Statistics



Previous Australian Study

- IAAust Convention, May 2001 (D.Service & K.Ferris)
- Looked at incidence, duration & % disabled
- Derived matrix correlations to the economy
- Reviewed previous analyses in Australia, Canada, USA and UK
- Found general support for economic influences on disability but extent of causal links not clear
- Considered some alternative explanations



Economic Factors Considered by Service & Ferris

	Economic Indicator		Economic Indicator		Economic Indicator
V6	Consumer Confidence	V15	Change in Real GDP	V24	Industrial Production
V7	Participation Rate	V16	Business Bankruptcy	V25	Private Final Demand
V8	Unemployment	V17	Non business Bankruptcy	V26	Private Non Farm Inventory
V9	Hours Worked	V18	Total Bankruptcy	V27	Household Savings Ratio
V10	Long Term Unemployment	V19	Burglary	V28	Terms of Trade
V11	Job Vacancies	V20	Car Theft	V29	GPI
V12	New Passenger Vehicles	V21	Larceny	V30	Dwelling Approvals
V13	New Vehicles Other	V22	Robbery	V31	Change in Dwelling Approvals
V14	Real GDP per Capita	V23	Manufacturing Production		

SIGNIFICANT CORRELATIONS FOUND:

1) Disability Incidence

V7: Participation Rate

V17: Non-Business Bankruptcy

2) Claim Duration

V10: Long-Term Unemployed

V17: Non-Business Bankruptcy

3) % Disabled*

V6: Consumer Confidence

V14: Real GDP per Capita

V16: Business Bankruptcy

**but interpret with caution*

4) Economic Correlations

positive to each other and

positive to each other and

negative to

negative to

5) no meaningful correlations

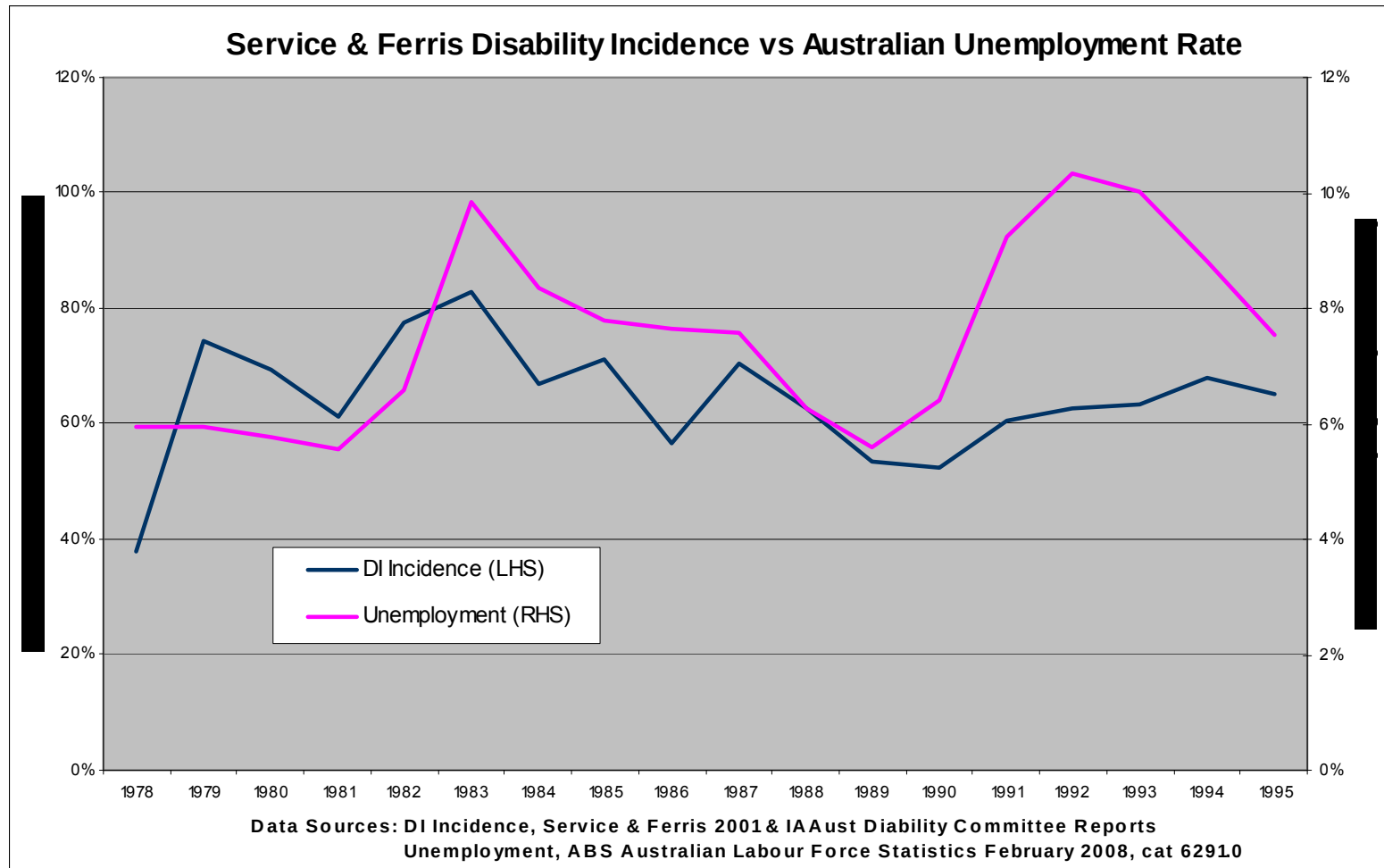


Other Analyses Reviewed

- Australia – Disability Committee Report 1993
 - Attributed lengthening claim durations to the recession
 - Referred to again in 1997 report but no statistical analysis
- Canada – Dept of Human Resources Development
 - Increasing % disabled, employment prospects related to age
- USA – Journal of Risk & Insurance - Doudna(1977)
 - “Effect of the Economy on Group Long Term Disability Claims”
 - Claim rates correlated to unemployment, consumer sentiment
 - Lenser & Green (1994) found GDP, unemployment and retail sales were good predictors of fluctuations in claim frequency and duration
- UK – inconclusive – Haberman/Walsh(98), Haberman/Renshaw(99)
 - May be related to timeframe studied or multi-year averaging of claims
- Among other variables, unemployment is a consistent indicator

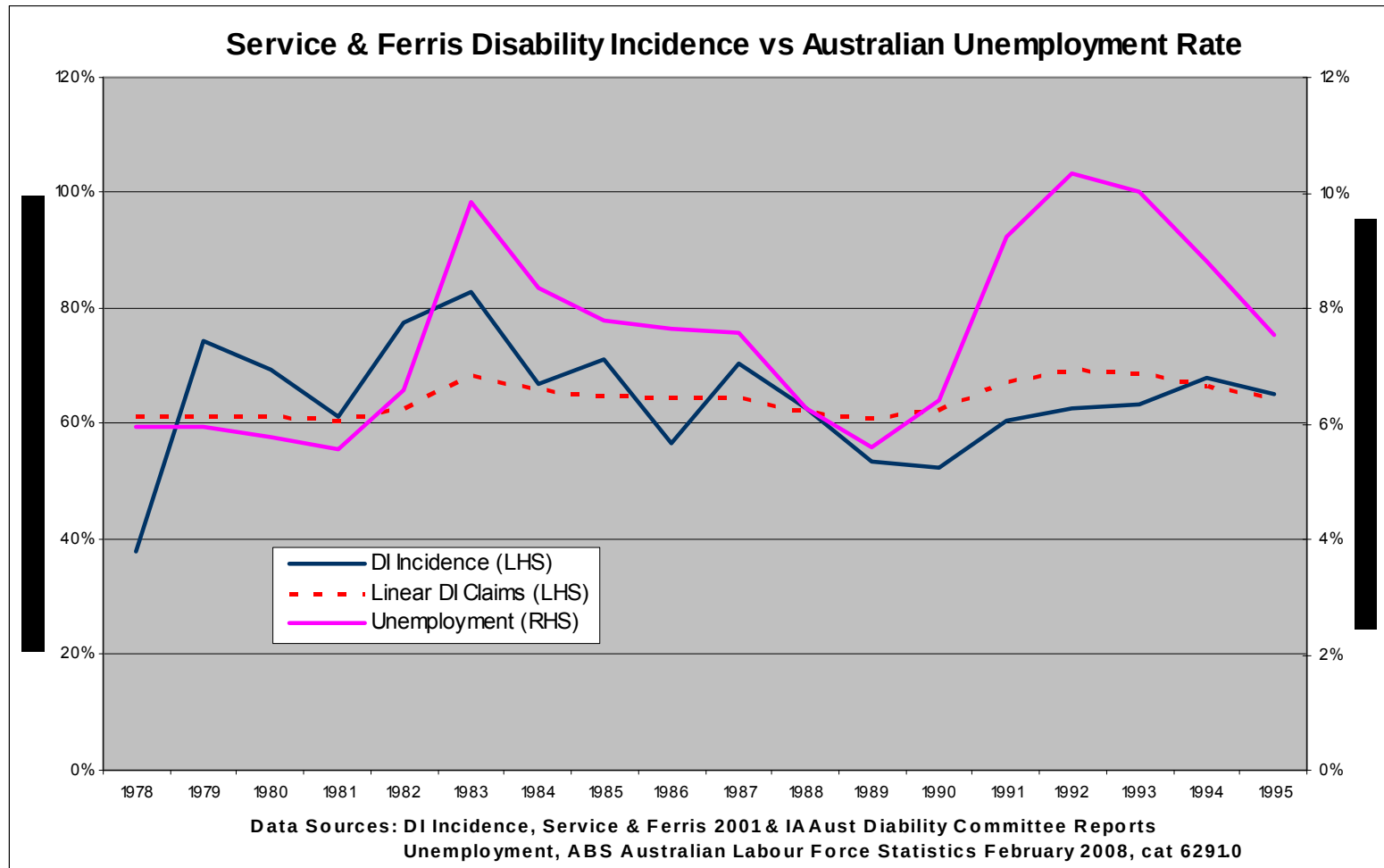


Australian Disability vs Unemployment



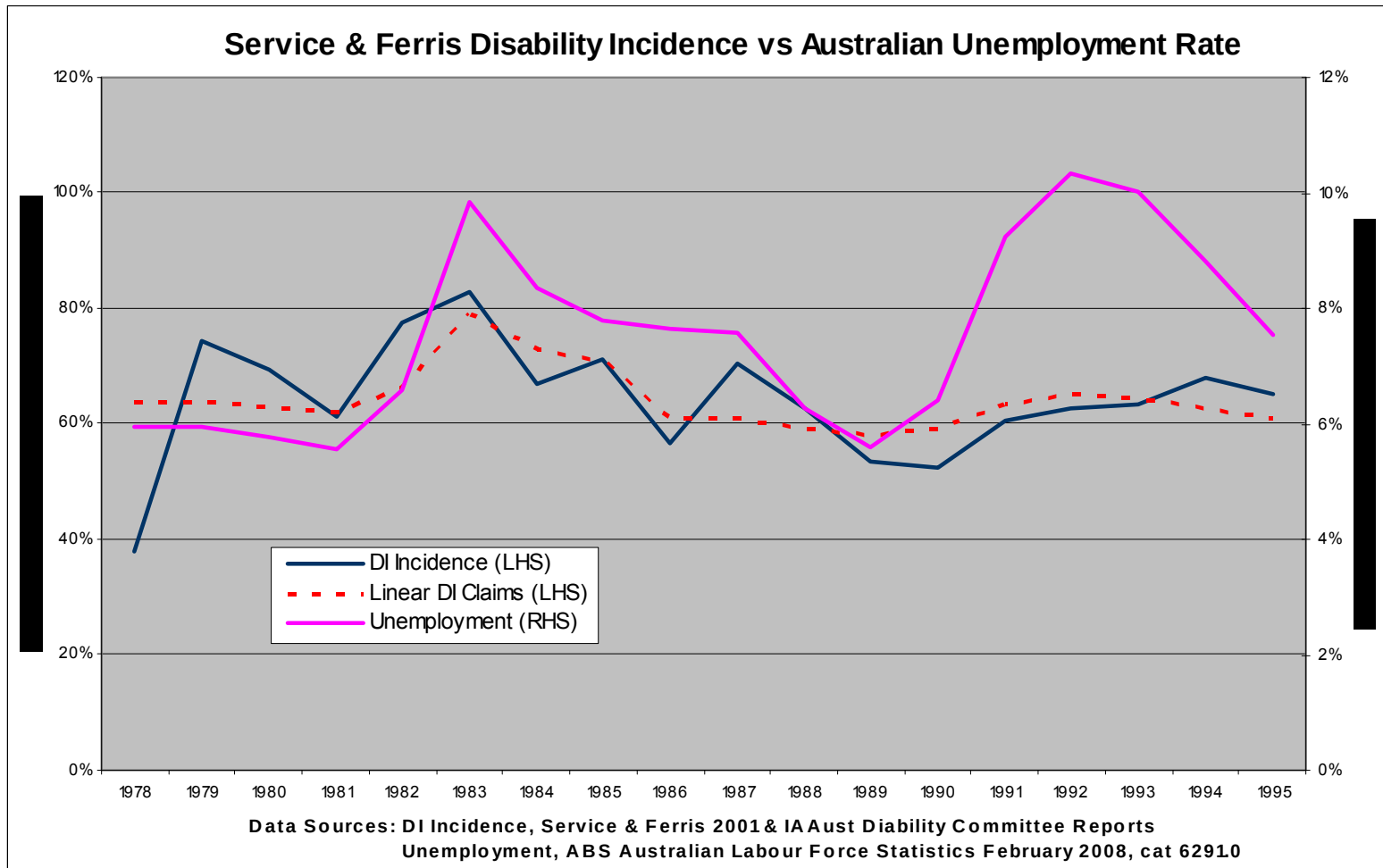


Full Predicted Disability vs Unemployment





Split Predicted Disability vs Unemployment





Correlation of Service & Ferris claims experience vs unemployment

y = (A/E)% Disability Incidence	x = Australian Unemployment Rate 1978 - 95	x = Australian Unemployment Rate 1978 - 85	x = Australian Unemployment Rate 1986 - 95
Linear Regression	$y = 1.83x + 0.50$	$y = 3.91x + 0.40$	$y = 1.47x + 0.50$
R Squared	0.09	0.25	0.20
Correlation	0.30	0.50	0.45

- For the whole period, the correlation is poor, despite the graph implying “closeness”.
- Correlation improves over the sub-periods but how do we predict the transition?
- Even with a period split, differences range from -15% to +15%, evenly distributed.
- As per the next graph, this is still quite a significant pricing variation, albeit unbiased.
- Service & Ferris obtained better correlations using a multi-linear regression model.



Other Possible Impacts on Experience Considered by Service & Ferris

- sales pressures and weaker underwriting standards
- under-resourced or under-skilled claims management
- greater awareness of cover and the right to claim
- changing work ethic and social attitudes to insurance
- more liberal definitions of disability including “any one duty” and the change from “any” to “own” occupation
- weakening of other policy terms and conditions

However, these are steady ongoing effects not fluctuating. Some influence is certain, particularly claims management and duration, but statistical measurement is a challenge! These effects and economic influences can exist together.



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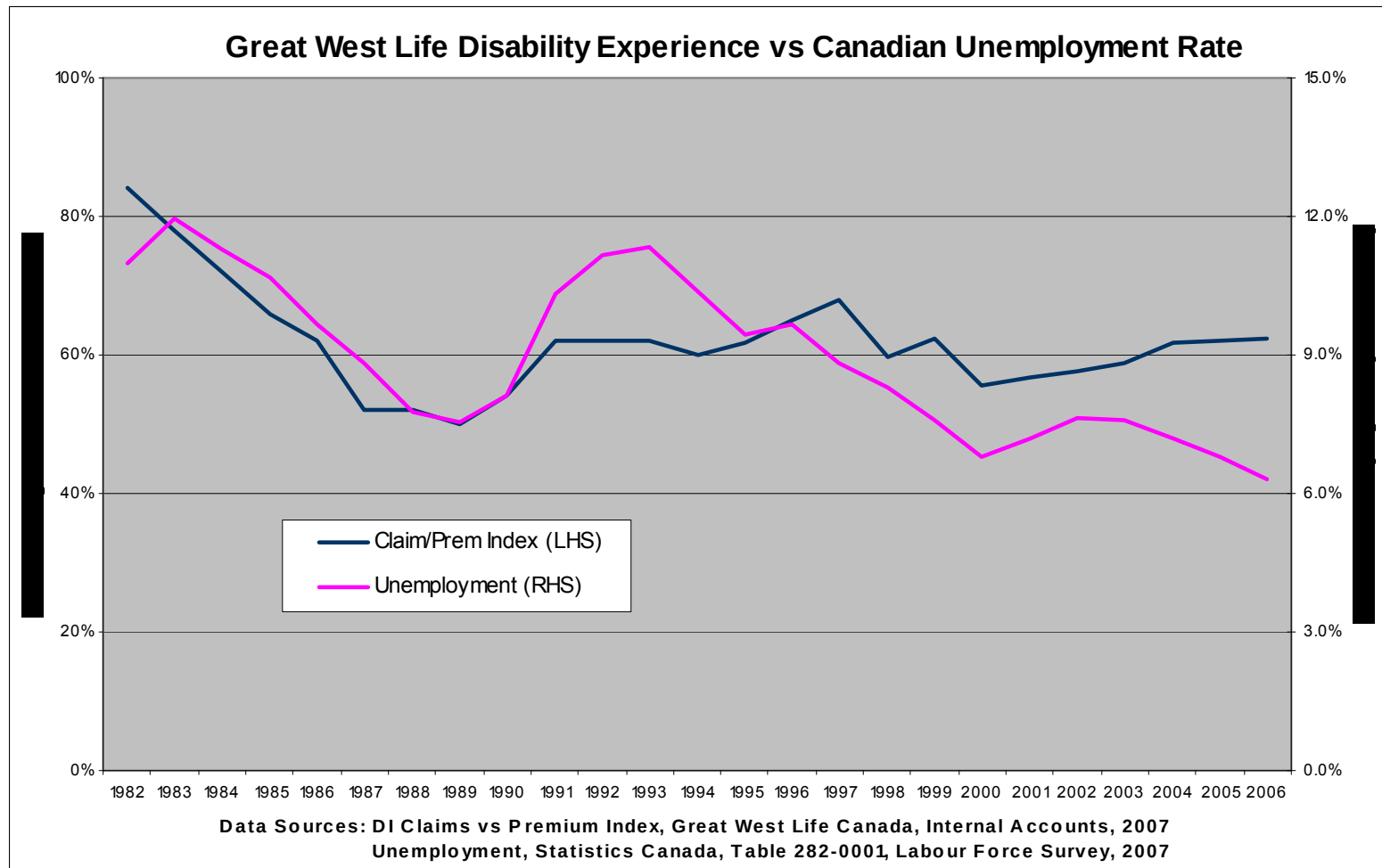
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- Analysis - Workers Compensation Statistics

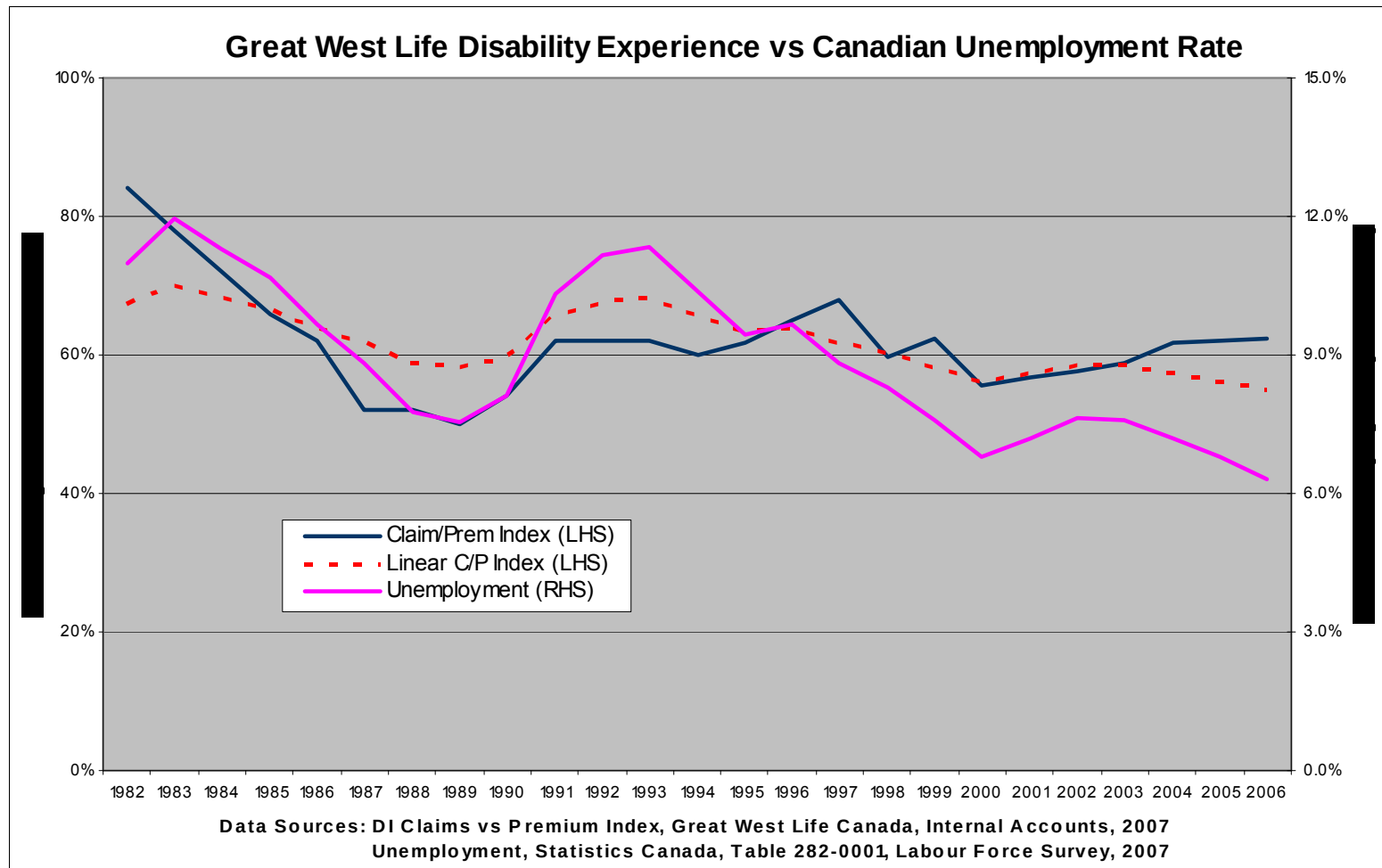


Canadian Disability vs Unemployment



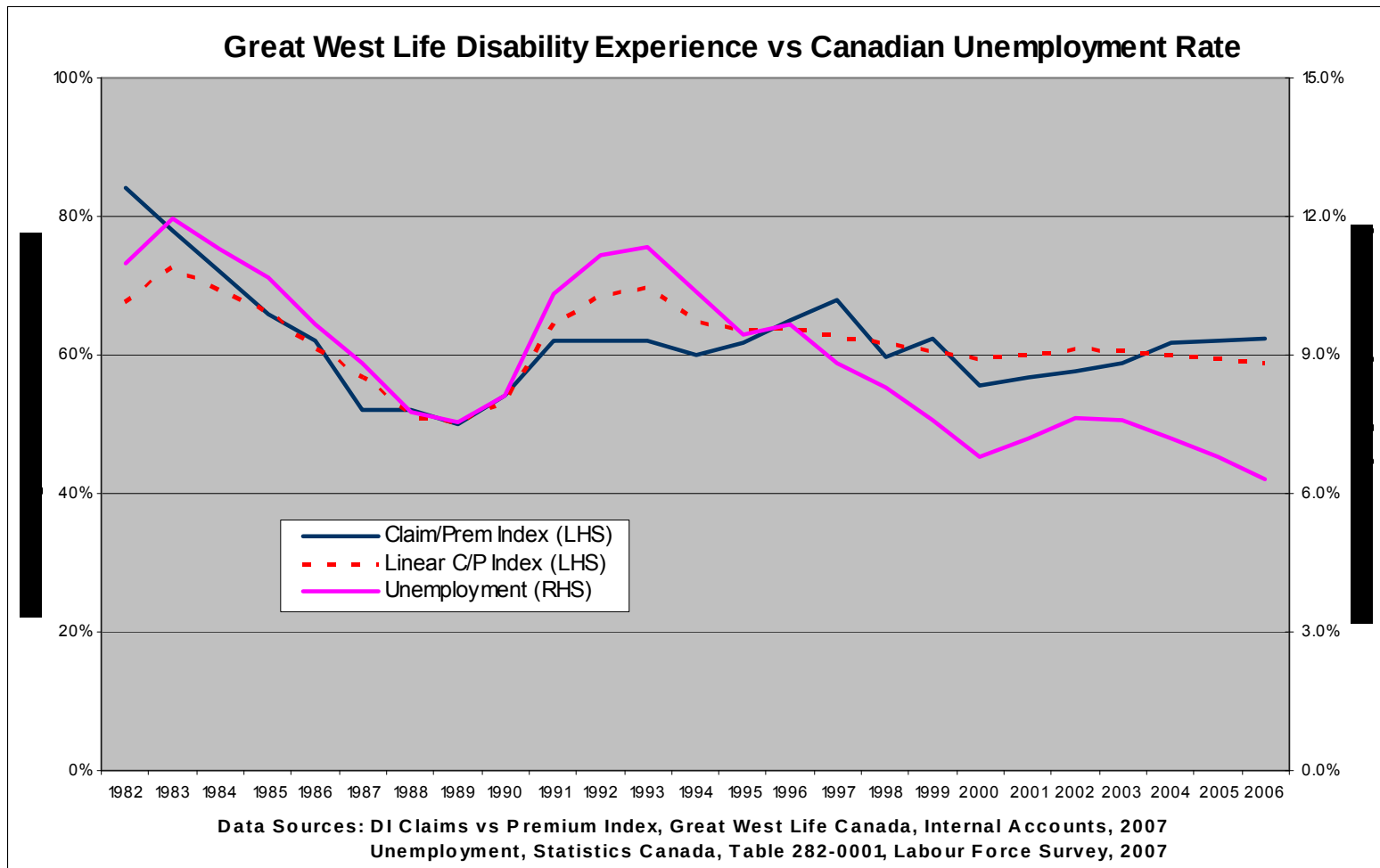


Full Predicted Disability vs Unemployment





Split Predicted Disability vs Unemployment





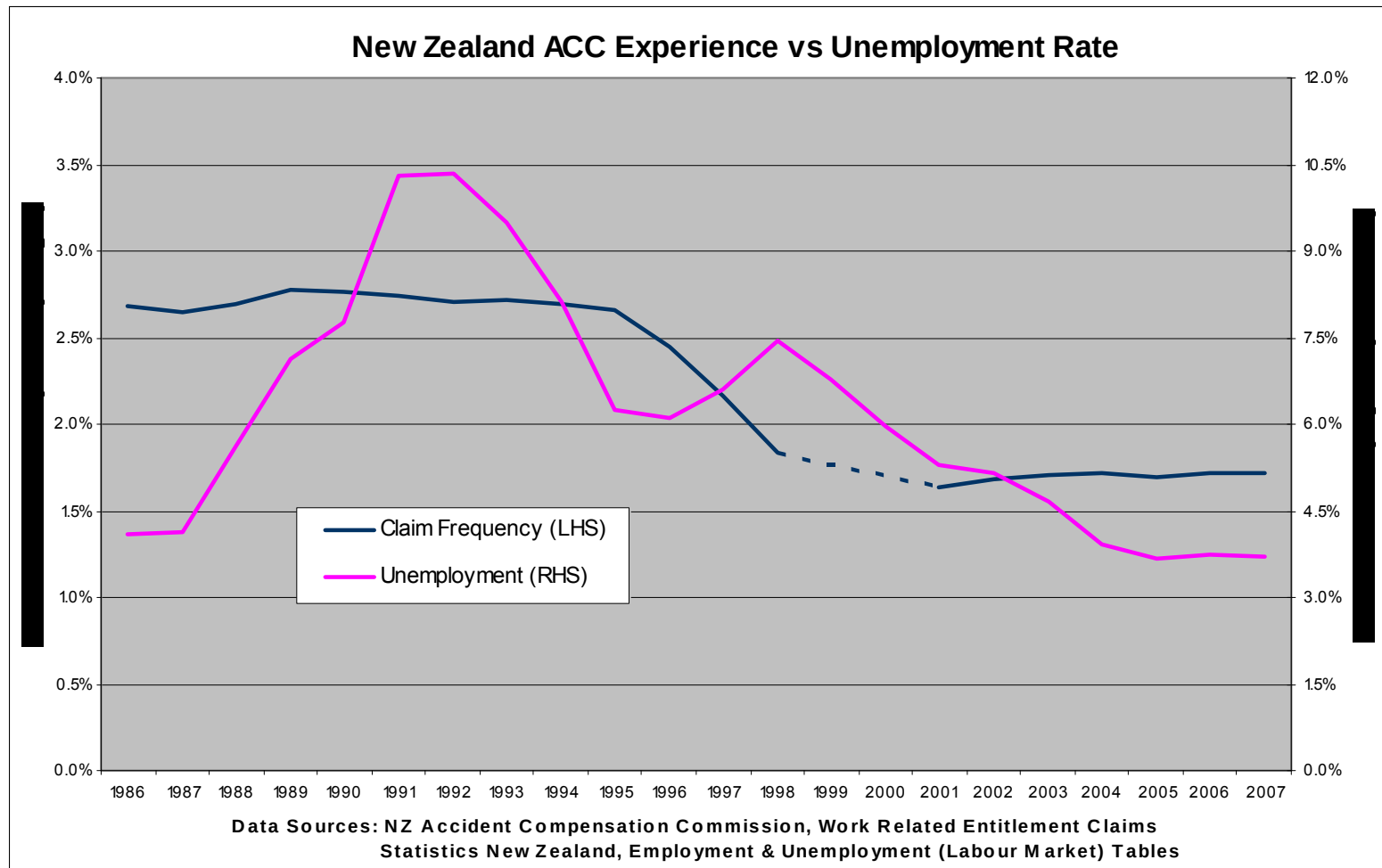
Correlation of Canadian claims experience vs unemployment

y = DI Claims to Premium Index Ratio	x = Canadian Unemployment Rate 1982 - 2006	x = Canadian Unemployment Rate 1982 - 1994	x = Canadian Unemployment Rate 1995 - 2006
Linear Regression	$y = 2.63x + 0.38$	$y = 5.13x + 0.11$	$y = 1.51x + 0.49$
R Squared	0.37	0.64	0.25
Correlation	0.61	0.80	0.50

- For the whole period, this correlation is good but note the claim duration element.
- Correlation improves in the first sub-period but is somewhat worse in the second.
- With better correlation, differences range from -10% to +10%, evenly distributed.
- As per the Australian data, this is still a significant though unbiased pricing variation.
- Great West Life insures > 50% of the Canadian DI market, so quite representative.

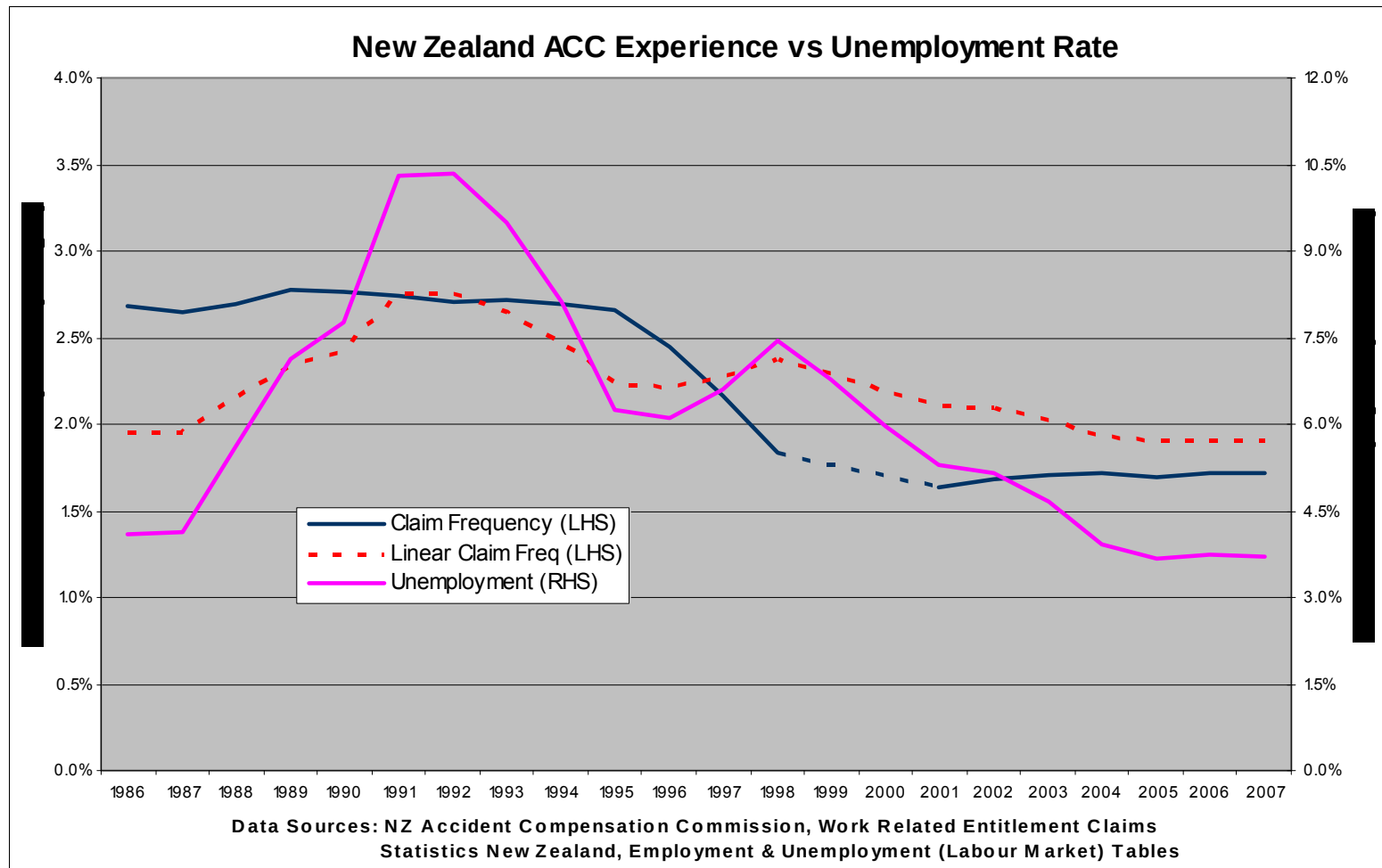


New Zealand Disability vs Unemployment



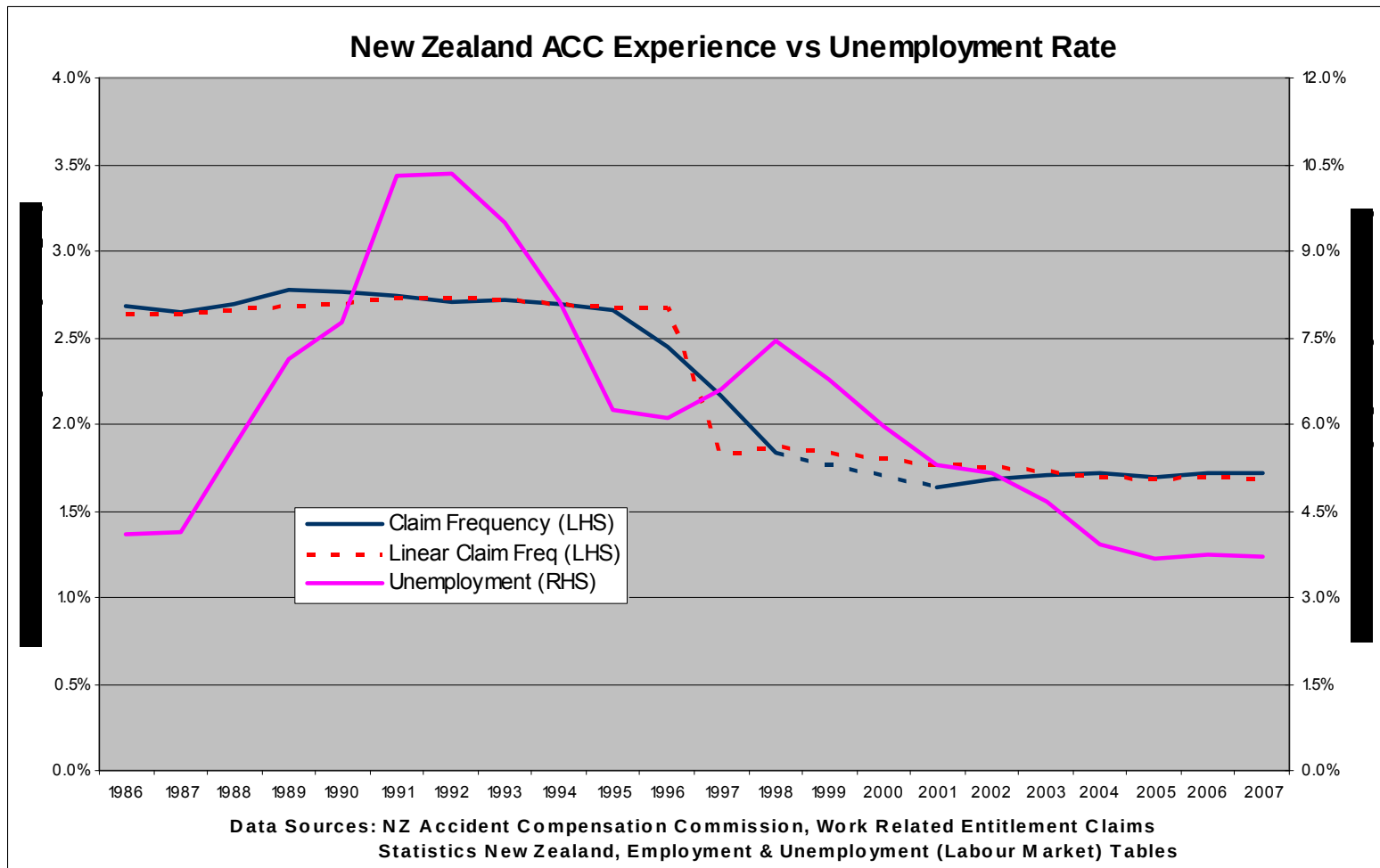


Full Predicted Disability vs Unemployment





Split Predicted Disability vs Unemployment





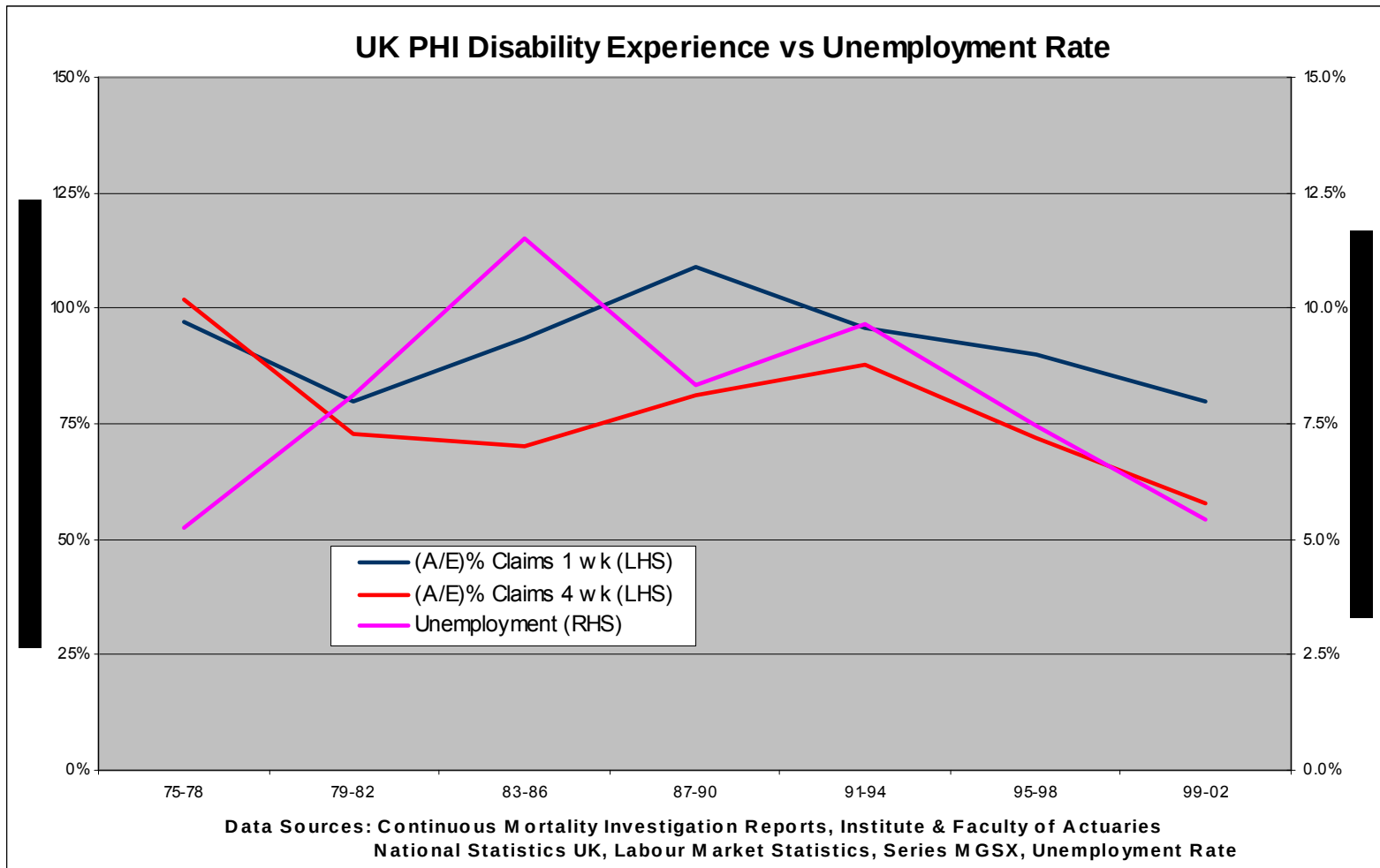
Correlation of New Zealand claims experience vs unemployment

y = ACC Work Claims as % of Population	x = New Zealand Unemployment Rate 1986 - 2007	x = New Zealand Unemployment Rate 1986 - 1996	x = New Zealand Unemployment Rate 1997 - 2007
Linear Regression	$y = 0.13x + 0.01$	$y = 0.01x + 0.03$	$y = 0.05x + 0.02$
R Squared	0.33	0.16	0.26
Correlation	0.57	0.40	0.51

- This sample is accidental work claims, possibly not expected to follow the economy.
- It could be that workers are pressured to “cut corners” more in times of scarce jobs.
- The correlation is reasonable for the whole period but worse for both sub-periods.
- This may be an averaging effect, with +/- fluctuations balancing out in the long run.
- For split periods, differences range from -6% to +6% versus -30% to +30% overall.
- This is most likely an aberration (see low x coefficients) of the unique data trend.



UK Disability vs Unemployment





Comments on analysis of UK experience

- Haberman & Walsh (98) had difficulty establishing any significant economic relationships with DI claims data
- Haberman & Renshaw (99) found cyclical trends in their time series analysis indicative of economic relationships
- This is also identified as needing further investigation
- Different timeframes were examined and some of the earlier claims data was averaged over a 4-year period
- This is a problem above, masking any short term effects
- Correlations of DI claims to unemployment in the above data are 25% for the 1-wk duration and -11% for 4-wk
- These do not indicate any significant relationships but this is quite expected due to the highly aggregated data



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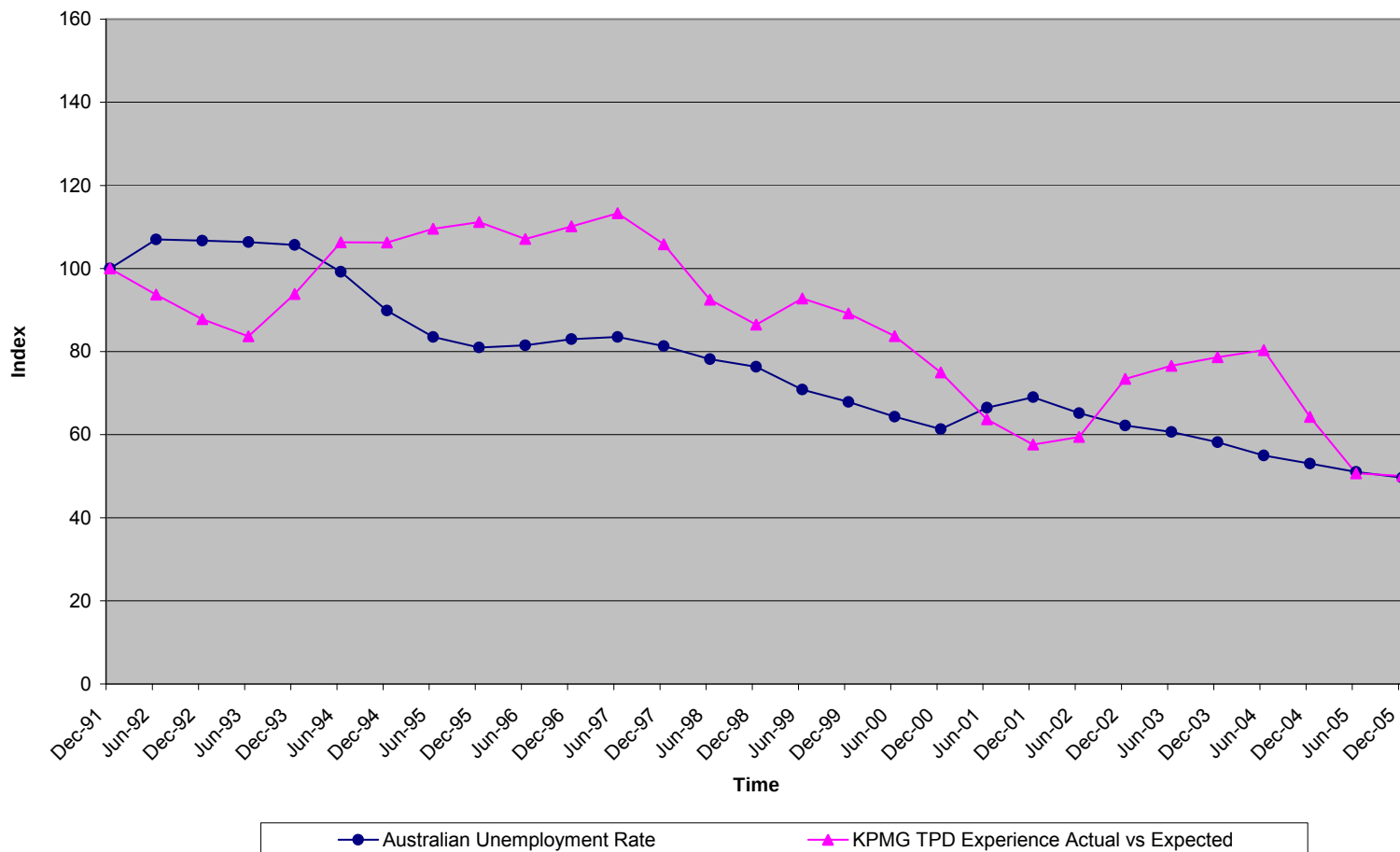


KPMG Group Life & TPD Survey

- Overview
 - 6 monthly insured claims experience survey (1991+)
 - Stand Alone & Mastertrust business
- Limitations!
 - Claims paid in period (not claims incurred)
 - Changes in reporting/payment speeds
 - Change in underlying composition (contributors)
 - Change in terms and conditions (e.g. claimable events)
 - Data errors and corrections

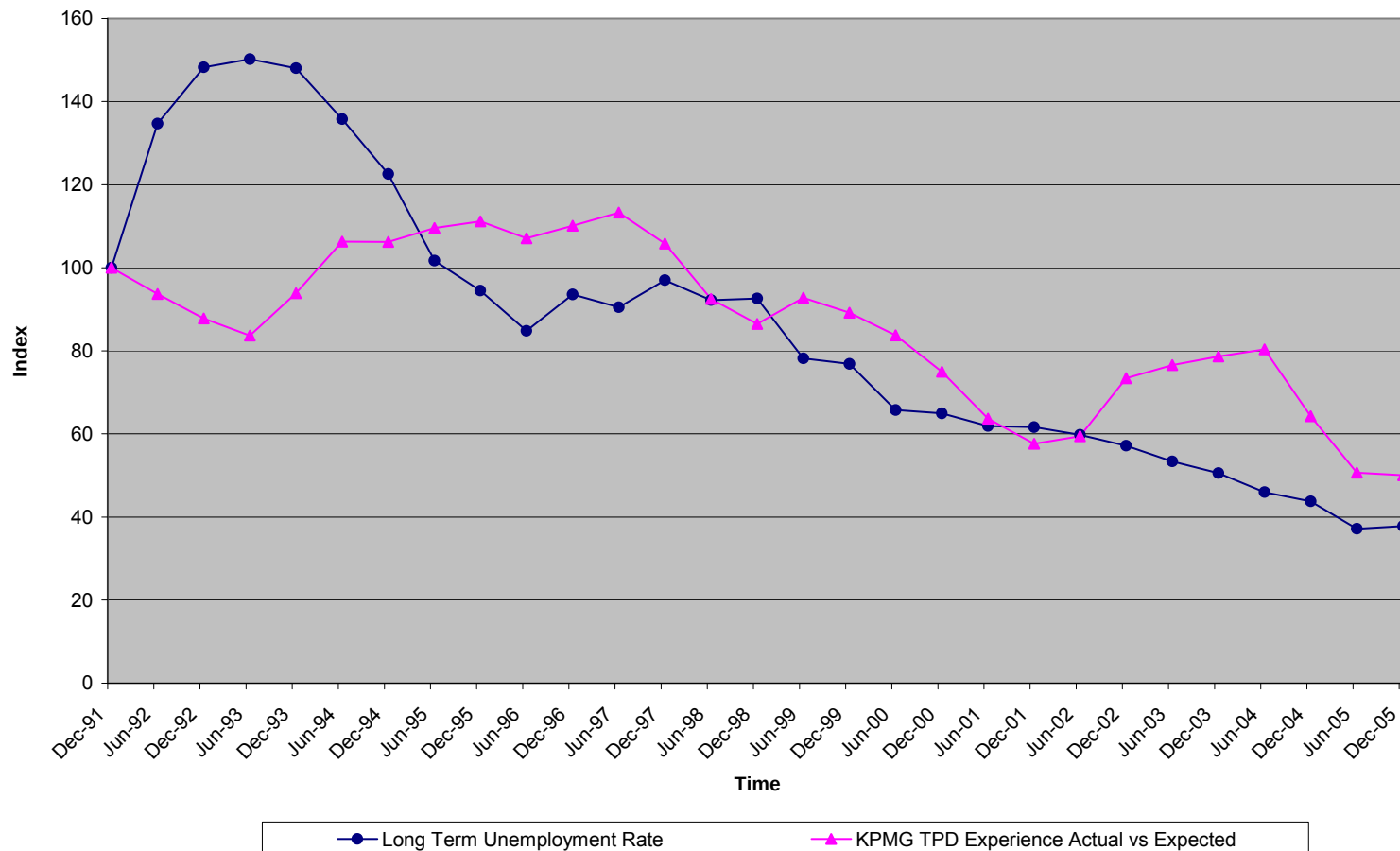


Unemployment Rate vs KPMG Group TPD Claims Rate





Long-Term Unemployment Rate vs KPMG Group TPD Claims Rate





Regression Results of Group TPD Experience and Economic Factors

	Australian Unemployment Rate	Long term Unemployment Rate	Participation Rate	Consumer Confidence Index	Business Confidence Index	Total number of Bankruptcies
Regression Parameter	0.70	1.29	-0.03	-0.12	2.06	-0.56
R Square	0.55	0.52	0.38	0.06	0.05	0.25
Correlations	0.74	0.72	-0.61	-0.24	0.23	-0.50

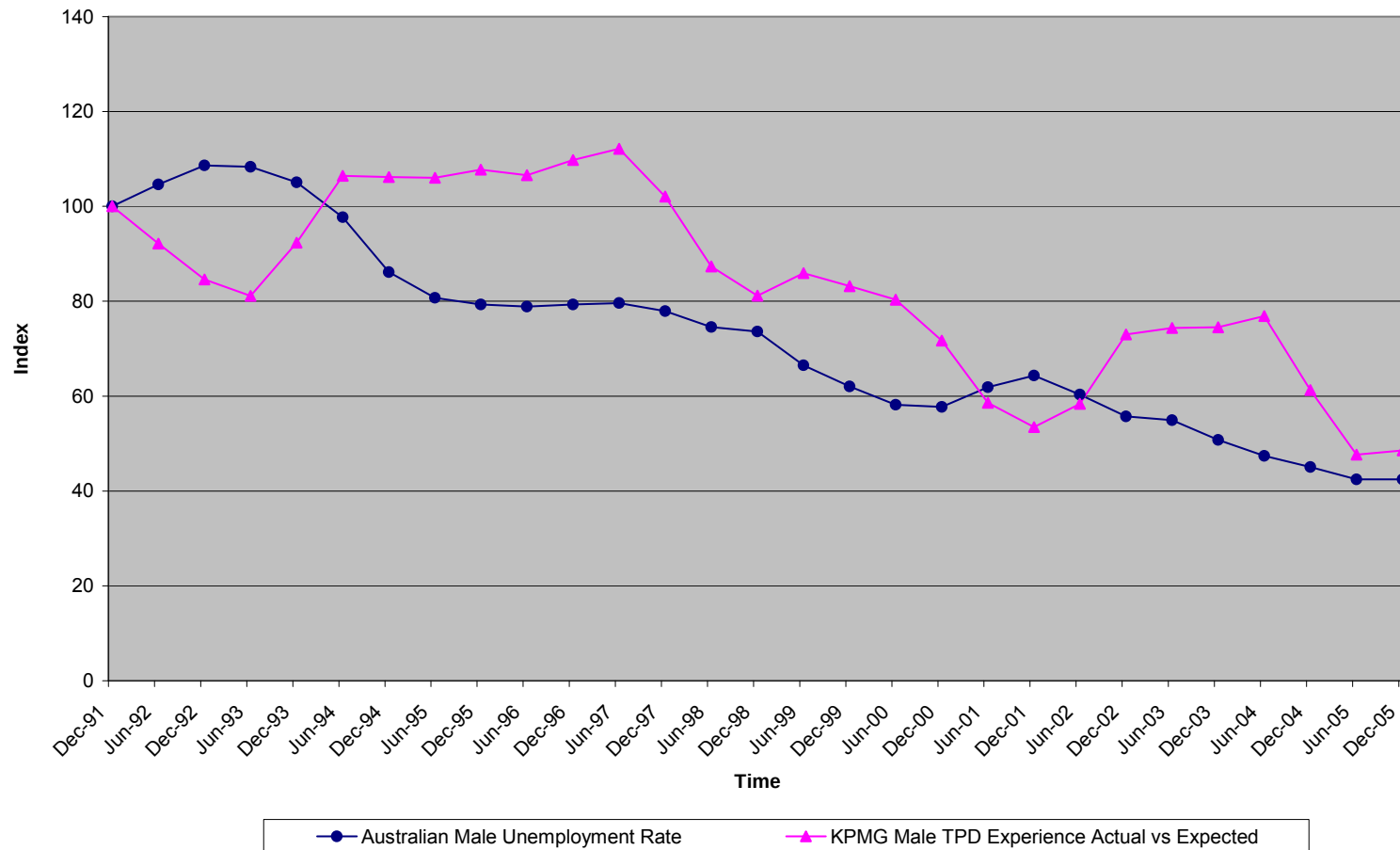


Regression Results of Group TPD Experience and Economic Factors

- Higher unemployment and long term unemployment rates appear to significantly increase the prevalence of TPD claims (evidenced by large positive regression parameters) and appear to explain a significant proportion of the variability in the injury rate (evidenced by high R-squares).
- The participation rate and consumer confidence appear to have less impact on TPD claims.
- Business confidence appears to have a significant negative impact on TPD claims but appears to explain only a small proportion of TPD claim variability.
- Increasing the number of total bankruptcies appears to decrease the number of TPD claims, and appears to be of moderate significance in explaining TPD claim variability.

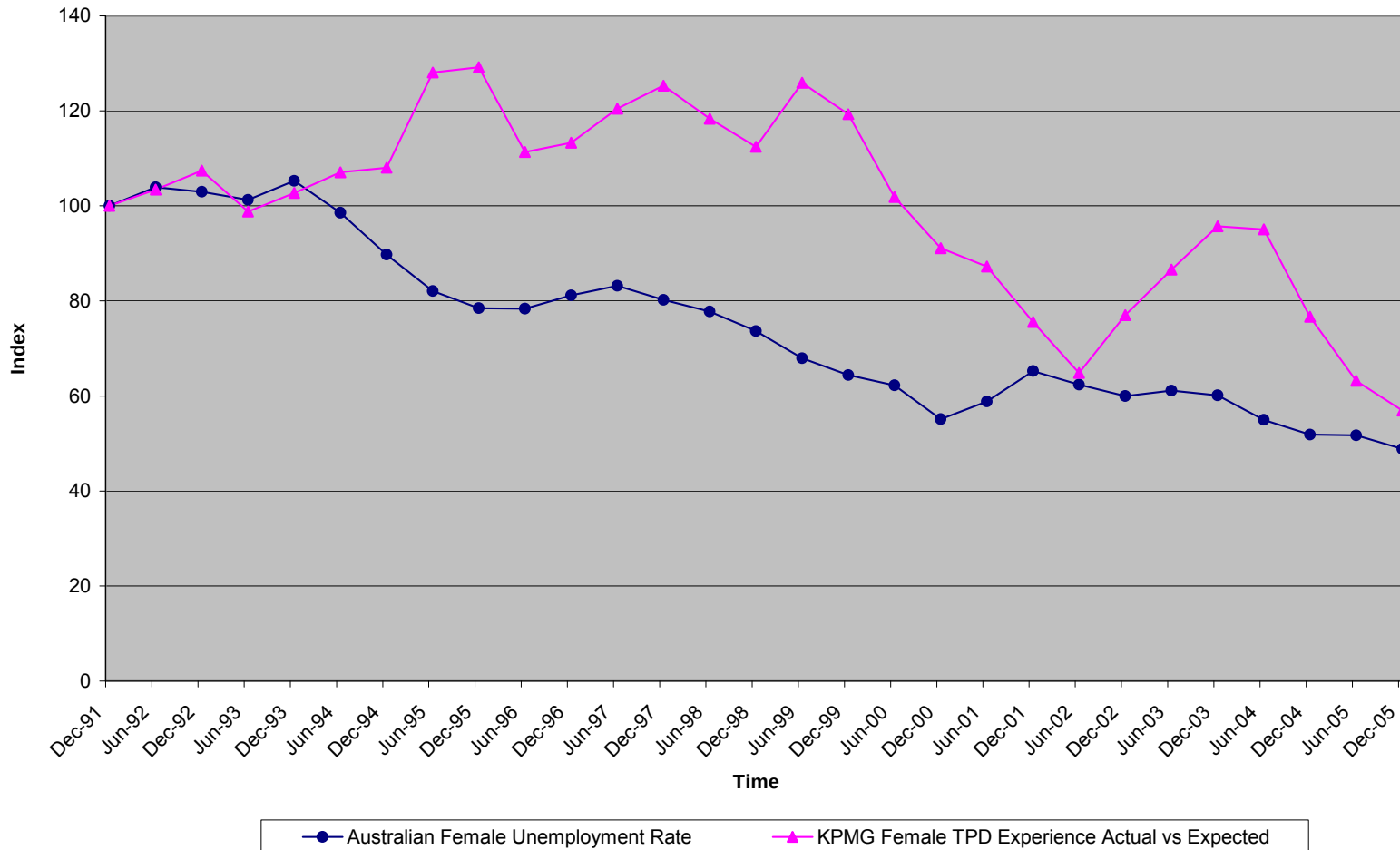


Male Unemployment Rate vs Male KPMG Group TPD Claims Rate





Female Unemployment Rate vs Female KPMG Group TPD Claims Rate





Unemployment regression with KPMG Group TPD Experience by Gender

- The prevalence of TPD claims appears to be more sensitive to the unemployment rate for males than females
- The unemployment rate appears to explain a greater proportion of the variability in TPD claim experience for males than females
- The apparent greater sensitivity for males than females may be due to differences in the underlying split between white and blue collar for the two sexes, and sensitivity of each.

Male

Regression Parameter	0.79
R Square	0.56
Correlations	0.75

Female

Regression Parameter	0.55
R Square	0.37
Correlations	0.61

Male and Female Combined

Regression Parameter	0.700
R Square	0.550
Correlations	0.740



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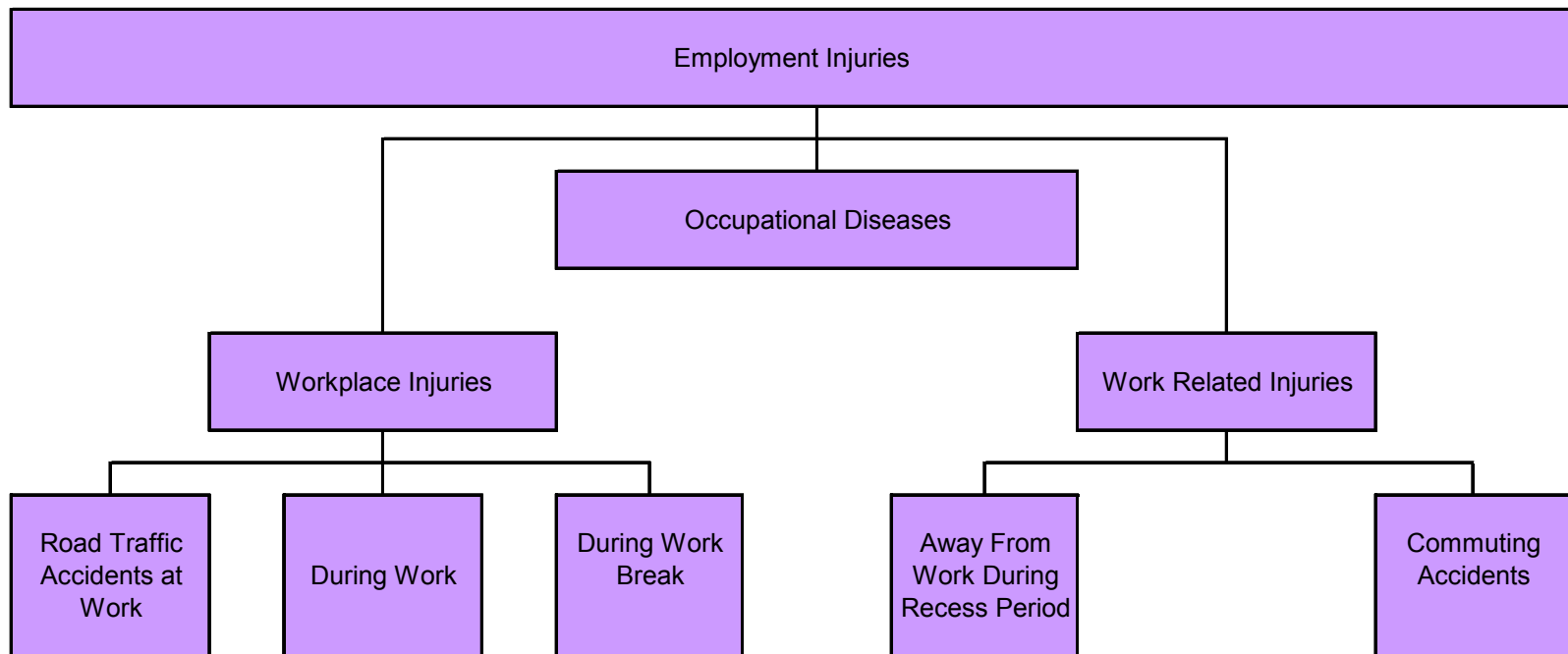


Workers Compensation Statistics

- Overview
 - Experience available by broad injury type
 - Experience available by Industry
 - Large volume of statistics
- Limitations!
 - NSW Scheme experience taken as proxy for Australian total
 - Changing Scheme initiatives
 - Changing claim management standards (incl. Court roles)
 - Changing Benefits (incl. commutation & common law access)
 - Degree of correlation with life insurance claims

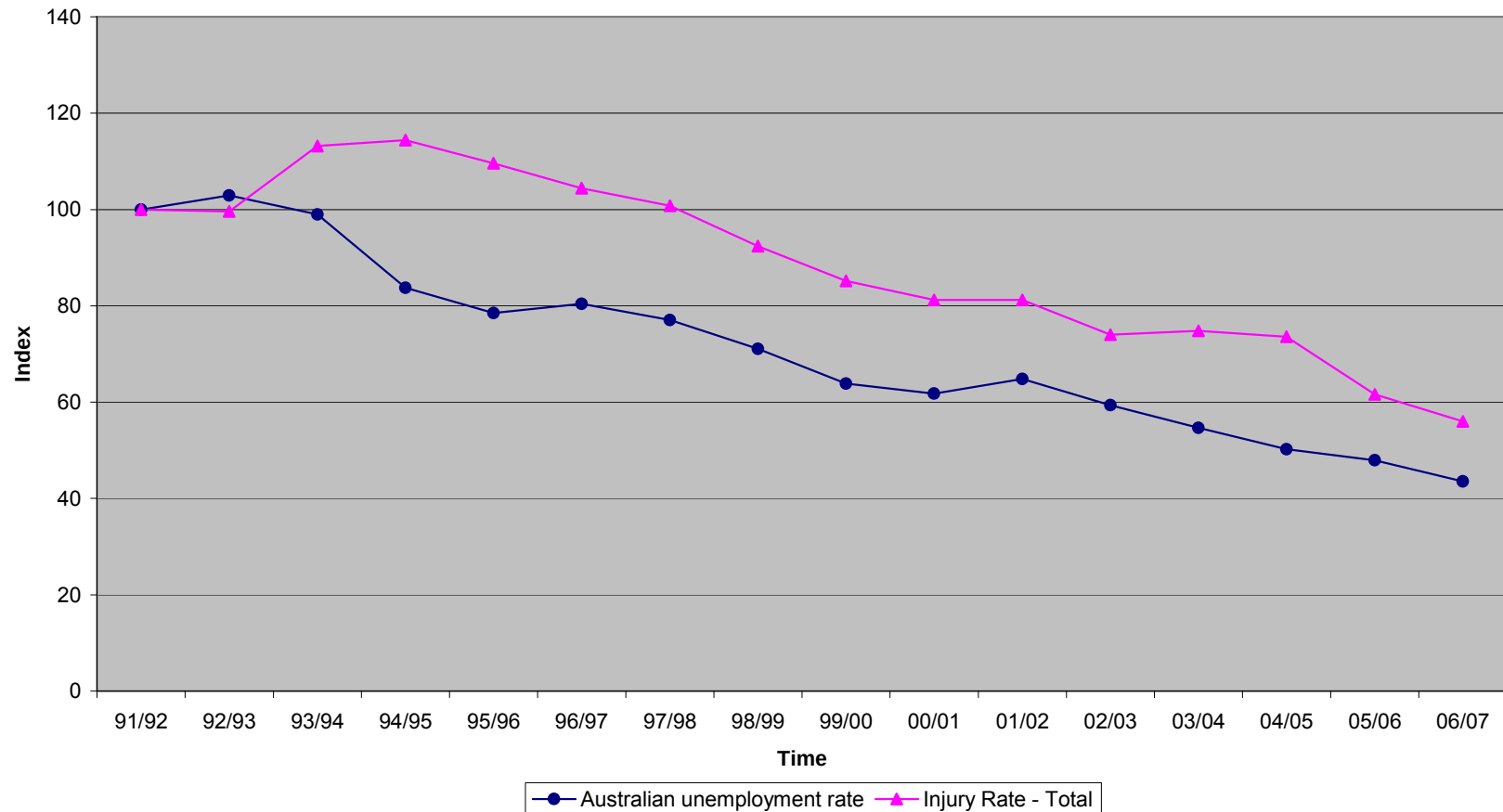


Workers Comp Employment Injury Types





Unemployment Rate vs Workers Comp Employment Injury Rate





Regression Results of Workers Comp Employment Injury Rate and Economic Factors

	Australian Unemployment Rate	Long term Unemployment Rate	Participation Rate	Consumer Confidence Index	Business Confidence Index	Total number of Bankruptcies
Regression Parameter	0.90	1.49	-0.04	-0.17	1.67	-0.85
R-squared	0.76	0.76	0.52	0.13	0.16	0.40
Correlation	0.87	0.87	-0.72	-0.35	0.40	-0.63

Regression of KPMG Group TPD Experience and Economic Factors

Regression Parameter	0.70	1.29	-0.03	-0.12	2.06	-0.56
R Square	0.55	0.52	0.38	0.06	0.05	0.25
Correlations	0.74	0.72	-0.61	-0.24	0.23	-0.50

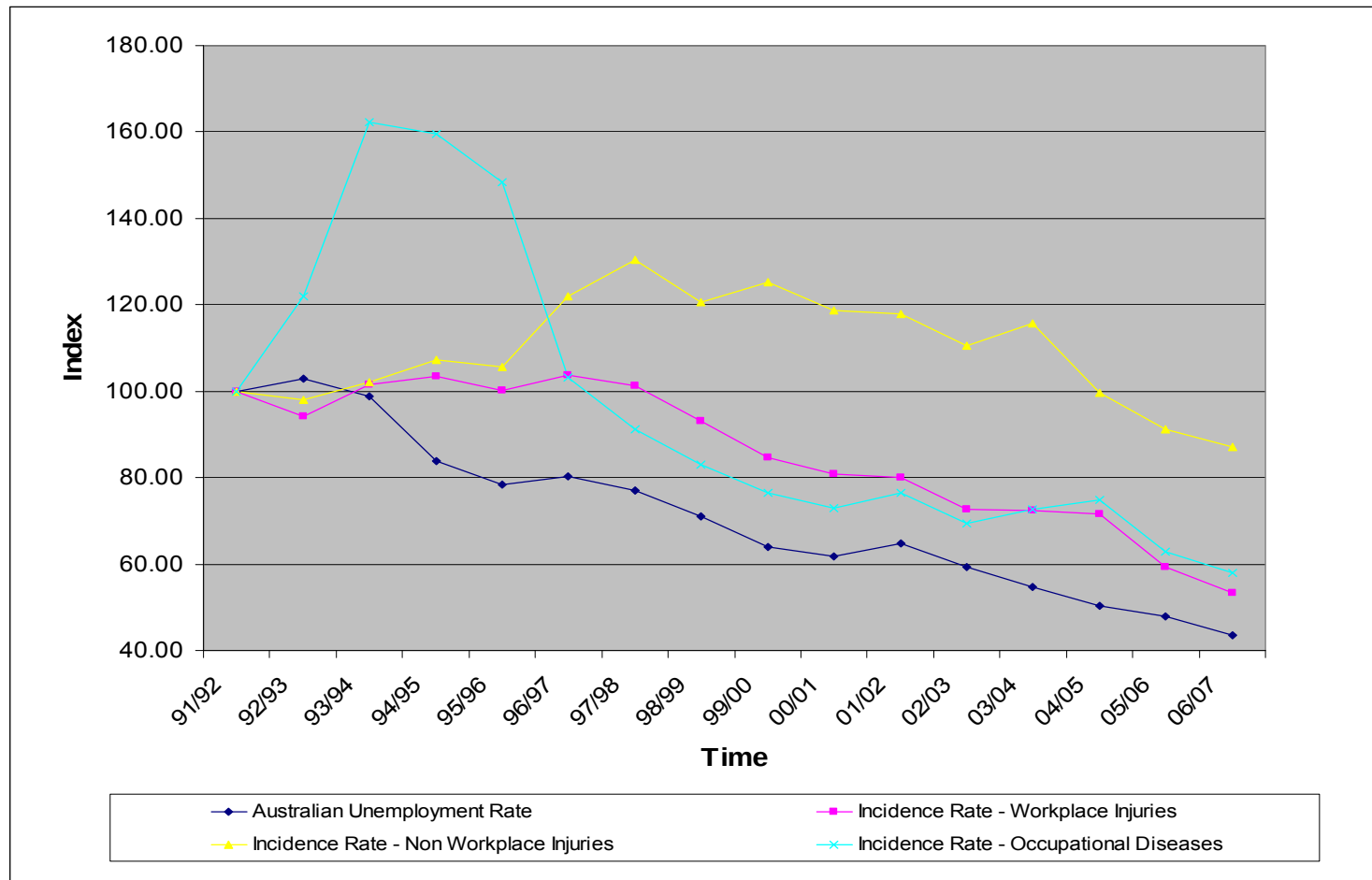


Regression of Workers Comp Employment Injury Rate and Economic Factors

- The unemployment and long term unemployment rates appear to have significant impacts on the injury rate (evidenced by large regression parameters) and appear to explain a significant proportion of the variability in the injury rate (evidenced by high R-squares).
- The participation rate and consumer confidence appear to have little impact on the injury rate.
- Business confidence appears to have a large impact on the injury rate, however, only explains a small part of the variability in the injury rate.
- Total bankruptcies appears to have a significant negative impact on the injury rate and explains a moderate proportion of the variability in the injury rate.



Unemployment Rate vs Workers Comp Employment Injury Type Rates





Regression of Workers Comp Employment Injury Type Rates

	Australian Unemployment Rate	Long term Unemployment Rate	Participation Rate	Consumer Confidence Index	Business Confidence Index	Total number of Bankruptcies
<u>Regression Parameter</u>						
Occupational Diseases	0.42	0.73	-0.01	-0.05	1.30	-0.59
Workplace Injuries	0.99	1.60	-0.04	-0.23	1.32	-0.74
Non Workplace Injuries	<u>0.09</u>	<u>0.15</u>	<u>-0.04</u>	<u>0.06</u>	<u>-1.31</u>	<u>0.76</u>
Aggregate	0.90	1.49	-0.04	-0.17	1.67	-0.85
<u>R-squared</u>						
Occupational Diseases	0.60	0.65	0.25	0.04	0.35	0.68
Workplace Injuries	0.74	0.72	0.59	0.18	0.08	0.25
Non Workplace Injuries	<u>0.00</u>	<u>0.00</u>	<u>0.23</u>	<u>0.01</u>	<u>0.05</u>	<u>0.16</u>
Aggregate	0.76	0.76	0.52	0.13	0.16	0.40



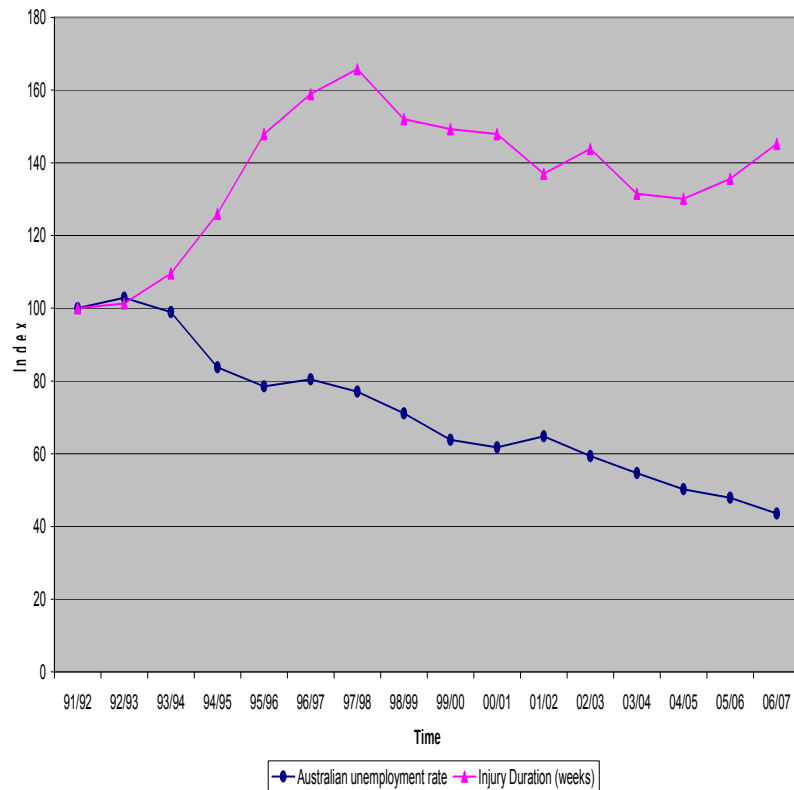
Regression of Workers Comp Employment Injury Type Rates

- While the unemployment and long term unemployment rates appear to have a significant impact on the incidence rates for occupational diseases and workplace injuries, they appear to have little impact on work related injuries.
- Business confidence appears to significantly increase injury rates for occupational diseases and workplace injuries, but appears to decrease the injury rate for work related injuries. As with the aggregate results, business confidence does not appear to explain a significant proportion of the variability in the injury rate.
- Total bankruptcies appears to significantly decrease injury rates for occupational diseases and workplace injuries, but appears to increase the injury rate for work related injuries. The proportion of the variability in the injury rate explained by total bankruptcies varies across injury types from high to low.

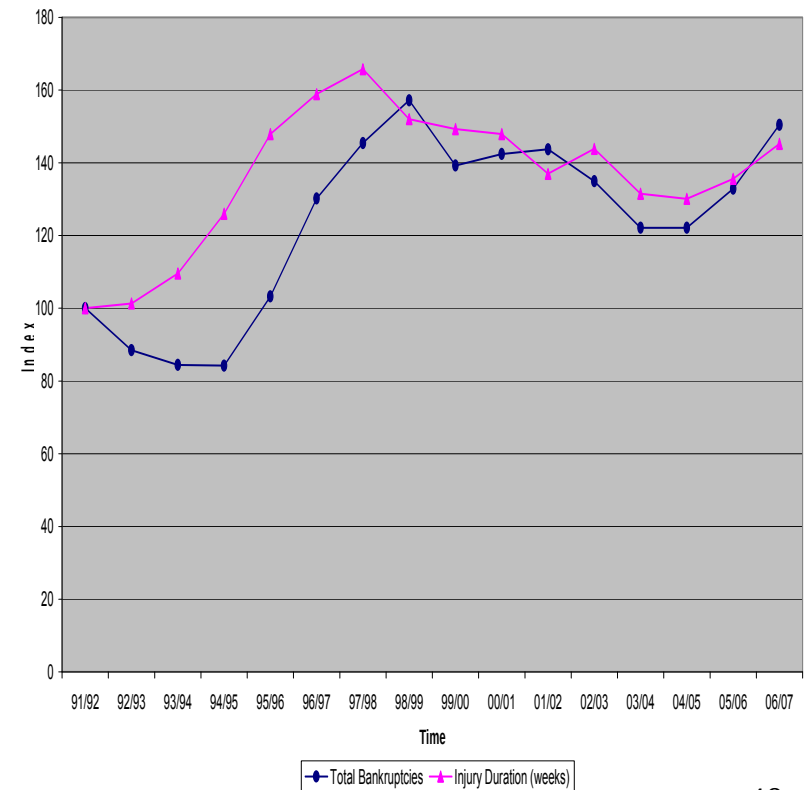


Regression of Workers Comp Employment Injury Duration and Economic Factors

Injury Duration v Unemployment



Injury Duration v Total Bankruptcies





Regression of Workers Comp Employment Injury Duration and Economic Factors

	Australian Unemployment Rate	Long term Unemployment Rate	Participation Rate	Consumer Confidence Index	Business Confidence Index	Total number of Bankruptcies
Regression Parameter	-0.51	-0.82	0.02	0.19	-1.94	0.96
R-squared	0.28	0.26	0.13	0.17	0.25	0.58
Correlation	-0.53	-0.51	0.36	0.42	-0.50	0.76



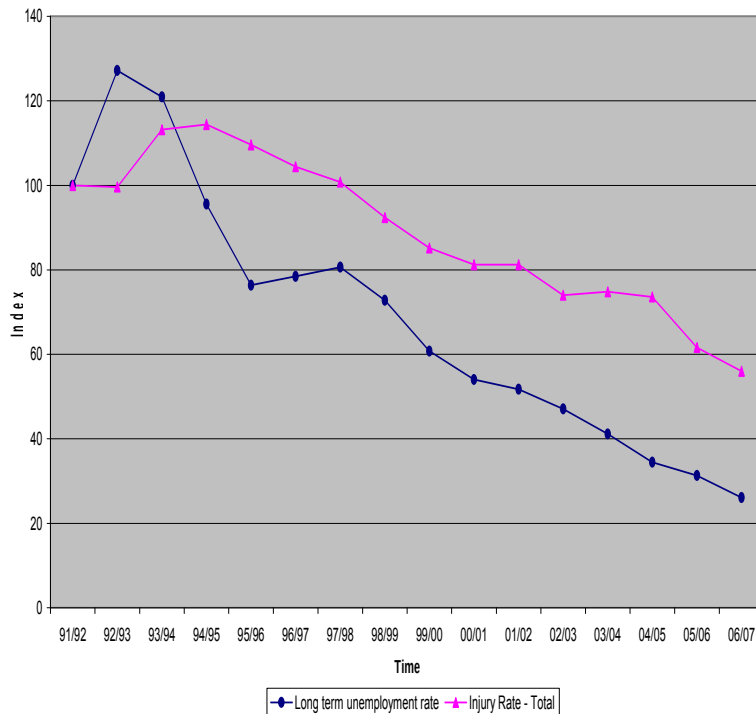
Regression of Workers Comp Employment Injury Duration and Economic Factors

- Duration of claims over the study period have been effected by significant changes in benefits, notably restrictions to commutations.
- Increasing the unemployment rate or long term unemployment rate appears to decrease injury duration significantly, however the factors only explain a moderate proportion of the variability in the injury duration. We believe this result should be interpreted with caution.
- The participation rate and consumer confidence appear to have only a small impact on injury duration.
- Increasing business confidence appears to have a significant impact on injury duration, however, only explains a moderate proportion of the variability in the duration.
- Increasing the total number of bankruptcies appears to significantly increase the injury duration and explains a significant proportion of the variability in the duration.

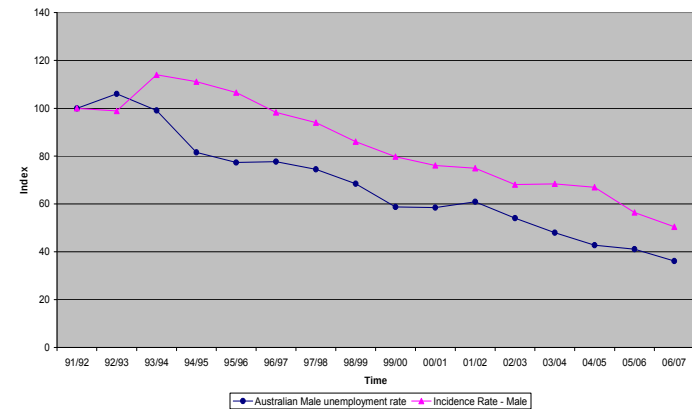


Unemployment vs Workers Comp Employment Injury Rates

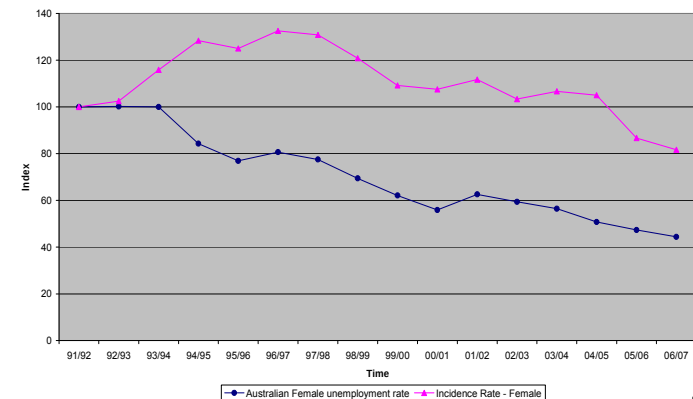
Male and Female Combined



Male



Female





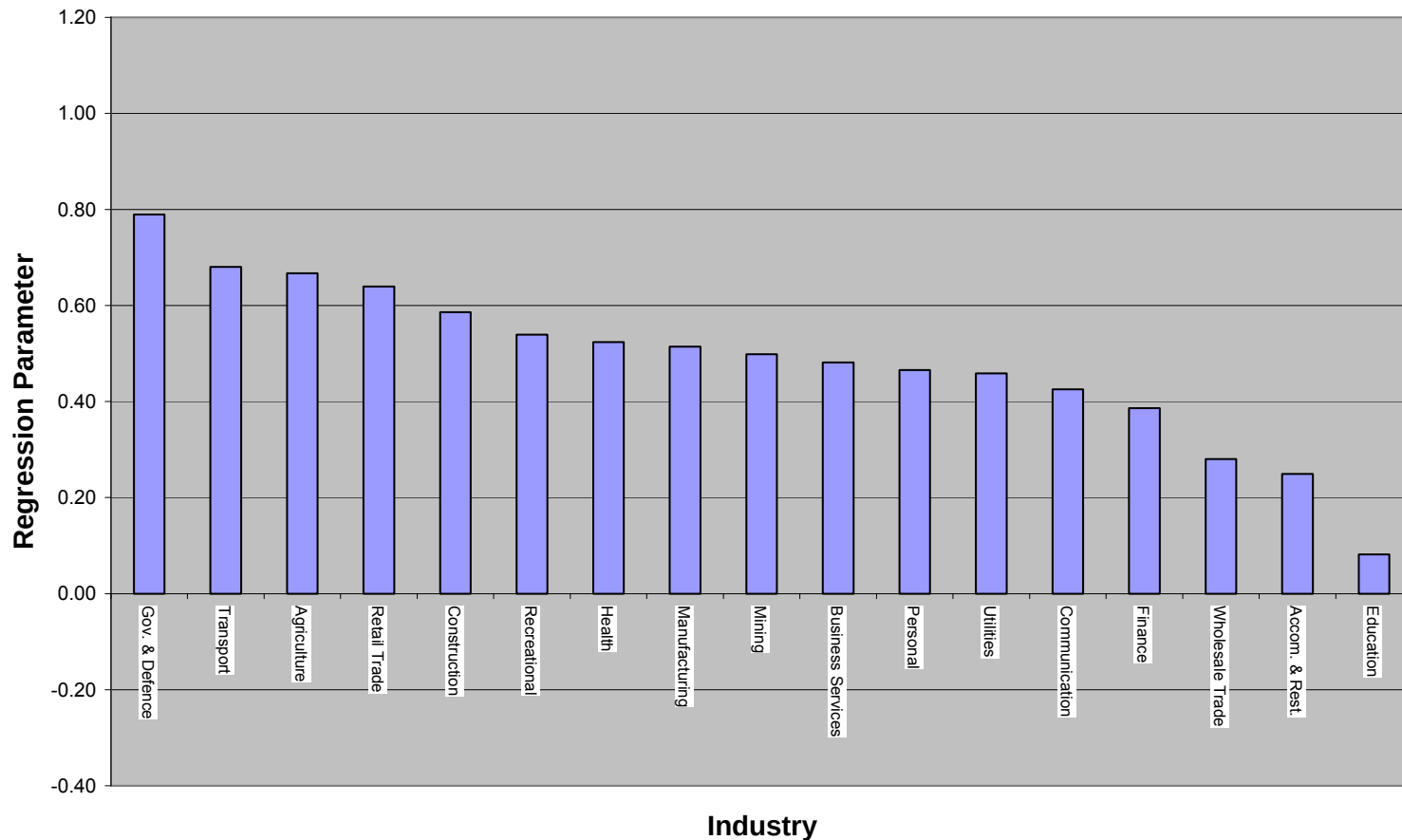
Unemployment Correlation with Workers Comp Employment Injuries

- The injury rate and duration both appear to be more sensitive to the unemployment rate for males than females
- The unemployment rate appears to explain a greater proportion of the variability in the injury rate and duration for males than females
- The apparent greater sensitivity for males than females may be due to differences in the underlying split between white and blue collar for the two sexes.

	Incidence	Duration
<u>Male</u>		
Regression Parameter	1.00	-0.61
R-squared	0.81	0.28
<u>Female</u>		
Regression Parameter	0.58	-0.42
R-squared	0.21	0.17
<u>Male and Female Combined</u>		
Regression Parameter	0.90	-0.51
R-squared	0.76	0.28

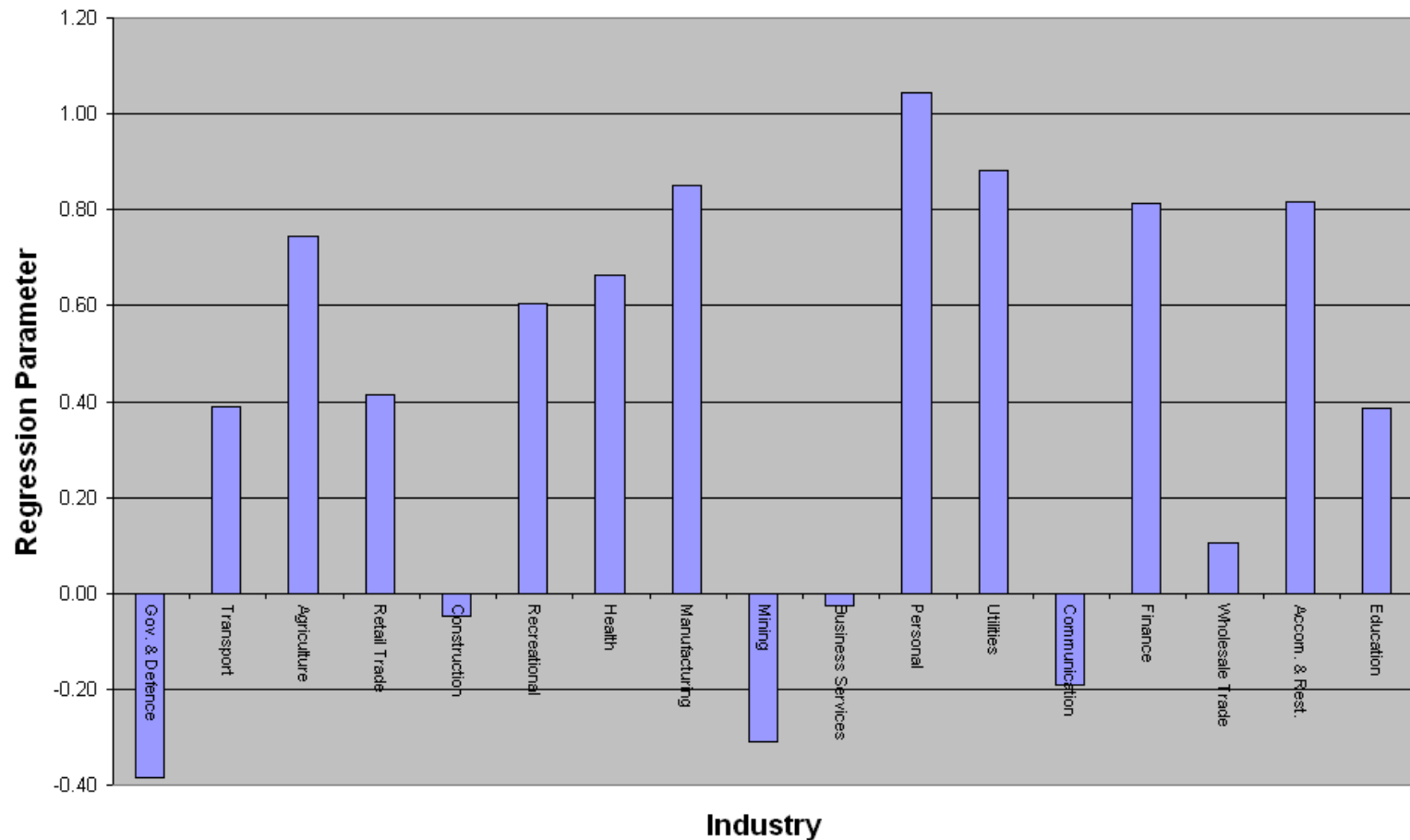


Unemployment vs Workers Comp Employment Injury Rate



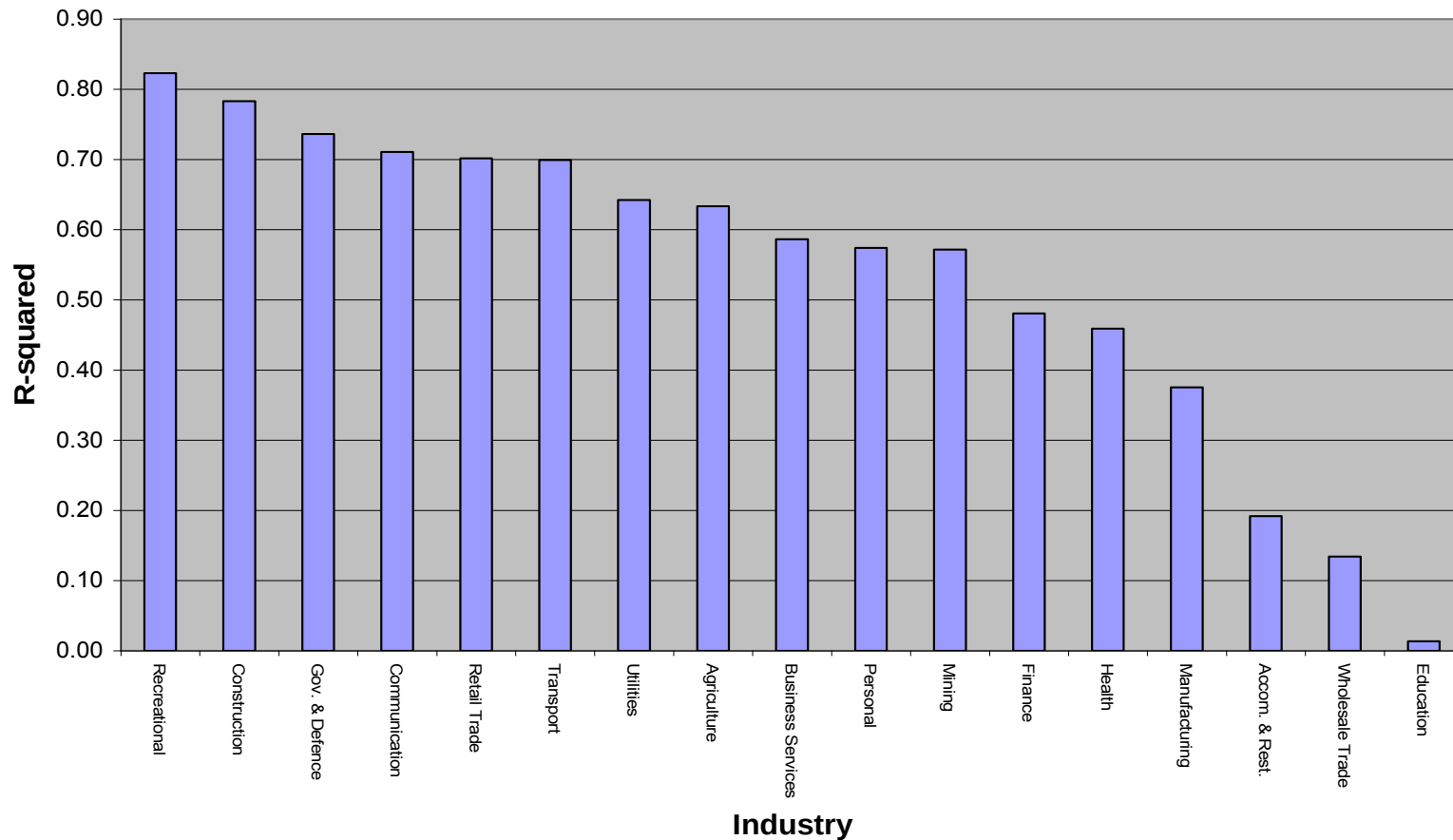


Unemployment vs Workers Comp Employment Injury Duration



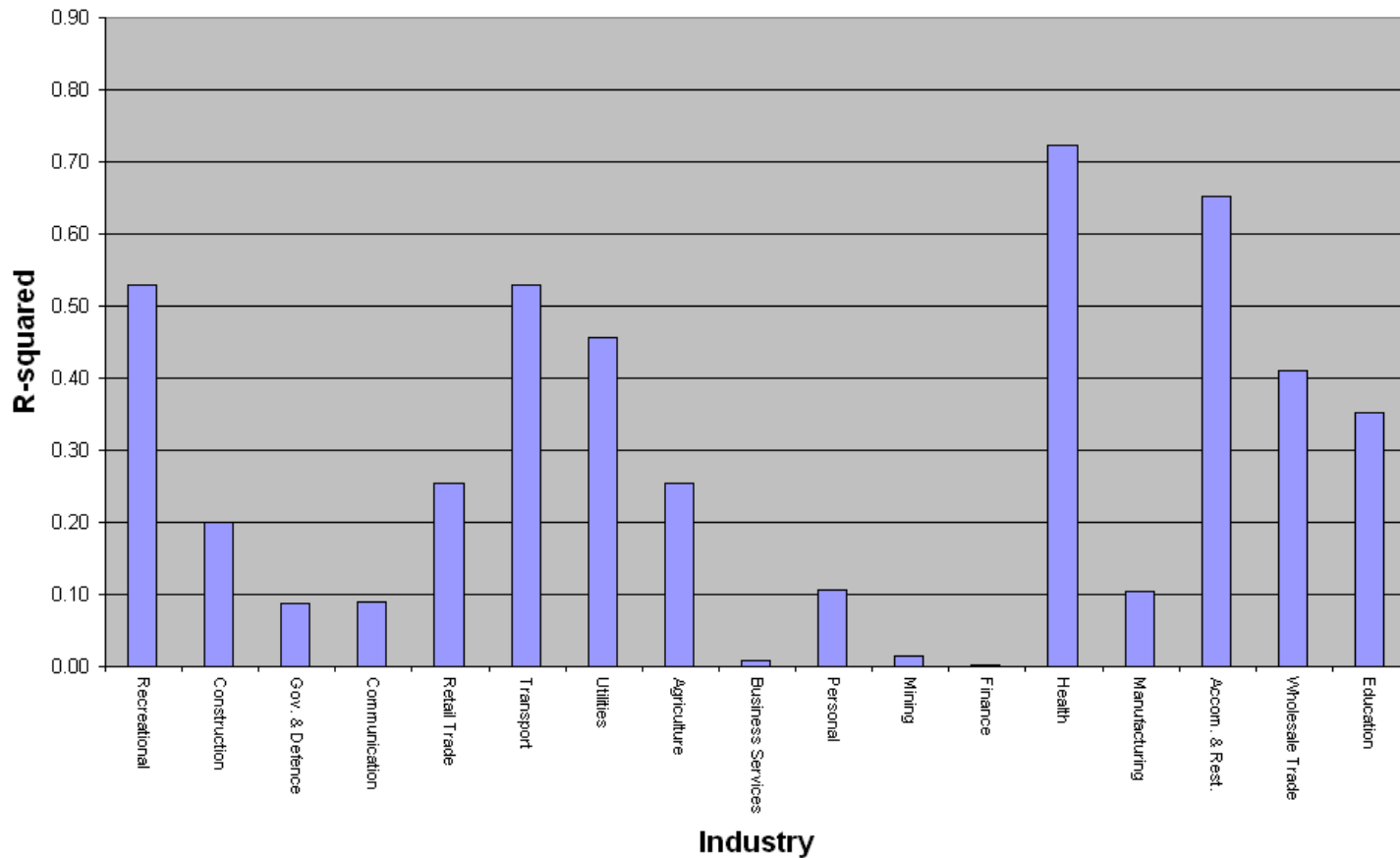


Unemployment vs Workers Comp Employment Injury Rates





Unemployment vs Workers Comp Employment Injury Duration





Regression of Workers Comp Employment Injury Rate and Economic Factors by Industry

	Australian Unemployment Rate	Long term Unemployment Rate	Participation Rate	Consumer Confidence Index	Business Confidence Index	Total number of Bankruptcies
<u>Regression Parameter</u>						
Minimum	0.08	0.13	-0.05	-0.20	-2.18	-0.31
Maximum	0.79	1.31	-0.02	0.06	-0.37	0.17
<u>R-squared</u>						
Minimum	0.01	0.01	0.14	0.00	0.01	0.00
Maximum	0.82	0.90	0.73	0.34	0.28	0.52



Regression of Workers Comp Employment Injury Duration & Economic Factors by Industry

	Australian Unemployment Rate	Long term Unemployment Rate	Participation Rate	Consumer Confidence Index	Business Confidence Index	Total number of Bankruptcies
<u>Regression Parameter</u>						
Minimum	-0.38	-0.69	-0.04	-0.88	-13.06	-0.36
Maximum	1.04	1.87	0.04	0.12	2.83	0.90
<u>R-squared</u>						
Minimum	0.00	0.00	0.00	0.00	0.01	0.01
Maximum	0.72	0.83	0.52	0.73	0.68	0.64



Regression of Workers Comp Employment Injury Experience and Economic Factors by Industry

- The impact the economic factors has on the injury rate appears to vary significantly across industries, however, all economic factors with the exception of total bankruptcies and consumer confidence, all appear to act on the injury rate in the same direction for all industries.
- The proportion of the variability in the injury rate explained by the economic factors also appears to vary significantly across industries.
- The impact the economic factors has on the injury duration appears to vary significantly across industries and appear to act on the injury duration in directions depending on the industry.
- The proportion of the variability in the injury duration explained by the economic factors also appears to vary significantly across industries.



Reliances & Limitations

- This presentation is provided for discussion purposes only. It does not provide advice upon which to base decisions. No liability to any party will be accepted for the consequences of relying on this presentation. In particular, the following limitations are noted:
 - Analysis has not been performed over a full economic cycle.
 - Relationships may change over time.
 - Analysis has been performed against only one variable, with no allowance taken for interactions.



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 - Bruce Edwards
- All views however expressed remain those of the authors.



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Discussion

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