COMPULSORY THIRD PARTY INSURANCE: METHODS OF MAKING EXPLICIT ALLOWANCE FOR INFLATION

B. J. Bruton and J. R. Cumpston
Australia

Summary

An inflation index is essential when constructing claim payment models from past payment data, and when projecting these results to give estimates of the provisions for outstanding claims and of necessary premiums.

This paper examines the choice of inflation indices for compulsory third party insurance in two Australian states. Two different indices, one based on average weekly earnings per employed male unit and the other based on consumer prices, were tested. The index based on average weekly earnings was considered to be superior in that past claim payment data, together with this index, gave reasonably stable claim payment models.

Some experiments were made for an actual office to illustrate the effects of different inflation rate assumptions.

1. Introduction

This paper briefly examines three problems associated with inflation—

(a) When determining provisions for outstanding claims, and premium rates, how can past claim payments be adjusted to remove the effects of inflation?

(b) What proportion of claim payments, if any, is unaffected by inflation after the accident?

(c) What is the effect of different assumptions in establishing provisions for outstanding claims and premium rates?

2. General Background

In Australia, compulsory third party insurance (CTP) covers personal injury received in road accidents, but not damage to vehicles. The amount payable is unlimited, but may be reduced if contributory negligence by the injured person occurred.

In Victoria a large number of insurers shared the market until recently when statutory control of premiums resulted in all but

https://doi.org/10.1017/S0515036100011399 Published online by Cambridge University Press

two insurers withdrawing from the field. In Western Australia, the Motor Vehicle Insurance Trust has had a statutory monopoly for about twenty-five years.

Data has been supplied by one of the two current Victorian insurers, and by the Motor Vehicle Insurance Trust of W.A. These two insurers are of similar size, each making payments to about 7,500 injured persons per annum. We record our appreciation in being able to publish figures from these two sources.

3. Insured Casualties

Data was obtained showing the numbers of vehicles insured during each financial year (period 1 July to following 30 June), together with claim payments for the corresponding twelve months sub-divided by financial year of accident.

It was considered necessary to convert data on numbers of vehicles insured into data on insured casualties. In both states the introduction of legislation making seat-belt use compulsory has led to a substantial decline in the numbers of persons injured or killed in road accidents per registered vehicle. For this reason it was considered that the numbers of insured vehicles provided a poor measure of the underlying exposure to risk.

The increasing use of seat-belts may result in lower claim payments per insured casualty, making insured casualties itself an unreliable measure.

4. Adjustment for Inflation

We consider it is most desirable that *explicit* allowance be made for inflation in determining premium rates and reserves for outstanding claims. Accordingly, past claim payments should be increased by subsequent inflation rates to bring them to current values.

The Australian Bureau of Statistics publishes a number of inflation indices, of which the most relevant are Average Weekly Earnings per Employed Male Unit (AWE), and Consumer Price Index (CPI).

Payments made in respect of CTP insurance can be classified into a number of categories. Hospital, medical, loss of income and other special damages amount to approximately 20% of total

payments. Legal and investigation costs amount to about 20%, and general damages account for the remaining 60%.

Hospital and medical expenses, loss of income payments and legal expenses can be expected to reflect changes in earnings patterns within the community. General damages are awarded by courts (or mutually settled before action) without indication as to the basis of determination; however, these amounts are set against the background of general income levels prevailing at point of payment.

Therefore, on *a priori* grounds it is considered that AWE is likely to prove a more relevant inflation index than CPI. However, a statistical method of testing the appropriateness of different indices would be useful.

5. Claim Payments per Insured Casualty

Table 1 illustrates claim payments per insured casualty in respect of the Motor Vehicle Insurance Trust of W.A., where past experience has been adjusted using AWE as the inflation index Further tables are shown in Appendix A for Western Australian data using CPI to adjust past experience, and for Victorian data using AWE and CPI.

Table 1

Financial year of payment — financial year of accident	W.A. claim payments per insured casualty during each of the following years (claim payments adjusted to 30/6/74 values using AWE index)							
	1966/67	1967/68	1968/69	1969/70	1970/71	1971/72	1972/73	1973/74
	$	$	$	$	$	$	$	$
0	60	58	125	104	101	113	124*	124*
1	326	395	313	396	366	326	414	331
2	469	460	475	414	504	419	438	404
3	307	439	388	339	332	308	303	303
4	134	233	218	177	236	142	156	175
5	75	68	99	86	80	111	93	137
6	50	156	98	193	61	36	52	121
7	0	69	0	0	0	47	64	0
8	0	0	0	0	0	0	81	0
Total	1,421	1,878	1,716	1,709	1,680	1,502	1,725	1,595

(* for explanation, see Appendix A).

https://doi.org/10.1017/S0515036100011399 Published online by Cambridge University Press

If the appropriate inflation index has been used, and the conditions affecting payments have been stable, *level* amounts should appear in each row of the above table.

Accordingly, for each row a straight line was fitted on a least squares basis (ignoring any values marked with asterisks).

This is illustrated in the following graph, where data from the second, third, fifth and sixth rows of Table 1, together with fitted lines, has been shown

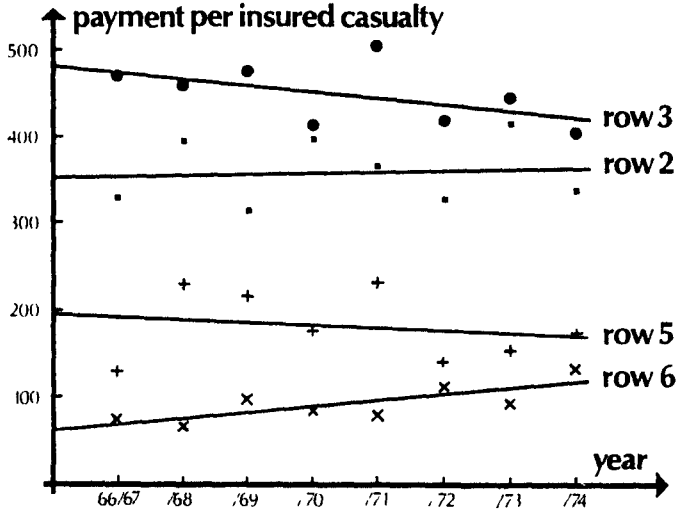

Fig. 1

The slope of each of the fitted lines was tested to see if it was significantly different from zero. The following table sets out the slopes of each line together with an asterisk if the slope was significantly different from zero (at the 5% level).

A two-sided t-test was used, with $(n - 2)$ degrees of freedom, where n was the number of observations.

For both states, the fitted lines obtained using AWE had a mixture of positive and negative slopes. By contrast, all but one of the fitted lines obtained using CPI had positive slopes. We consider this provides some indication that AWE is a more suitable inflation index than CPI in adjusting CTP experience.

TABLE 2

Financial year of payment — financial year of accident	Slopes of trend lines fitted to claim payments per insured casualty (claim payments adjusted to 30/6/74 values)			
	W.A.		Victoria	
	AWE index	CPI index	AWE index	CPI index
0	11	12*	— 1	— 1
1	2	15*	4	12
2	— 8	11	— 8	13
3	— 11	3	— 7	13
4	— 3	4	7	18*
5	7*	9*	29*	32*
6	— 4	0	32*	33*

Although the significance levels between AWE and CPI were inconclusive, we consider that the lower slopes generally provide further confirmation that AWE is a more relevant index.

6. Tests Using Different Proportions Unaffected by Inflation

The preceding section assumes that all payments are affected by inflation. However, it is possible that a proportion of payments (for example, hospital and medical expenses) is *not* affected by inflation after the accident.

TABLE 3

Financial year of payment — financial year of accident	Slopes of trend lines fitted to claim payments per insured casualty (claim payments adjusted to 30/6/74 values using AWE index and assuming that proportions (p) of payments are not affected by inflation after the accident)					
	W.A.			Victoria		
	$p = 0.0$	$p = 0.2$	$p = 0.4$	$p = 0.0$	$p = 0.2$	$p = 0.4$
0	11	11	11	— 1	— 1	— 1
1	2	2	2	4	4	5
2	— 8	— 8	— 8	— 8	— 6	— 4
3	— 11	— 11	— 11	— 7	— 4	— 2
4	— 3	— 3	— 3	7	10	14
5	7*	8*	9*	29*	33*	37*
6	— 4	— 4	— 4	32*	36*	41*

https://doi.org/10.1017/S0515036100011399 Published online by Cambridge University Press

The following table examines the slope of fitted lines using AWE as an inflation index but assuming 20% and 40% of payments are not affected by inflation.

As in the preceding table, the asterisks indicate the statistical significance of the difference from zero of the slopes of the fitted lines.

The above results do not provide any clear support for any particular choice of p. Most of the available data, however, came from a period of low stable inflation rates. Data from a period of unstable inflation rates is necessary before any clear indication as to the true value of p can be obtained.

7. Weighting Factor

In order to reduce the effect of year by year fluctuations, it seems desirable that several years' past experience should be combined when making estimates for future experience.

However, it is likely that various changes have occurred in past years which could permanently affect future experience, e.g. the growing use of seat-belts has reduced the severity of road accidents.

Therefore, we consider that data from recent years is likely to be more reliable than old data. This suggests that estimates should be made using weighted averages of data from several years, placing more weight on the most recent data.

A method by which this can be achieved is described in Appendix B. This method involves the use of a weighting factor in the range 0 to 1. Claim payments made "n" years ago are weighted by the factor raised to the power $(n - 1)$. A zero weighting factor only considers the most recent year's data, and a weighting factor of 1 gives a simple mean of the estimates derived from all the available payment data.

8. Effect of Varying Assumptions

To illustrate the effect of varying assumptions on premium rates and provisions for outstanding claims, the following estimates were made for the Motor Vehicle Insurance Trust of W.A.

TABLE 4
Premiums

Weighting factor	Estimates of necessary earned premiums during 1974/75					
	High future inflation			Low future inflation		
	AWE index, $p = 0.0$	AWE index, $p = 0.4$	CPI index, $p = 0.0$	AWE index, $p = 0.0$	AWE index, $p = 0.4$	CPI index, $p = 0.0$
	$M	$M	$M	$M	$M	$M
0.0	19.7	17.8	16.8	13.0	13.2	11.0
0.2	19.9	17.9	16.8	13.1	13.3	11.0
0.4	20.0	17.9	16.6	13.2	13.4	10.9
0.6	20.2	18.0	16.3	13.3	13.4	10.7
0.8	20.3	18.1	15.7	13.4	13.5	10.3
1.0	20.4	18.1	15.0	13.5	13.5	9.9
Range of estimates	3 %	2 %	11 %	4 %	2 %	10 %

TABLE 5
Outstanding claims

Weighting factor	Estimates of provisions necessary for outstanding claims at 30/6/74					
	High future inflation			Low future inflation		
	AWE index, $p = 0.0$	AWE index, $p = 0.4$	CPI index, $p = 0.0$	AWE index, $p = 0.0$	AWE index, $p = 0.4$	CPI index, $p = 0.0$
	$M	$M	$M	$M	$M	$M
0.0	40.0	36.7	35.5	30.0	29.8	26.7
0.2	40.8	37.3	35.8	30.5	30.2	26.8
0.4	40.9	37.3	35.4	30.6	30.2	26.5
0.6	41.0	37.3	34.4	30.7	30.2	25.8
0.8	41.1	37.1	33.1	30.9	30.1	24.9
1.0	41.1	37.0	31.6	31.0	30.1	23.8
Range of estimates	3 %	2 %	12 %	3 %	1 %	12 %

Inflation was taken into account on the following bases:

High future inflation: AWE increases by 28%, 24%, 20%, 16% and 13% for financial years 1974/75 to 1978/79 and 10% p.a thereafter.

Low future inflation: AWE increases by 7% for each future year.

https://doi.org/10.1017/S0515036100011399 Published online by Cambridge University Press

In all cases CPI increases have been taken as 4% p.a. less than those for AWE. The above estimates were made assuming:

— investment earnings of 9% p.a. in future
— claims administration expenses of 1% of the average provision for outstanding claims during the year
— average premium delay of one month
— initial expenses of 1% of premiums
— profit and solvency margins of 12.5% of premiums.

The above estimates show that when high future inflation is expected, the use of a low index (such as CPI) can, as would be expected, lead to underestimation of necessary future premiums and provisions for outstanding claims. In such conditions, the use of a more appropriate index (such as AWE) but too high a value of p, can also lead to underestimation. Where a low index is used, the degree of underestimation increases as the weighting factor increases. This occurs because increasing weight is being placed on payments made many years ago, which have not properly been converted to current values.

If low future inflation is expected, the use of a low index can also lead to underestimation. The use of a more suitable index, but too high a value of p, may however cause very little error. This is because a high value of p leads to higher claim payments per insured casualty derived from past data, compensating partly or wholly for the underestimation of the future effects of inflation.

We consider that some indication of the relevance of the inflation index can be obtained from the range of results obtained with different weighting methods. The above tables show that the estimates obtained using CPI as an index have a much greater spread than those obtained using AWE. If there is reason to believe that the underlying payment process has been stable for a number of years, then a wide range of estimates resulting from different weighting methods suggests that an inappropriate inflation index has been used. This is only a rough criterion, however, and it would appear unwise to conclude from the above ranges that the use of AWE with $p = 0.4$ is better than the use of AWE with $p = 0.0$.

The above tables clearly show the effect of high inflation on this class of insurance.

https://doi.org/10.1017/S0515036100011399 Published online by Cambridge University Press

APPENDIX A

Claim payments per insured casualty

Table 1: See section 5 of text.

Table 6: Western Australia data using CPI to adjust past experience.

Table 7: Victorian data using AWE to adjust past experience.

Table 8: Victorian data using CPI to adjust past experience.

TABLE 6

Financial year of payment — financial year of accident	W.A. claim payments per insured casualty during each of the following years (claim payments adjusted to 30/6/74 values using CPI index)							
	1966/67	1967/68	1968/69	1969/70	1970/71	1971/72	1972/73	1973/74
	$	$	$	$	$	$	$	$
0	41	42	95	83	87	102	112*	118*
1	224	285	237	318	315	293	373	315
2	323	332	359	332	435	377	394	384
3	211	317	294	272	286	277	273	288
4	92	168	165	142	203	128	141	166
5	52	49	75	69	69	100	83	130
6	34	113	74	155	52	33	47	115
7	0	50	0	0	0	42	58	0
8	0	0	0	0	0	0	73	0
Total	977	1,356	1,299	1,371	1,447	1,352	1,554	1,516

TABLE 7

Financial year of payment — financial year of accident	Victorian claim payments per insured casualty during each of the following years (claim payments adjusted to 30/6/74 values *using AWE index*)								
	1965/66	1966/67	1967/68	1968/69	1969/70	1970/71	1971/72	1972/73	1973/74
	$	$	$	$	$	$	$	$	$
0	24	19	14	21	19	16	36*	53*	50*
1		260	259	245	273	165	247	264	314
2			583	610	603	529	494	550	588
3				551	609	537	541	510	563
4					380	394	349	414	407
5						196	204	246	278
6							97	127	161
7								57	83
8									41

https://doi.org/10.1017/S0515036100011399 Published online by Cambridge University Press

TABLE 8

Financial year of payment — financial year of accident	Victorian claim payments per insured casualty during each of the following years (claim payments adjusted to 30/6/74 values *using CPI index*)								
	1965/66	1966/67	1967/68	1968/69	1969/70	1970/71	1971/72	1972/73	1973/74
	$	$	$	$	$	$	$	$	$
0	17	14	10	16	16	14	33*	49*	48*
1		193	196	193	228	146	224	247	300
2			441	480	503	467	449	514	561
3				434	507	474	491	477	537
4					317	348	316	388	388
5						173	185	230	265
6							88	119	153
7								53	80
8									39

Values marked with an asterisk are suspect, as they depend considerably on the accuracy of adjustments made in order to remove the effects of no-fault payment schemes. *All* the Victorian values are approximate, as they have been derived from records sub-divided by year of *reporting*, not year of accident.

APPENDIX B

Estimation methods

Let $m(k)$ be the claim payments (in current values) per unit of risk, paid in the $(k-1)$th year after the year of accident, which is to be estimated

$c(j)$ be the conversion factor used to convert claim payments during the j'th most recent payment year to current values (assuming that 100% of all payments are directly linked to the inflation index)

$e(j)$ be the exposure to risk in the j'th most recent accident year

p be the proportion of claim payments not affected by inflation after the accident

$P(j, k)$ be the claim payments made in the j'th most recent payment year as a result of accidents in the $(k-1)$th year prior to the payment year

https://doi.org/10.1017/S0515036100011399 Published online by Cambridge University Press

n be the number of payment years for which data is available
$M(j, k)$ be the estimate of $m(k)$ derived from $P(j, k)$
w be the weighting factor used when combining values of $M(j, k)$ in order to make an estimate of $m(k)$
$g(i)$ be the increase in the inflation index forecast during the i'th future year
and $F(i, j)$ be the claim payments in the i'th future year resulting from the j'th most recent accident year.

The estimation methods used in this paper were:

$$M(j,k) = \frac{P(j,k)}{e(j+k-1)} \left[\frac{c(j)}{(1-p) + p\,\dfrac{c(j)}{c(j)+k-1)}} \right]$$

$$m(k) = \frac{\sum_{j=1}^{n} w^{j-1} M(j,k)}{\sum_{j=1}^{n} w^{j-1}}$$

$$F(i,j) = e(j)\,\frac{m(i+j)}{c(j)} \left[p + (1-p)c(j) \prod_{k=1}^{i-1} (1+g(k)) \left(1 + \frac{g(i)}{2}\right) \right]$$

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