Price Expectations in Australia*

1. *Introduction*

Economic theory frequently discusses the role of expectations, often with some *ad hoc* theorizing about their formation. Expectations about changes in the price level are of special relevance in periods of more rapid inflation. As persistent inflation becomes built in to expectations, workers will be likely to demand higher money wages to offset it. Employers, if they share these expectations, will feel confident of being able to pass on the increased costs and so will more readily accede to wage demands. Financial assets, such as cash or government securities, have capital values fixed in money terms. In contrast, real assets, such as consumer durables or investment goods, have values that rise in line with prices and hence provide hedges against inflation. Thus, if a higher rate of inflation is expected, there will be an incentive to switch from financial to real assets. In the process, rates of return on financial assets (nominal interest rates) will, given relative supplies, become higher. Hence wage, price, asset demand and nominal interest rate equations will have price expectations as an explanatory variable.[1]

This article presents three measures of price expectations in Australia, compares their properties and explains the two directly measured series. We preface the more detailed discussion of the Australian measures with a brief survey of the various indirect approaches to the representation of expectations in previous empirical studies.

Anything as subjective as people's expectations is of course difficult to measure. An approach frequently adopted is to assume that expectations are based simply on past values of the variable concerned. Although Parkin[2] has called this the 'dumb beast' approach, it is possible to allocate weights to allow for extrapolation of trends, reversal of trends, or to include both extrapolative and regressive elements. Helliwell and Glorieux,[3] as well as surveying earlier contributions, have generalized this approach in representing income expectations for investment equations.

[1] The influence of price expectations, on wage and interest rate determination in particular, is discussed in M. Friedman, 'The Role of Monetary Policy', *American Economic Review*, March 1968.

[2] M. Parkin, 'The U.K. Evidence on the Causes of Inflation' in G. Haberler, M. Parkin and H. Smith, *Inflation and the Unions*, Institute of Economic Affairs. 1972.

[3] J. F. Helliwell and G. Glorieux, 'Forward Looking Investment Behaviour', *Review of Economic Studies*, October 1970.

A related approach employs the quite plausible 'adaptive expectations' mechanism, which postulates that expectations are revised in proportion to the error in the previous forecast. The adjustment weights can be estimated directly,[4] but a more reliable technique utilizes a mathematical transformation, which shows that expectations derived according to the adaptive expectations hypothesis are, in fact, a weighted average of all past values of the variable, with geometrically declining weights. In both this and the extrapolative/regressive scheme, many sets of expectational variables are tried and the one that performs best in the relevant equation is selected to represent expectations. Cagan[5] used this approach in representing price expectations in a demand for money function, and Solow[6] in a reduced form price equation. Fisher,[7] who seems to have been the first to attempt to represent price expectations empirically, tried various declining weight patterns on past price changes in an interest rate equation, but with arithmetically declining weights.

A slightly more sophisticated version allows the model to choose the weights directly, by inserting several values of past price changes in the equation, or more reliably by using a constrained lag estimation procedure such as the Almon technique.[8] This approach was used by Helliwell and others[9] in Australian (and Canadian) interest rate equations. The 'dumb beast' technique can be modified by introducing non-price variables thought likely to influence price expectations. Boxall and Helliwell's results, with a modification discussed below, represent one measure of price expectations in Australia.

It is, however, placing considerable weight on the specification of the model being tested to ask it to measure price expectations in one of the above ways. Hence we report two attempts to measure price expectations more directly. Forecasts of economic magnitudes are made by various groups, and they may have a considerable influence on the users of these forecasts. For the United States, Turnovsky[10] has used the results of a long-established survey of economists' price forecasts collected by J. A. Livingston. More relevant may be the predictions of influential private forecasting enterprises and we

[4] E. L. Feige, 'Expectations and Adjustments in the Monetary Sector', *American Economic Review*, May 1967.

[5] P. Cagan, 'The Dynamics of Hyper Inflation', in M. Friedman (ed.), *Studies in the Quantity Theory of Money*, University of Chicago Press, 1956.

[6] R. M. Solow, *Price Expectations and the Behaviour of the Price Level*, Manchester University Press, 1969.

[7] I. Fisher, *The Theory of Interest*, Macmillan, 1930.

[8] S. Almon, 'The Distributed Lag between Capital Appropriations and Expenditures', *Econometrica*, January 1965.

[9] J. Helliwell *et al.*, 'The Supply Price of Capital in Macro-economic Models', in A. A. Powell and R. A. Williams (eds.) *Econometrics of Macro and Monetary Relations*, North Holland, forthcoming; and P. J. Boxall and J. F. Helliwell, *The Share Market Value of Business Assets, The Supply Price of Capital and Price Expectations*, Reserve Bank of Australia, Research Discussion Paper No. 23, December 1971.

[10] S. J. Turnovsky, 'Empirical Evidence on the Formation of Price Expectations', *Journal of the American Statistical Association*, December, 1970.

report the forecasts of Philip Shrapnel and Company, a well-known market research organization in Australia.[11] Newspapers frequently discuss economics, and although they rarely make specific numerical forecasts, their readers usually gain a fairly firm opinion of where the economy is headed. Our third measure of price expectations is thus based on statements about inflation made by the *Australian Financial Review*.

One advantage of direct measures of price expectations is that one can check how expectations are formed by statistical explanation of these variables. In explaining the Livingston series, Turnovsky explored various lag structures on past price changes, then introduced the unemployment rate as an indicator of current economic conditions, although he found this to be statistically unimportant.[12] We reach the opposite conclusion—variables reflecting current economic conditions generally believed to influence prices (in particular wage rate changes, labour market conditions and government policy changes) are important in modifying the influence of past price changes.

2. *Direct Measures of Price Expectations*

The only reasonably long time series of price forecasts that were available to us were the forecasts of Philip Shrapnel and Company. This company prepares quantitative economic forecasts twice a year (in March and September), and these include forecasts of the future annual change in the price level. We interpolated the series linearly for quarterly predictions, and Mr Shrapnel agreed that this was a reasonable procedure to adopt for his forecasts. Of course we have no direct evidence of the degree to which these forecasts are accepted by Australian businessmen, but a growing readership may suggest that in general subscribers are happy with the forecasts. It is doubtful if more than a few subscribers have the resources to produce an independent estimate, and so the Shrapnel forecast is likely to be widely accepted by businessmen. Presumably, there are also quantitative official forecasts, although these are not published. It would of course be interesting to see if the Shrapnel forecast often differed from official ones.

The second approach is to infer the price expectations likely to be generated by statements on the state of the economy made by an influential newspaper, the *Australian Financial Review* (A.F.R.). Although the A.F.R. does not often offer a specific price forecast, we believe that their readers would obtain a fairly firm feeling about expected inflation. However, there are obviously serious problems in

[11] We would like to acknowledge with thanks Mr Philip Shrapnel's co-operation in allowing us to use and publish his forecasts. It would have been interesting to obtain other private forecasts, but the other long-established forecasts known to us were not made available.

[12] This modification has also been used by L. C. Andersen and K. M. Carlson, 'A Monetarist Model for Economic Stabilization', *Federal Reserve Bank of St. Louis Review*, April 1970.

trying to place a precise quantitative figure on some of the more obscure comments made by a newspaper. To reduce the subjective element involved, four people[13] independently examined a list of quotations from the A.F.R. and each constructed his own series. They then conducted an exercise in jawboning in which each person attempted to defend his position where figures differed, and convince the others that he was right. The group generally reached a consensus about the direction of change fairly readily, although the timing of changes differed slightly. The particular level chosen at any time was more difficult to establish although some benchmarks were provided by the A.F.R. in the form of particular figures. The remaining differences in both level and timing are illustrated in Figure 1, where each person's estimates are graphed. We are confident that the close similarity of the individual estimates did not arise because of domination of the group by one of its members. A vital test would be provided, however, if another group could construct a similar series in the same manner, without of course knowing the details of our series. For our measure of the price expectations of the A.F.R. we averaged the four individual series, and this average is presented in Appendix A.

Figure 2 compares the Shrapnel and A.F.R. series. The A.F.R. series was constructed before we had any detailed knowledge of the Shrapnel series, and so the general similarity of the two is encouraging.[14] The chief difference lies in the greater variability of the Shrapnel series, which could well reflect conservatism in constructing the A.F.R. series. In addition, the Shrapnel series often leads the A.F.R. series. This may reflect conservatism in the construction of the latter, or a conservative bias in press comments on inflation. There is of course the possibility that the A.F.R. takes considerable notice of Shrapnel's forecasts.

3. *Portfolio Balance Theory*

As noted above, Boxall and Helliwell have used portfolio equilibrium theory[15] to derive a measure of price expectations in Australia. They 'explain' statistically the difference between the current yield on government securities (a nominal rate of return) and a measure of the yield on business assets (a real rate of return) by the earnings yield on foreign assets and price expectations, represented in their equation as a distributed lag on past price level changes. The lag dis-

[13] At the time, all four were employed by Economist Section, Reserve Bank of Australia, Melbourne. They were Miss Karen Hurrell, Mr T. S. Flanagan, Mr T. J. Barker and Mr P. D. Jonson. The present writers would like to acknowledge with thanks the assistance of the other three involved.

[14] Simple regression results of Shrapnel series on A.F.R. series $r^2 = 0{\cdot}67$, $DW = 0{\cdot}6$.

[15] Similar studies, with British and American data include: T. J. Sergeant, 'Commodity Price Expectations and the Interest Rate', *Quarterly Journal of Economics*, February 1969; S. B. Gupta 'The Portfolio Balance Theory of the Expected Rate of Change of Price', *Review of Economic Studies*, April 1970.

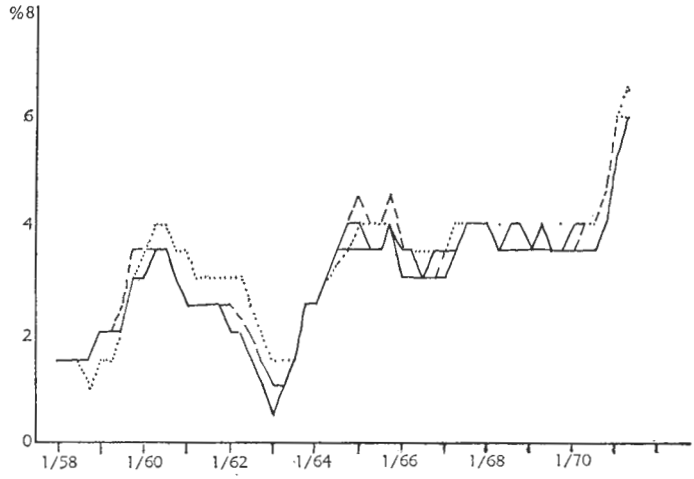

Figure 1: Individual Estimates of A.F.R. Price Expectations

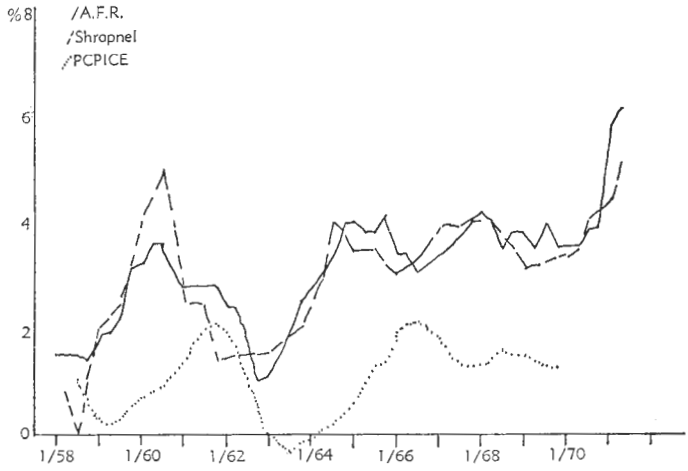

Figure 2: Three Price-expectation Series

tribution is estimated with the Almon technique and, in some experiments, a labour market variable is allowed to influence the weights on past price changes. Their theory suggested the inclusion of a term to represent the relative supply of bonds and equities, but this was not significant in their equations.

Although the labour market variable slightly improved the fit of their equation, they decided that the improvement was not sufficient to justify the added complexity, and their preferred equation includes only past price changes to represent price expectations. Their measure of price expectations (denoted *PCPICE*) is obtained by multiplying the weights obtained in their equation by past price changes, and their series is included in Appendix A. In view of our finding (see Section 4 below) that the rate of change of the money supply is an important determinant of the directly measured price expectation series, we re-estimated[16] Boxall and Helliwell's preferred equation (No. 16(a)) with this variable included. The result is included in Appendix A, and the revised price expectation series included on Figure 2 with the direct measures.

Figure 2 illustrates that the level of *PCPICE* is considerably below that of the direct measures, and its turning-points lag behind the Shrapnel series by up to eight quarters. Since the series derived from portfolio theory is based on market behaviour, it seems important to explain these differences. A major point is that the direct measures

[16] We revised the estimate of *PCPICE* by including the rate of change of the money supply in equation 16(a) of Boxall and Helliwell, op. cit. We also reduced the lag on past prices to eight quarters in line with the results of equation 4 below. The resulting equation, with our notation for past prices, is:

$$RGM - 100\left(\frac{J4S(YCUN)}{VKB}\right) = \underset{(2.18)}{1.65} + \sum_{i=0}^{7} \dot{p}_{t-i} + \underset{(1.28)}{0.04\,\dot{m}s_t} - \underset{(8.51)}{0.61\,RYPUKUS}$$

$$S.E.E. = 0.408 \qquad \bar{R}^2 = 0.84 \qquad D.W. = 1.08$$

Weights on p_{t-i}

Lag	*Weight*	*t-ratio*
W_0	−0·08309	(1·61)
W_1	0·04667	(3·27)
W_2	0·11497	(4·91)
W_3	0·13548	(5·59)
W_4	0·12188	(7·53)
W_5	0·08786	(6·51)
W_6	0·04709	(2·35)
W_7	0·01324	(0·70)
Sum	0·48409	

The revised estimate of *PCPICE* in Appendix A is derived from this equation, i.e.

$$PCPICE \text{ (Revised)} = \sum_{i=0}^{7} W_i \dot{p}_{t-i} + 0.04\,\dot{m}s_t$$

We acknowledge with thanks the assistance of Mr R. E. Lightfoot in the above re-estimation.

are measures of the current quarter expectation of the change in the price level over the next year; the portfolio model measure is conceptually the change expected in the current quarter, expressed as an annual rate. The residual lag is probably explained by the inertia usually postulated in adjustment of financial market behaviour to changing prices. Shrapnel and Company, and to a lesser extent the *Australian Financial Review* (as interpreted by economists interested in inflation), are likely to react more rapidly to changes in prices than would the average market operator. The market inertia may have been especially strong over the PCPICE sample period of 1958(3) to 1969(4) as during this time inflation only once became a serious policy problem.

4. *Statistical Explanation of the Directly Measured Series*

The general agreement of the Shrapnel and A.F.R. series is reflected in similar results when we use regression analysis to 'explain' them. Hence we discuss the statistical results together, giving both versions of the most important equations. Our statistical investigations have followed two main directions. We have experimented with various simple lag structures on past price level changes and then added other variables, to represent current economic conditions or policy variables, to the lagged price equations. We found that adding other lag structures sometimes meant that one lag structure did relatively better than in the simple regression. As well as p_t, the annual average percentage change in the consumer price index, we define p_t^{ei} $(i = 1, 2)$. p^{e1} is the Shrapnel series and p^{e2} the A.F.R. series.

Lag Structures on Past Price Changes

Following Solow,[17] we constructed several weighted averages of past price level changes using the adaptive expectations hypothesis discussed above. It is worth explaining this procedure in some detail, because, although we later replace this mechanical method of representing past price changes, our results using it have an implication for an important theoretical issue.

The adaptive expectations hypothesis assumes that the change in 'expectations' (p^*) is a constant proportion of the difference between the actual results and 'expectations', giving equation 1.

$$p^*_{t+1} - p^*_t = (1 - \theta)(\dot{p}_t - p^*_t), \quad 0 < \theta \leqslant 1 \tag{1}$$

This is equivalent to[18]

$$p^*_{t+1} = \theta p^*_t + (1 - \theta)\dot{p}_t \tag{2}$$

Hence one can generate a series for p^* by starting with an assumed value

[17] Op. cit.

[18] And also $p^*_{t+1} = (1 - \theta)\sum_{i=0}^{\infty} \theta^i \dot{p}_{t-i}$

for p_0^* and working forward. Following a similar procedure to Solow, we started with $p^*_{50(1)} = \dot{p}_{50(1)}$. Solow constructed nine such series with weights from 0.1 to 0.9, selecting the weight that performed best in his price equation. That is, Solow used his p^* series to represent price expectations in his price equation, and drew some important policy conclusions from the fact that his best result had a coefficient of less than unity on past prices.

Sergeant[19] has criticized this, and other similar studies, because, to identify the coefficient on p^*, it is necessary to assume that the sum of the weights on past prices is unity. But he produces persuasive theoretical argument to show that with observed American (and we add Australian) price experience, the sum of the weights should be less than unity. Imposing the restriction that this sum is unity produces an underestimate of the coefficient on price expectations, and thus misleading policy prescriptions about possible 'trade-offs'.

We used three p^* series to explain our directly measured price expectation series, and hence we can test the assumption about the sum of the weights on past prices. We experimented with $\theta = 0{\cdot}25$, $0{\cdot}50$ and $0{\cdot}75$, and for both our dependent variables our best results were achieved with the first series:

$$p^{e1} = \underset{(6.20)}{1.69} + \underset{(4.95)}{0.50}\, p^* \qquad (3)$$

$S.E.E. = 0.9387 \qquad \bar{R}^2 = 0.36 \qquad D.W. = 0.40$

$$p^{e2} = \underset{(10.79)}{1.90} + \underset{(7.11)}{0.47}\, p^* \qquad (4)$$

$S.E.E. = 0.6065 \qquad \bar{R}^2 = 0.53 \qquad D.W. = 0.46$

In both cases, the coefficient on p^* is considerably less than unity, which would appear to provide important empirical support for Sargeant's argument.

We also carried out other relatively simple experiments using $\dot{p}_t$ (the special case of $\theta = 0$) $\dot{p}_{t-1}$ and $\dot{p}_{t-2}$ in place of p^*. The best results were obtained with $\dot{p}_t$ which improved on equation (3) for p^{e1}. We also tried the Almon lag technique, to estimate the lag weights on past prices directly and obtained improved results for p^{e2}. The best result was obtained with a lag of eight quarters (and in this case, the sum of the weights was also less than unity).

Current Economic Variables

Our three p^* series, $\dot{p}_t$, $\dot{p}_{t-1}$ and $\sum_{i=0}^{k} W_i\, \dot{p}_{t-i}$ (with $k = 3$, 7 and 11 respectively) were each used with the rate of change of wages, the money supply and government expenditure, the unemployment rate, the average income tax rate and a dummy variable with arithmetically declining weights from the fourth quarter of 1960 to represent the

[19] T. J. Sergeant, 'A Note on the "Accelerationist" Controversy', *Journal of Money, Credit and Banking*, August 1971.

5. *Conclusions*

We believe that our results establish the importance of changes in current economic variables in establishing price expectations, and thus throw doubt on the common practice in both theoretical and empirical work of using some arbitrarily selected distributed lag of past price level changes. The relative simplicity of our best equations suggest alternatives for theoretical work, and the directly measured series themselves could be used in empirical work as well as *PCPICE*. One way to determine which series best represents price expectations in Australia is to see which does best in wage, price and asset demand equations.[22] However, it may not be a matter of simply selecting one of the measures; *PCPICE* is likely to do relatively better in asset demand and interest rate equations and one of the direct measures could do better in wage and price equations.

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APPENDIX A

Four Price-expectation Series

Quarter	*Shrapnel*	*A.F.R.*	*PCPICE*	*PCPICE (Revised)*
1-58	0·8	1·5		
2-58	0·4	1·5		
3-58	0·0	1·5	1·25	1·10
4-58	1·0	1·4	0·64	0·66
1-59	2·0	1·9	0·32	0·66
2-59	2·2	1·9	0·21	0·72
3-59	2·5	2·2	0·34	0·90
4-59	3·2	3·1	0·57	1·06
1-60	4·0	3·2	0·74	1·11
2-60	4·5	3·6	0·81	1·09
3-60	5·0	3·6	0·90	1·07
4-60	3·7	3·1	1·11	1·24
1-61	2·5	2·8	1·42	1·54
2-61	2·5	2·8	1·74	1·90
3-61	2·5	2·8	2·00	2·23
4-61	1·2	2·8	2·09	2·33
1-62	0·0	2·4	1·96	2·16
2-62	0·7	2·4	1·63	1·75
3-62	1·5	1·9	1·09	1·17
4-62	1·5	1·5	0·51	0·66
1-63	1·5	1·0	0·05	0·34
2-63	1·6	1·1	—0·22	0·23
3-63	1·8	1·5	—0·28	0·29
4-63	2·1	2·5	—0·18	0·49
1-64	2·5	2·5	—0·05	0·60
2-64	3·2	3·0	0·10	0·66
3-64	4·0	3·5	0·23	0·73
4-64	3·8	4·0	0·37	0·76

[22] Following for example: S. J. Turnovsky, 'The Expectations Hypothesis and the Aggregate Wage Equation: Some Empirical Evidence for Canada', *Economica*, February 1972; Solow, op. cit.; Cagan, op. cit.

Quarter	*Shrapnel*	*A.F.R.*	*PCPICE*	*PCPICE (Revised)*
1-65	3·5	4·0	0·64	1·01
2-65	3·5	3·8	0·96	1·33
3-65	3·5	3·8	1·31	1·63
4-65	3·2	4·1	1·62	1·88
1-66	3·0	3·4	1·88	2·09
2-66	3·1	3·4	2·02	2·17
3-66	3·3	3·1	2·07	2·24
4-66	3·6	3·2	1·98	2·17
1-67	3·9	3·4	1·78	2·00
2-67	3·9	3·6	1·53	1·80
3-67	3·9	4·0	1·32	1·61
4-67	4·0	4·0	1·31	1·69
1-68	4·1	4·0	1·34	1·74
2-68	3·9	3·5	1·44	1·90
3-68	3·7	3·8	1·56	2·01
4-68	3·4	3·8	1·53	1·85
1-69	3·1	3·5	1·45	1·75
2-69	3·1	4·0	1·39	1·67
3-69	3·2	3·5	1·32	1·61
4-69	3·3	3·5	1·28	1·68
1-70	3·3	3·6		
2-70	3·7	3·9		
3-70	4·1	3·9		
4-70	4·3	4·4		
1-71	4·5	5·8		
2-71	5·3	6·1		

APPENDIX B

Notation and Data Sources

$\dot{p}_t$ Annual percentage rate of exchange of the CPI (All groups) 1966-67 = 100. Source: Commonwealth Bureau of Census and Statistics, *Monthly Review of Business Statistics.*

$\dot{w}_t$ Annual percentage change of average weekly earnings per employed male. Source: as for $\dot{p}_t$.

$\dot{m}s_t$ Annual percentage change of the volume of money published in the Reserve Bank of Australia, *Statistical Bulletin,* various issues.

u_t Deseasonalized ratio of total registered unemployed to all non-rural civilian and defence forces: Sources: Department of Labour and National Service, *Monthly Review of the Employment Situation* (formerly *News Release*) and the Commonwealth Bureau of Census and Statistics, *Employment and Unemployment,* respectively.

$\dot{g}_t$ Annual percentage rate of change of total government expenditure comprising net current expenditure on goods and services by public authorities plus gross fixed capital expenditure by public authorities and public enterprises. Commonwealth Bureau of Census and Statistics, *National Accounts—National Income and Expenditure.*

a_t Average taxation rate constructed by dividing total Commonwealth and State taxation revenue (Consolidated Revenue Fund) seasonally adjusted by gross national product seasonally adjusted. Sources: Commonwealth Bureau of Census and Statistics, *Monthly Review, National Accounts,* respectively.