Partial Adjustment, Multiple Expectations and the Demand for Money in Australia*

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I. Introduction

The specific form of the demand function for money is of paramount theoretical and practical importance. From the theoretical point of view a considerable part of the differing views held by the *Keynes*ians and the monetarists can be made explicit in terms of the specific demand function for money each favours. Although a host of differences about the appropriate form of this demand function exists, the focal point of divergence concerns the interest elasticity of the demand for money. Advocates of the liquidity preference theory emphasise the interest variable within demand functions for money and postulate that the elasticity is high. Adherents of the restated quantity theory do not disregard the interest rate, but posit that the observed and preponderantly considered interest rate, say on bonds, is only of secondary importance for the decision to hold money. Consequently, they expect the interest elasticity with respect to money balances to be low. This controversy dominated the debate for a long time. However, recently some other vital issues have come to the forefront, demanding attention. These include the evaluation of the *Baumol-Tobin* hypothesis for the demand function for money, its stability, the search for the homogeneity degree of the money demand in absolute prices and the discussion of whether expectations influence the desired money balances. For the monetary authorities these questions are of considerable practical importance. If monetary policy is based on an incorrect idea about the shape of the money-demand-function, then the Reserve Bank or the Treasury might find it difficult to calibrate the desired interest rate policy. Monetary policy

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might even have fatal consequences for economic stability if it is not realised that inflationary expectations may well play a role in determining the demand for money. A priori considerations suggest that inflationary expectations might be relevant and may gain even more importance in the future. However, not very much is known about the magnitude of any such influence in the case of Australia. It is the main purpose of this study to investigate the determinants of the demand for money in Australia. In particular we are interested in isolating the effects of expectations with respect to income, interest rates and inflation on money balances and the consequences of delayed portfolio adjustments. The application of distributed lags permits one to go beyond the limits of the static liquidity preference function in order to accomplish this task. The widely used partial adjustment and adaptive expectations models, however, implicitly assume that the lagged influence of the independent variables follows a geometrically declining pattern. This assumption is probably unnecessarily restrictive. For this reason the more flexible *Almon* interpolation technique was also employed.

The paper is ordered in the following manner: Section II contains an outline of the principal issues and a summary of previous research. In Section III a partial adjustment model is developed, estimated and the results interpreted, while Section IV examines the influence of income, interest and price expectations on the demand for money. Finally part V contains a summary and the concluding remarks.

Briefly, the most striking feature of the empirical results is the manner in which price expectations emerge as a significant factor in portfolio choice.

II. Principal Issues and Previous Research

The Cambridge version of the quantity theory posited that the economy will hold a constant proportion of current income in the form of cash balances. The theoretical justification for formulating the demand for money as a function of the bond interest rate has been provided mainly by *Keynes'* liquidity preference concept. In empirical studies these relations were combined in the demand-for-money-function. The literature centering around this traditional approach is by now voluminous.

The debate has been rekindled recently when the importance of expectations, especially inflationary expectations, and the effects of delayed portfolio adjustments for the demand for money became apparent.

With respect to the traditional approach three crucial points have retained currency in the course of the discussion. First and foremost, there is the controversy about the influence of the interest rate on the demand for money. Authors writing in the tradition of the quantity theory questioned on a priori grounds the importance of the bond interest rate for the decision to hold cash balances. Their most prominent scholar, Milton *Friedman* (1959), found the influence of the interest rate to be insignificant, although he has since altered his position, admitting that the interest rate might be relevant (1966). On the basis of the empirical evidence it is now agreed that the interest elasticity of the demand for currency ranges between -0.10 and -1.10. *Laidler* (1966), *Teigen* (1964), *Heller* (1965) *and Hamburger* (1966) are some of those with low values of the interest elasticity, whereas *Meltzer* (1963), *Brunner-Meltzer* (1964), *Courchene* and *Shapiro* (1964) and C. A. E. *Goodhart* and A. D. *Crockett* (1970) found the values to be high. The concept of money used and the interest rate selected might explain some of the differences in the findings on the interest elasticity. Theoretical considerations suggest the value of the interest elasticity to be lower, the more short-term the nature of the interest rate.

Secondly, divergent opinions are held about the appropriate constraint for the demand for money. In all the empirical studies current income has been found to be of considerable importance in explaining the aggregate demand for money. It derives its theoretical justification from the transactions motive. *Friedman* (1956) reinterpreted income, within a theory of portfolio choice, as a constraint on the demand for money and replaced it in his empirical work (1959) by the more appropriate variable permanent income, which is a proxy for the immeasurable variable total wealth. *Meltzer* (1963) and *Brunner* and *Meltzer* (1963) concluded on the basis of their empirical work that non-human wealth alone is an even better explanatory variable. This result has been corroborated by *de Leeuw* (1965) and *Chow* (1966). However researchers continue to use current and permanent income in demand-for-money equations. This procedure is justifiable on the grounds that their explanatory power has never been in doubt, and that wealth data are not available for most countries.

Thirdly, another important controversial issue concerns the stability of the demand function for money. This matter is partly the heritage of *Keynes'* General Theory, as Axel *Leijonhufvud* (1968) conclusively demonstrated. Most writers' comments on this instability charge are not

particularly clear[1]. Therefore it is stressed here that the lack of predictability of the demand-for-money function does not have its origin in the volatility of speculators in the bond markets, creating a situation known as the liquidity trap (a point which has not received much attention in the recent empirical literature) but rather it follows from the long-run fluctuations of the "normal" level of interest rates[2]. In empirical analysis the question of stability may be decided on the basis of such tests as the *Chow*-test.

Given the theoretical development of the demand for money within the framework of portfolio balance, some empirical analyses[3] have allowed for the possibility that it may take time for actual money balances to adjust to the level desired as determined by the values of the independent variables. In most cases this has resulted in the employment of the partial adjustment model whose reduced form includes a lagged value of the dependent variable among the independent variables. Alternatively, other writers have recognised that money balances (quite aside from any lags in adjustment) may depend not on the current values of the independent variables but on the expected values of these variables[4]. This approach has usually resulted in the use of the adaptive expectations model which has an identical reduced form to the partial adjustment model. In other words it is possible to interpret the same estimating equation as having its rationale in either a partial adjustment process or an adaptive expectations mechanism.

In most of the expectational studies the demand for money equation was restricted to be dependent only on expected (or permanent) income and expected interest rates. Theoretical considerations, however, suggest that individuals might take price expectations into account in decisions concerning their desired money holdings. It seems likely that people will economize on their money holdings the more rapidly they expect

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[1] A recent example is C. A. E. *Crockett* and A. D. *Goodhart* (1970) p. 181. They fail to distinguish between the stable (short run) and the unstable (long run) liquidity preference schedule: " . . . there is nothing in *Keynes'* work to suggest that the demand for money should be unpredictable . . ."

[2] The demand for money in the long run with income given, "will not have a definite quantitative relation to a given rate of interest of r; what matters is not the absolute level of r but the degree of its divergence from what is considered a fairly *safe* level". *Keynes,* (1936) p. 201.

[3] See *Bronfenbrenner* and *Mayer* (1960), *de Leeuw* (1965), *Teigen* (1965), *Chow* (1966), *Fisher* (1968), *Laidler* and *Parkin* (1970), *Goodhard* and *Crockett* (1970).

[4] See E. L. *Feige* (1967).

prices to rise. The first to have explicitly introduced price expectations as an additional variable in a liquidity preference function on a purely theoretical basis was M. *Friedman* (1956, p. 61). Attempts, however, to empirically confirm this relationship have generally been unsuccesful[5], except in the case of galloping inflation[6]. The first to have isolated the price expectations effect on the demand for money appears to have been S. B. *Gupta* (1970). He made use of I. *Fisher's* hypothesis that during inflationary periods the nominal interest rate is the sum of the real rate and price expectations, i. e.

$$r_t = \varkappa_t + \pi_t$$

where r is a nominal rate, $\varkappa$ a real rate of interest and π stands for price expectations. If this hypothesis is correct, *Gupta* argues, then either r or $\varkappa + \pi$ can be employed as independent variables in a standard *Keynes*ian demand for money function. The following regression equations were used to test his theory:

$$\log M = \log a_0 + a_1 \log Y_p + a_2 r + e$$
$$\log M = \log b_0 + b_1 \log Y_p + b_2 \varkappa + b_3 \pi + \varepsilon$$

where M stands for the money stock and Y_p is defined as permanent income.

The results suggest that the coefficients a_2, b_2 and b_3 are all equal. This supports *Gupta's* position and taken at face value, confirms that inflationary expectations in fact do play a decisive role in determining desired money balances. However as R. *Roll* (1972, p. 275) points out, *Gupta's* results can only be accepted with reservation since he chose that definition of the real rate out of twenty possible constructs that gave the "best" results. L. B. *Smith* and J. W. L. *Winder* (1971) found some indication using Canadian data that price exceptations play a role. In a recent study A. A. *Shapiro* (1973) found that price expectations significantly determine the holdings of money balances in the U.S.

III. Partial Adjustment

The partial adjustment process assumes, that the actual demand for real money holdings M_t^D is linked in the following way with the long-run desired real balances, M_t^*

[5] See for example M. *Friedman* and A. J. *Schwartz* (1963, pp. 657 - 59).

[6] See *Cagan's* (1956) findings for some European countries. A. C. *Harberger* (1963 p. 219 - 250) presented evidence for Chile.

$$M_t^D = M_{t-1} + \beta (M_t^* - M_{t-1}) + e_{1_t} \quad 0 < \beta < 1 \tag{1}$$

where β is the adjustment coefficient. This stock adjustment model, in logarithmic form, specifies the desired long-run real demand for money as a function of current values of real income, Y, and an interest rate, r[7]

$$M_t^* = a_0 + a_1 Y_t + a_2 r_t \tag{2}$$

Desired real money balances cannot be observed directly. Substituting (2) into (1) results in

$$M^D = \beta a_0 + \beta a_1 Y_t + \beta a_2 r_t + (1 - \beta) M_{t-1} + e_{1_t} \tag{3}$$

where M_t^* has been eliminated. If we specify the equilibrium condition for the money market as

$$M_t^D = M_t^s + e_{2t} = M_t + e_{2t} \tag{4}$$

equation (3) can be rewritten in a form which contains only observable values of the variables

$$M_t = \beta a_0 + \beta a_1 Y_t + \beta a_2 r_t + (1 - \beta) M_{t-1} + \varepsilon_t \tag{3'}$$

where ε equales $e_1 - e_2$. It is assumed that the main influence of ε is on M and not on r. Bias is present only to the extent that ε influences r. Equation (3'), in logarithmic form, has been estimated using Australian quarterly data for the period 1952 (1) to 1972 (3). The money stock comprises currency plus demand deposits in the hands of public, time and certificates of deposits of the public at trading banks plus deposits with all savings banks. It is therefore identical with the volume of money as defined by the Reserve Bank. The stock of money and data for gross national product are deflated by the consumer price index (1966 = 100). A short- (r^s) and a long-term (r^L) interest rate have been employed; they correspond to the two year and the ten year re-

[7] The necessity to assume the demand for money to be homogeneous of degree one in absolute prices results from *Patinkin's* (1956, p. 254) correction of the Keynesian liquidity preference function. This correction is now generally accepted. However, some models (See equation 48 in W. E. *Norton* and J. F. *Henderson,* 1972) still use nominal values of M and Y in the estimated equation. The charge of implicitly assuming money illusion can be validly put forward against these studies.

bateable bond rates, respectively[8]. Since we used seasonally unadjusted figures, seasonal dummies had to be included in the regression equations. Their estimated coefficients, as well as the intercept values, are not reported here. The test results, the long-run elasticities of income and the interest rates with respect to the money demand as well as the adjustment coefficients are given in the following tables 1 and 2.

Table 1: Results of Estimated Equations of the Form

$$M_t = \beta a_0 + \beta a_1 \mathrm{GNP}_t + \beta a_2 r_t + (1 - \beta) M_{t-1} + \varepsilon_t$$

Estimated Coefficients of						
Y	r_s	r_1	M_{t-1}	$\bar{R}^2$	ϱ	h
0.177(9.5)	− 0.034(2.2)		0.80(33.5)	0.992	.29	0.51
0.172(9.8)		− 0.09(3.2)	0.82(34.5)	0.993	.24	0.37

ϱ = Hildreth-Lu rho
h = Durbin statistic
t − statistics are shown in brackets

Table 2: Long-run Elasticities implied by Equations of Table 1

Estimated Long-Run Elasticities of			Adjustment Coefficient
Y	r_s	r_1	
0.89	− 0.17		0.20
0.96		− 0.50	0.18

The income elasticity takes on plausible values which are compatible with the findings of similar econometric studies carried out for other countries on the same subject. These results confirm the assumptions that the demand function for money is homogeneous of degree one in real income. However the discovered property of the money demand function does not allow us to discriminate between, on the one hand, the *Baumol-Tobin* hypothesis which postulates that there are economics of scale in the holding of money, and *Friedman's* hypothesis, on the other, which

[8] From 1952 to 1957 the yield on the long-term security includes bonds with a maturity date of over 10 years. The data on interest rates and the money aggregate are from *Statistical Bulletin*, Reserve Bank of Australia; quarterly GNP data for the period 1952 - 1958 (2) are from R. V. *Kennedy* (1969), thereafter the data are from "Quarterly Estimates of National Income and Expenditure", Commonwealth Bureau of Census and Statistics.

posits that money is a "luxury" good. To accomplish this we would have to use real per capita instead of real income as the independent variable, since only this procedure can eliminate the impact of rising prices and population on the demand for money. Consequently, in the above equation, an elasticity of roughly unity of money demand with respect to income does not imply that money is a neutral good.

The estimated values of the interest elasticities of the money demand range from -0.17 to -0.50 depending on the interest rate employed. These values are fairly low, but quite compatible with results achieved on the basis of U.S and U.K. data. In absolute terms our equations imply that a one percent increase in the short-term interest rate, for example a rise from 4.95 per cent (which was the short-term rate in April, 1973) to about 5.00 per cent will, after the adjustment process has been completed, result in a reduction in the demand for money of an amount approximating 37 million dollars. A corresponding one per cent rise in the long-term interest rate from 5.52 per cent (April 1973) to about 5.60 per cent will decrease the demand for money by approximately 108 million dollars.

The size of the interest elasticity of the demand for money is of decisive importance with respect to the substitution relationship between money and bonds. *Keynes*ians assume that money substitutes only with bonds. A low interest elasticity therefore is an indication of the fact that money and bonds are not very close substitutes. However a low value of the interest elasticity of money demand can also result from the fact that money does not only substitute with bonds but with a wide range of financial and real assets including possibly consumer durables. This is the position held by the monetarists. Consequently, the empirical evidence does not allow us to discriminate between the competing monetary schools. The only conclusion which can be drawn from the low values of the interest elasticity with any certainty is that, in Australia, money and bonds are either not very close substitutes or that money substitutes with a variety of assets.

As expected from the theoretical consideration, the values of the interest elasticities are higher for long-term than for short-term rates. This is so because short-term rates fluctuate more markedly than long-term rates. Therefore each percentage change of the short-term interest rate has to explain a smaller change in the demand for money. With respect to the explanatory power of short-term and long-term interest

rates there is little to choose between them as the *t*-values in Table 1 clearly show.

The time lags involved in the adjustment process as measured by the coefficients of adjustment are fairly long. This means that at the end of one quarter about 20 per cent of the initial difference between desired and actual money holdings will have been eliminated. Two quarters after the change in the interest rate has taken place approximately 50 per cent of the full portfolio adjustment has occured. After two years 83 per cent of the adjustment will have taken place and so on. The time required for the completion of the adjustment process after changes in the independent variables might be caused by the pecuniary and the nonpecuniary costs associated with rearrangements of portfolios, the delayed recognition of and retarded reaction to changing market conditions. The existence of time lags therefore forces us to consider the static textbook liquidity preference function with great reservation.

An important part of the debate among monetary economists is devoted to the question of the stability of the demand function for money. The relationship between cash balances, income and interest rates is said to be stable, if money holdings vary with these other variables systematically and the values of the estimated parameters of the function which follow from the empirical data have remained fairly constant over time. The statistical properties of the estimated equations in terms of *t*-values, coefficients of determination, *Durbin*-statistics and "correct" signs of the parameters are not sufficient to indicate that the demand for money is predictable from the income and the interest rate values. However, the outcome of the Chow-test confirmed the stability assumption.

IV. Multiple Expectations

An alternative interpretation of the reduced form equation (3′) is that an adaptive expectations process[9] is operating with respect to both the interest rate and income, where the expectation coefficients are identical for both independent variables. This is demonstrated by the following set of relationships, where the actual demand for money is a function of the expected values of the two independent variables. We thus have:

[9] E. L. *Feige* (1967, p. 464).

(5) $$M_t = a_0 + a_1 Y_t^e + a_2 r_t^e + \mu_t$$

Where Y^e and r^e are the expected income and the expected interest rate respectively. The expected values are related to the current values by means of an adaptive expectations mechanism.

(6) $$Y_t^e = Y_{t-1}^e + \lambda (Y_t - Y_{t-1}^e)$$

and $$0 < \lambda < 1$$

(7) $$r_t^e = r_{t-1}^e + \lambda (r_t - r_{t-1}^e)$$

the solutions of the above difference equations show, how expectations are formed

(8) $$Y_t^e = \lambda \sum_{i=1}^{n} (1-\lambda)^{i-1} Y_t$$

and

(9) $$r_t^e = \lambda \sum_{i=1}^{n} (1-\lambda)^{i-1} r_t$$

The expectations generating functions are represented by distributed lags with exponentially (or geometrically) declining weights.

The model (5), (6) and (7) also has equation (3′) as its reduced form. However, with this interpretation the error term takes on a different form. Apart from this the two approaches differ significantly in their economic interpretation. The rationale for the lagged response in the partial adjustment model is provided in terms of the costs associated with frequent portfolio changes, of market imperfections and of slow reactions of the market participants. In the adaptive expectations model the influence of lagged values of the independent variables reflects corrections of errors arising from previous expectations and discounting of information. Generally one cannot discriminate on empirical grounds between the above alternative interpretations[10]. In theory it is possible to combine both the partial adjustment and the adaptive expectations processes into one estimating equation. But such an equation would contain two lagged values of the dependent variable. This creates estimation problems in terms of multi-collinearity quite apart from the problems associated with the disturbance term.

Consequently the approach which explicitly takes account of both mechanisms was discarded. However, this does not imply a caesura

[10] Z. *Griliches* (1967, p. 42) gives an example for a situation where a discrimination can be made.

between our previous results and those derived within the framework of an adaptive expectations model, which are presented below. *Feige* (1967) has shown that the single partial adjustment model as described by equation (1) is compatible with adaptive expectations. This requires that the costs for an individual, given his expected income, not to hold a level of money balances desired in the long-run, can be approximated by quadratic cost functions and that a cost minimizing behaviour is assumed. This approach then provides a rationale for the adjustment coefficient β in terms of the marginal costs associated with being out of equilibrium and those arising from adjustment[11].

The values for real income derived within an adaptive expectations model in the demand functions for money allow two conceptually distinct interpretations. The portfolio balance approach to the demand for money views expected income to be a suitable proxy for the expected yield on total wealth. M. *Friedman's* permanent income is a concept directly related to that of expected income[12]. Adaptive expectations models have also been utilised for optimal predictions. Given certain properties of the expectations generating mechanism described by equation (6), anticipated income is an optimal predictor of measured income[13]. Expected interest rates can be interpreted analogously.

In the present study two approaches are followed to isolate the effect of price expectations on the demand for money. Price expectations are approximated by a distributed lag on present and past price changes. In one approach the lag structure is specified by using geometrically declining weights whereas in the other approach no such constraint is placed on the lag distribution.

The necessary modifications which the explicit consideration of inflationary expectations in the demand function for money require, are readily made by adding a price expectations variable to equation (5)

$$M_t = a_0 + a_1 Y_t^e + a_2 r_t^e + a_3 \Delta P_t^e + \mu_t \tag{5'}$$

where money balances and income are as above in real terms and ΔP^e stands for price expectations. Inflationary anticipations are generated

[11] This framework originates from R. *Eisner* and R. *Strotz* (1963). E. *Feige* (1967) applied it to problem of optimal money balances in a form developed by Z. *Griliches* (1967).

[12] For the development of permanent income see M. *Friedman* (1957) and its application to monetary economics, see M. *Friedman* (1959).

[13] J. F. *Muth* (1960).

by an adaptive expectations mechanism in a fashion similar to that of expected real income and expected interest rate.

$$\Delta P^e = \Delta P^e_{t-1} + \lambda (\Delta P_t - \Delta P^e_{t-1}) \tag{10}$$

This results in the following estimating equation:

$$M_t = \lambda a_0 + \lambda a_1 Y_t + \lambda a_2 r_t + \lambda a_3 \Delta P_t + (1 - \lambda) M_{t-1} + \mu_t - (1 - \lambda) \mu_{t-1} \tag{11}$$

This equation was tested. Real money balances, real income and the intercept are in logarithms[14]. Since not all price changes were positive, ΔP entered the regression equation in non-logarithmic form. The regression coefficients, which, with the exception of the price-expectations coefficient, can be interpreted as short-run elasticities, together with the calculated values of the long-run elasticities of the dependent variable with respect to each of the independent variables, are given in *Table 3*. This table also contains the statistical properties of the estimated regression equations. The regression coefficients have the expected signs. The adjusted coefficients of determination ($\bar{R}^2$'s) are very high, from which one can conclude a strong relationship between the demand for real money balances and the independent variables. These values warrant some comment. Preliminary estimates suffered from significant auto-correlation in the residuals. In order to avoid this defect the *Hildreth-Lu*-transformation was applied. This procedure casts the estimating equation in quasi-differenced form. This usually has the effect of reducing the value of the coefficient of determination. The values of the *Durbin* statistic suggest that the problem of serial correlation has been satisfactorily overcome. The interpretation of the elasticities of real income, price expectations and the interest rates with respect to the demand for money will be given at a later stage. The above approach assumes, as already mentioned, that the expectations generating process is conceived as a distributed lag with exponentially declining weights. This might be unnecessarily restrictive. For this reason the *Almon* interpolation technique was applied to generate expected values of income, the interest rate an prices. This method allows the lag structure of each independent variable to be determined separately. The demand for real money balances is, as before, expressed as a function of expected real income, expected interest rates and inflationary expectations.

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[14] The money stock, as defined above, and gross national product are deflated by the consumer price index (1966 = 100); ΔP stands for the quarter to quarter percentage change in the consumer price index.

Table 3: Regressions Results and Expectations Elasticities

$$M_t = \lambda a_0 + \lambda a_1 Y_t + \lambda a_2 r_t + \lambda a_3 \Delta P_t + (1 - \lambda) M_{t-1} + \mu_t - (1 - \lambda) \mu_{t-1}$$

Coefficients and Elasticities					λ	ϱ	$\bar{R}^2$	h
Y	r^S	r^L	ΔP	M_{t-1}				
0.162(10.7) 1.01	− 0.050(4.5) − 0.31		− 0.0127(6.6) − 0.079	0.84(43.3)	0.16	0.14	0.996	0.46
0.155(9.8) 0.97		− 0.068(2.8) − 0.43	− 0.0103(4.9) − 0.064	0.84(39.8)	0.16	0.23	0.995	0.48

ϱ = Hildreth-Lu rho, h = Durbin statistic, t − statistics are shown in brackets.
The values of the long-run elasticities are given below the regression coefficients.

(12) $$M_t = (f\, Y_t^e,\ r_t^e,\ P_t^e)$$

Making use again of the assumption that expectations are formed on the basis of current and past values of the variables in question leads to the following regression equation

(13) $$M_t = a_0 + \sum_{i=0}^{j} a_{1i}\, Y_{t-i} + \sum_{i=0}^{k} a_{2i}\, r_{t-i} + \sum_{i=0}^{1} a_{3i}\, \Delta P_{t-i} + \nu_t$$

where M, Y, r and ΔP are used as defined above. Equation (13) was estimated using real money balances, real income and a short- and long-run interest rate as defined above; ΔP stands for the percentage change of the consumer price index.

In this case the lag structures are free to vary as between the three independent variables. The final choice of these structures was determined on the basis of repeated experiments with alternative combinations of maximum lag lengths and degrees of polynomials. The results suggested that a polynomial of degree three was adequate for all three independent variables and that a maximum lag length of six quarters was sufficient in the case of the income and the interest rate variables and a lag length of four quarters in the case of price expectations.

The empirical findings are shown in *Table 4*. All coefficients have the signs expected on the basis of a priori considerations. When evaluating the coefficients of determination one has to bear in mind that the value of the *Hildreth-Lu* auto-correlation coefficient is equal to 0.99 which implies, as already mentioned, that the regression equations are virtually cast in terms of first differences. The values of the *Durbin-Watson* statistic suggest that serial correlation of the residuals presents no problem.

Turning now to the interpretation of the results, the elasticity of the real demand for money with respect to real income varies between 0.911 and 0.918[15]. These values are compatible with the results achieved earlier (see columns one in *Tables 2* and *3*). A comparison of the structures of the *Almon* lag with that of the geometrically declining lag is of particular interest. This is shown in Chart I using the results of the equation containing the short-term interest rate. The time profile traced by the *Almon* lag clearly indicates that income expectations are formed

[15] Since M_t, Y_t and r_t are cast in logarithmic form, the estimated coefficients can be interpreted as elasticities. The coefficient of the price variables has a slightly different meaning.

Table 4

$$M_t = a_0 + \sum_{i=0}^{6} a_{1i} Y_{t-i} + \sum_{i=0}^{6} a_{2i} r_{t-i} + \sum_{i=0}^{4} a_{3i} \Delta P_{t-i}$$

	Lags	Y_{t-1}		r_{t-1}		ΔP_{t-1}		$\bar{R}^2$	ϱ	DW
		Coeff.	*t*-Values	Coeff.	*t*-Values	Coeff.	*t*-Values			
r^S	0	.164	9.0*	— .053	— 3.2*	— .013	— 6.7*	.930	.99	2.025
	1	.171	5.7*	— .032	— 3.1*	— .009	— 4.3*			
	2	.166	6.1*	— .023	— 2.0*	— .007	— 3.6*			
	3	.150	9.4*	— .021	— 2.3*	— .007	— 3.3*			
	4	.123	6.9*	— .021	— 2.5*	— .005	— 2.9*			
	5	.089	3.2*	— .021	— 1.9	0				
	6	.047	1.9	— .015	— 1.5					
	7	0		0						
		Σ .911		Σ— .186		Σ— .041				
r^L	0	.167	8.7*	— .075	— 2.4*	— .014	— 6.9*	.923	.99	1.883
	1	.181	5.5*	— .038	— 2.0*	— .010	— 4.8*			
	2	.175	5.9*	— .026	— 1.2	— .009	— 4.3*			
	3	.153	8.9*	— .028	— 1.7	— .008	— 4.0*			
	4	.121	6.7*	— .036	— 2.3*	— .006	— 3.6*			
	5	.082	2.8*	— .040	— 1.9	0				
	6	.040	1.5	— .031	— 1.6					
	7	0		0						
		Σ .918		Σ— .275		Σ— .048				

* Significant at 0.05 level, Almon Interpolation with 3rd degree polynomial.

ϱ: Minimum rho of the Hildreth-Lu transformation.
DW: Durbin-Watson Statistic.

only on the basis of income over the last six quarters. The expectations hypothesis implying an exponentially declining structure of weights suggests that the economy responds to income values stretching much further into the past. However, it seems likely that this may be more a reflection of the inflexibility inherent in the geometrically declining lag structure than a consequence of actual economic behaviour. These remarks are also true for the other two indepedent variables where lag profiles are shown in Charts II to III. It is also apparent from these graphs that, with the possible exception of income, the sum of the lagged coefficients of the independent variables is larger in the case of the adaptive expectations model. This may be due to bias in the estimates of this model, resulting from the possibility that serial correlation in the residuals has not been entirely removed in the estimated equations, in

spite of the fact that the *Durbin* statistics do suggest the absence of significant serial correlation. Any such remaining serial correlation will necessarily result in bias where a lagged value of the dependent variable is included as one of the independent variables.

The elasticities of the demand for money with respect to the interest rates are also comparable with those calculated for the partial adjustment model (see *Table 2*) and the long-run elasticities of the expectations model (see *Table 3*). As with our previous results the values of the elasticities vary in the expected way when applying the short- or long-run interest rate. Not unexpectedly, the interest elasticity is higher for the long-term rate than for the short. The most striking feature of the results however is the manner in which price expectations emerge as a significant influence on the demand for money.

Each of the coefficients has the expected negative sign and all are statistically significant[16]. The sum of the current and lagged coefficients of the percentage changes in prices, at a value of -0.41, implies that a change in the expected rate of inflation from say, 1 percent to 2 percent per quarter, will reduce the demand for money by 4.2 per cent (which is the percentage change corresponding to a change in the natural logarithm of 0.041).

The lags associated with the formulation of price expectations are very short and are much shorter than those pertaining to income an interest rate expectations. This implies that the impact of changing prices on the demand for money materialises more quickly than that of real income and interest rates. The result with respect to the latter variable is somewhat surprising since it is generally held that adjustments to financial variables occur reasonably rapidly.

The above equations using the *Almon*-technique were re-estimated for the two subperiods 1952 (1) to 1963 (3) and 1963 (4) to 1972 (3). The application of the usual *Chow* test suggested the absence of any significant structural change in the relationship as between these two periods.

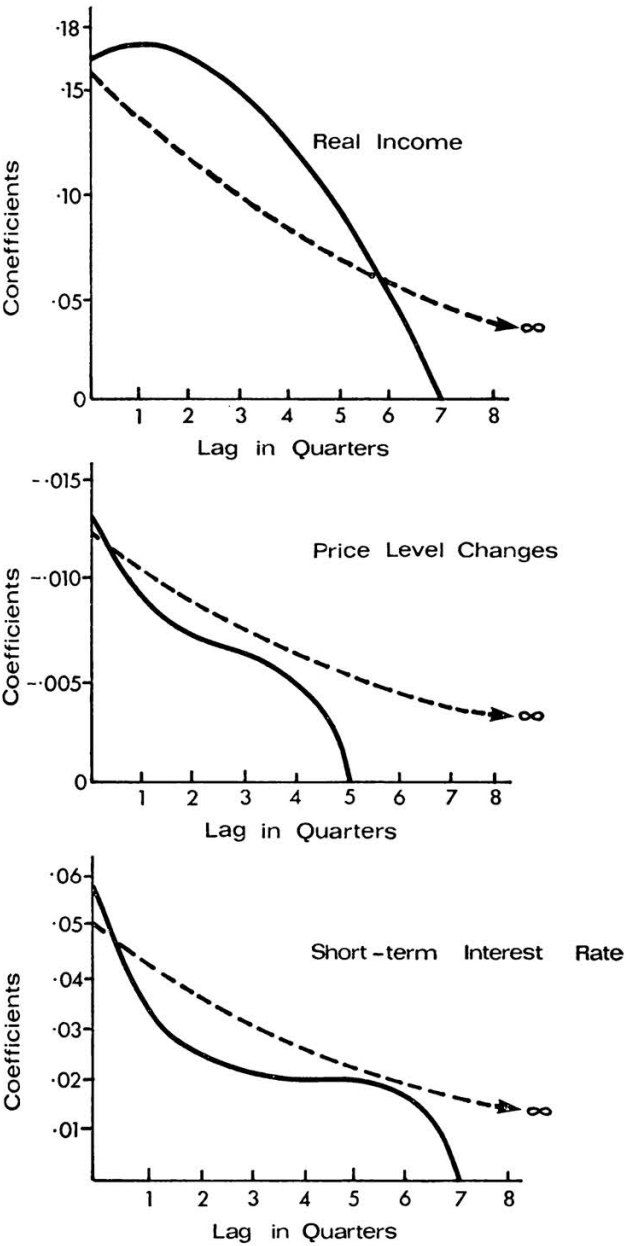
The fact that price expectations are a determinant of the demand of money in the Australian economy implies that economic agents are

[16] We re-estimated equation (13) excluding the period starting 1970 (1) in order to obtain some indication as to whether the significance of price expectations was mostly due to the acceleration of inflation which occured recently. The results, however, were practically identical.

Charts I–III

COMPARISON OF ALMON AND GEOMETRICALLY DECLINING LAG STRUCTURES

$M = f(Y, r^s, \Delta P)$



well aware of the losses incurred when holding money balances[17]. Economising on real money holdings when inflation is expected to increase, suggests that money is gradually losing its function as a store of value.

V. Summary and Concluding Remarks

This study has been mainly concerned with the relationships between the demand for money holdings, delayed portfolio adjustments and expectations regarding real income, interest rates and price level changes. Our findings suggest, that expectations with respect to real income, interest rate, and future price level changes significantly influence the demand for real money holdings. The application of the *Almon* distributed lag technique indicates that the expectations with respect to real income and interest rates are generated on the basis of the values of the respective variables over the present and previous six quarters. On the other hand it seems that inflationary anticipations are based on present price changes and those occurring over the previous four quarters only. The fact that price expectations appear to have had such a significant influence on the demand for money in Australia, irrespective of whether the last two or three years of accelerating inflation are taken into account or not, has definite implications for the future effective conduct of monetary management.

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[17] The interest bearing components of the volume of money are apt to mitigate the inflation induced capital losses resulting from holding wealth in this liquid form to the extent that these rates vary systematically with inflationary expectations.

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Zusammenfassung

Partielle Anpassung, multiple Erwartungen und die Geldnachfrage in Australien

Die Studie beschäftigt sich hauptsächlich mit den Beziehungen zwischen der Nachfrage nach Geldanlagen, verzögerten Portfolio-Veränderungen und Erwartungen auf Veränderungen des Realeinkommens, des Zinssatzes und des Preisniveaus. Die Ergebnisse legen nahe, daß Einkommenserwartungen, Zins- und Preiserwartungen von maßgeblichem Einfluß für die Nachfrage nach realer Geldanlage sind. Die Anwendung des *Almon*-Verfahrens zeigt, daß sich die Einkommens- und Zinserwartungen auf der Grundlage der Werte der entsprechenden Variablen im gegenwärtigen und in den sechs früheren Quartalen bilden. Andererseits scheint es so, daß die Vorweg-Berücksichtigung inflationärer Entwicklungen auf den aktuellen Preisveränderungen und auf den Preisveränderungen nur in den vergangenen vier Vierteljahren beruhen. Die Tatsache, daß Preiserwartungen einen so bedeutenden Einfluß auf die Geldnachfrage in Australien haben (wobei es dahingestellt bleibt, ob die letzten zwei oder drei Jahre beschleunigter Inflation in Betracht gezogen werden), hat bestimmte Folgen für die künftige Wirksamkeit der Geldpolitik.

Résumé

Adaptation partielle, multiples attentes et la demande monétaire en Australie

L'étude traite principalement des relations entre la demande de placements monétaires, les modifications retardées des portefeuilles et les perspectives de changements du revenu réel, des taux d'intérêt et du niveau des prix. Les conclusions établissent que les perspectives de revenu, de taux d'intérêt et de prix sont d'une influence déterminante sur la demande de placements monétaires réels. L'application de la procédure d'*Almon* démontre que les perspectives de

revenu et de taux d'intérêt s'établissent en fonction de la valeur des variables correspondantes du trimestre en cours et des six précédents. Il semble par ailleurs que l'anticipation des développements inflationnistes repose sur les changements actuels du niveau des prix ets ur ceux qui eurent lieu au cours des quatre trimestres antérieurs seulement. Le fait que l'évolution escomptée des prix ait une influence aussi importante sur la demande monétaire en Australie (sans qu'il ait été recherché si l'on avait pris en considération l'accélération de l'inflation des deux ou trois dernières années) a certaines conséquences sur l'efficacité future de la politique monétaire.