The Economic Journal of Nepal,Vol.9,No.3,Issue 35,July-September 1986

The Demand for Cash by Corporations

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The interest in the study of behaviour of the transactions demand for cash by corporations has been stimulated by Baumol (1952), Tobin (1956), and Friedman (1959). Baumol and Tobin suggested that there are economies of scale in cash holdings and transactions elasticity of cash balances is 0.5. Friedman's results showed a permanent income elasticity of 1.8. The other later studies on demand for cash by firms either supported Baumol and Tobin or Friedman. Among others, Frazer (1964), Nadiri (1969), and Coates (1976) supported Baumol and Tobin while Meltzer (1963 June, 1963 August), Whalen (1965), De Allessi (1966), and Vogel and Maddala (1967) supported Friendman. Those who supported Baumol and Tobin found that under moderately restrictive assumptions optimal transactions cash balances vary less than in proportion with sales and those who supported Friedman found that the elasticity of cash with respect to sales is about or more than unity.

There is also no unanimous finding as regards to the effect of interest rate on demand for cash. Among others, Selden (1961), De Allessi, Nadiri, and Coates showed the statistically significant negative relationship between interest rates and demand for cash while Friedman did not find the same. It all shows that there is no unanimous finding with respect to the economies of scale in cash holdings, and the interest cost effect on demand for cash. In order to validate one view or the other, no study has so far been conducted in the context of Nepal. This paper therefore tests out the models that will either support or reject the Baumol - Tobin hypothesis.

Section I of this paper describes the models that attempt to explain firm's demand for cash and the nature and sources of data used in the statistical analysis. The regression results are presented and interpreted in Section II. Finally, the empirical findings are summarised and the conclusions are indicated in Section III.

The major conclusion indicated by this paper is the empirical evidence in support of the presence of the economies of scale in cash holdings, significant effect of interest cost on investment in cash, and the slow speed of adjustment between actual and desired level of cash.

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THE MODEL

The decision about the aggregate level of cash to be held may be regarded as subject to the constraint of wealth and the cost of holding cash. As a first approximation to the theory, the function may be written as,

$$Y^* = f(W, i) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

where, Y^* is real desired level of cash, W is the real desired wealth defined in terms of sales (S), and i is the short-term interest rate. In an empirical investigation, expression (1) takes the form;

$$Y^* = k\, S^{b_1}\, i^{b_2}\, e^{u} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

where, the error term e^u is assumed to be independently and normally distributed. Taking the natural logarithm of the expression (2) gives,

$$\ln Y^* = \ln k + b_1 \ln S + b_2 \ln i + U_i \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

It is assumed that desired level of cash (Y^*) is equal to its actual level (Y). Thus,

$$Y = \left[(M_{t-1}) + (M_t)\right] / 2 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

where, M_{t-1} and M_t are beginning and end of the year balances of cash respectively. The equation to be estimated is, therefore,

$$\ln Y = b_0 + b_1 \ln S + b_2 \ln in + U_i \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

where, b_0 is constant, b_1 and b_2 are elasticities of Y with respect to the sales and short-term interest rate respectively. The above models assume the following reasonable a priori hypothesis:

$$dy/dS > 0 \quad \text{and} \quad dy/di < 0 \quad \ldots \quad \ldots \quad \ldots \quad (6)$$

After estimating the above equations, capacity utilization (CU) variable is introduced in the models. The relationship of capacity utilization with the desired level of cash is postulated to be negative.

While estimating the above equations, the figures of cash balances and sales have been deflated by using a suitable deflator.

The empirical analysis in this paper also takes into account a partial adjustment or flexible accelerator model of cash behaviour. This model hypothesizes that each corporation has a desired target level of cash, and that each corporation, finding its actual cash not equal to its desired level, attempts only a partial adjustment towards the desired level of cash within any period. The partial adjustment model is used to indicate the speed with which corporations adjust their actual cash level to desired cash level.

The simple assumption to make about the adjustment process in cash is that,

$$\left[\frac{Y_t}{Y_{t-1}} = \frac{Y_{t*}}{Y_{t-1}}\right]^{\emptyset} e^{Ut} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (7)$$

where, $\emptyset$ = rate of adjustment or adjustment coefficient,

$0 < \emptyset \leq 1.$

The multiplicative form of the adjustment mechanism implies that the time required for the firm to adjust is a function of the relative size of the required adjustment rather than the absolute size.

Substituting the expression (7) for desired level of cash into equation (2) gives.

$$\frac{Y_t}{Y_{t-1}} = \left[\frac{k\, S_t^{b_1}\, i_t^{b_2}}{Y_{t-1}}\right]^{\emptyset} e^{u} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (8)$$

Taking logs of this equation gives,

$$\ln Y_t - \ln Y_{t-1} = \emptyset \ln b_0 + \emptyset\, b_1 \ln S_t + \emptyset\, b_2 \ln i_t - \ln Y_{t-1} + U_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (9)$$

or

$$\ln Y_t = c_0 + c_1 \ln S_t + c_2 \ln i_t + (1 - \emptyset) \ln Y_{t-1} + U_t \quad \ldots \quad (10)$$

where, c_1 and c_2 are the short-run elasticities of cash with respect to sales and interest cost respectively. The long-run elasticities with respect to sales and cost are b_1 and b_2.

Since, $c_1 = \emptyset\, b_1$ and $c_2 = \emptyset\, b_2$,

$b_1 = c_1/\emptyset$ and $b_2 = c_2/\emptyset$

Specification of Explanatory Variables:

Wealth: Nearly almost all the studies on demand for cash have used sales as a proxy for wealth. It is postulated here that expected sales are some function of past sales, i.e., $S_t = S_{t-1}$. This specification seems to have provided the best fit in most of the cases.

Cost of Holding Cash: The studies on demand for cash indicated that short-term interest rate, among others, seems to be a popular measure of the opportunity cost of funds invested in cash. However, it has always been difficult to find a suitable measure. There is also no clear-cut case for using a particular measure. Hence, this paper uses short-term interest-rates of commercial banks as a proxy for the opportunity cost of holding cash.

Capacity Utilization: The capacity utilization rate (CU) has also been introduced as an explanatory variable in the estimated equations. The actual rates of capacity utilization for the selected corporations were not available for the study period included in this paper. Hence, the industrywise capacity utilization rate has been used as a proxy for the selected corporations. This is consistent in view of the fact that these corporations dominate largerly if not wholly in their respective industries.

NATURE AND SOURCES OF DATA

The data on cash balances and sales have been collected from Profit and Loss Accounts and Balance Sheets as presented in the "Reports of the Auditor General" published by the Office of the Auditor General, His Majesty's Government of Nepal (HMG/N). The price deflator and short-term interest rates of commercial banks have been compiled from "Quarterly Economic Bulletin" published by the Central Bank of Nepal, i.e., Nepal Rastra Bank. Similarly, capacity utilization rates have been taken from the "Economic Survey" brought out by the Ministry of Finance, HMG/N. These data are collected for nine manufacturing public corporation for ten years from 1973 to 1982. The nine selected corporations are Agriculture Tools Factory, Brick and Tile Factory, Balaju Textiles Ltd., Dairy Development Corporation, Janakpur Cigarette Factory, Nepal Tea Development Corporation, and Royal Drugs Limited. These corporations represent about 80 percent of Nepalese public corporations in the manufacturing sector for which data are supposed to be available from 1973 to 1982. The number of corporations and study period could not be extended due to the unavailability of data.

EMPIRICAL RESULTS

The demand for cash equations specified above was estimated with pooled data consisting of 90 observations. First of all, an effort is made to indicate the scale effect on the transactions demand for cash. The regression of cash on sales showed the following:

$$\ln Y_t = \underset{}{-0.36} + \underset{(12.97^*)}{0.76} \ln S_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (12)$$

$$\bar{R}^2 = 0.653 \qquad F = 168.25 \qquad DW = 1.59$$

In the regression equations presented throughout this paper, t-values are indicated by figures in parentheses. Similarly, the asterisk sign (*) indicates that the result is significant at 5 percent level of significance.

Equation (12) shows that the sales coefficient is significant with a priori expected sign. The elasticity of sales with respect to cash is less than unity. It thus contradicts the findings of Friedman, Meltzer, Whalen, De Allessi, and Vogel and Maddala. It all shows the evidence of economies of scale with respect to the demand for cash by manufacturing public corporations of Nepal.

In order to find out whether or not there is any significant influence of cost of holding cash on investment in cash, short-term interest rate (i) is included in the above explanatory equation. The regression of cash on sales and interest rate produced the following:

$$\ln Y_t = \underset{}{0.68} + \underset{(12.29*)}{0.74} \ln S_t - \underset{(1.99*)}{0.47} \ln i_t \quad \ldots \quad \ldots \quad \ldots \qquad (13)$$

$$R^{-2} = 0.657 \qquad F = 86.40 \qquad DW = 1.78$$

The above equation supports the theoretical propositions presented in expression (6). It provides an interest rate coefficient that is statistically significant at 5 percent level with a theoretically correct sign. Previously, this coefficient used to be either positive or insignificant in many of the studies on demand for cash by firms. The coefficient of sales in equation (13) is also highly significant and indicate that higher sales increase investment in cash. The sales coefficient of 0.74 suggests further economies of scale in cash holdings.

Contrary to many of the previous studies, equation (13) shows that fluctuations in cash level depend in a statistically significant manner on fluctuations in financial carrying cost of cash. This finding supports the conclusion of Selden, De Allessi, Nadiri, and Coates and contradicts the result of Friendman.

Equation (13) reveals some further facts. Holding the sales constant, it indicates that a one percentage point increase in interest cost led on the average to about a 0.47 percent decline in investment in cash. Similarly, holding the interest cost constant, a one percentage point increase in sales led on the average to about 0.74 percent increase in cash. However, the change in these values is to be noticed in the equations presented hereafter in this section.

So far the estimated results are based on previous year sales (S_t) as a proxy for W. These results may not be directly comparable to the results of some of the earlier studies which used current year sales as a proxy for W so long as the results are similar. Hence, it is felt necessary to use current year sales (S_t') as a proxy for W in order to see whether the functions using S_t' produces the results similar to the functions using S_t. The regressions of Y_t on S_t' and on S_t' and i_t produced the following results:

$$\ln Y_t = \underset{(12.06^*)}{-0.35 + 0.75 \ln S'_t} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \qquad (14)$$

$$\bar{R}^2 = 0.619 \quad F = 145.49 \quad DW = 1.60$$

$$\ln Y_t = \underset{(11.50^*)\ (1.99^*)}{0.94 + 0.72 \ln S'_t - 0.59 \ln i_t} \quad \ldots \quad \ldots \quad \ldots \qquad (15)$$

$$\bar{R}^2 = 0.628 \quad F = 76.12 \quad DW = 1.93$$

When equations (14) and (15) are compared with equations (12) and (13) respectively, it can be seen that the use of S_t or S'_t produced the similar results. The coefficients of S_t or S'_t are more or less identical. It thus shows that either S_t or S'_t can be used as a proxy for W.

After assessing the scale effect and interest cost effect on demand for cash, we now estimate the partial adjustment model of cash demand. The pooled estimate of the partial adjustment model as specified in equations (9) and (10) is as follows:

$$\ln Y_t = \underset{(4.28^*)\ (2.45^*)}{1.24 + 0.18 \ln S_t - 0.69 \ln i_t} +$$

$$\underset{(10.90^*)}{0.75 \ln Y_{t-1}} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \qquad (16)$$

$$\bar{R}^2 = 0.853 \quad F = 173.73 \quad DW = 1.80 \quad h = 0.16$$

It is to be noted that DW statistic cannot be used to detect (first order) serial correlation in the autoregressive model (Gujarati, 1979, pp. 109-111). In autoregressive model, DW value generally tends toward 2.0. If DW values are used in such a case, there will be built-in bias against discovering (first order) serial correlation. In this connection, Durbin himself has proposed to use h statistic (Durbin, 1970). Therefore, h statistic is presented in equation (16) which shows that the result is free from the problem of serial correlation.

In equation (16), the coefficient of the lagged dependent variable has been observed to be 0.75. Since the coefficient of lag $\ln Y_t$ is equal to 1 minus the adjustment coefficient $(1-\emptyset)$, the adjustment coefficient is equal to 0.25. The speed of adjustment between desired and actual levels of cash as implied by this value is therefore slow. It seems that only 25 percent of the adjustment, of actual to desired cash levels is completed within a year.

In the partial adjustment model, the estimated coefficients of the independent variables are equal to the elasticities of these variables times the adjustment coefficient. In other words, $c_1 = \emptyset b_1$ and $c_2 = \emptyset b_2$

as shown in expression (11). These elasticities are thus 0.72 for sales and 2.76 for interest rate which again conform the conclusions drawn earlier concerning the sales elasticity.

It can be argued that capacity utilization also effects the demand for cash by corporations. The relationship of capacity utilization with the desired level of cash is postulated to be negative as businesses tend to smooth out the pattern of production in order to avoid or minimise the loss of efficiency (and other costly changes) associated with rapid changes in production process by adjusting the desired level of cash. This means that businesses will tend to reduce the level of cash rather than to make production changes to meet current demand, whil at low capacity utilization levels, they will tend to build-up high stock of cash to avoid further cuts in production. Moreover, if production levels of firms rise sufficiently close to capacity, the level of cash may be reduced below the normal levels in response to growing and unfilled orders. All these led to hypothesize a negative relationship between the demand for cash and capacity utilization.

The regression results of cash on sales, interest rate, and capacity utilization are as follows:

$$\ln Y_t = \underset{}{8.14} + \underset{(13.73^*)}{0.80} \ln S_t - \underset{(3.67^*)}{1.43} \ln i_t - \underset{(3.79^*)}{3.04} \ln CU_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \qquad (17)$$

$$R^{-2} = 0.703 \quad F = 91.20 \quad DW = 1.81$$

$$\ln Y_t = \underset{}{0.92} + \underset{(3.96^*)}{0.17} \ln S_t - \underset{(1.44)}{0.74} \ln i_t + \underset{(0.27)}{0.24} \ln CU_t + \underset{(10.39^*)}{0.75} \ln Y_{t-1} \quad \ldots \quad \ldots \quad \ldots \qquad (18)$$

$$R^{-2} = 0.852 \quad F = 128.91 \quad DW = 1.61 \quad h = 0.17$$

In the above equations, the capacity utilization coefficient has a priori expected sign but the coefficient is significant in equation (17) only. In addition, the coefficient of interest rate has also gone insignificant with the inclusion of capacity utilization variable as indicated by equation (18). Also the overall fit and explanatory power of the model have gone poor in equation (18) as compared to equation (16). Thus, the inclusion of capacity utilization variable in the model has not contributed much to the cash demand functions.

CONCLUSIONS

The earlier studies on the demand for cash did not report unanimous findings. A lot of controversies exist with respect to the presence of economies of scale in cash holdings and the effect of capital costs on the demand for cash. This paper investigates these various issues alongwith the effect of capacity utilization on the demand for cash and the speed with which actual level of cash is adjusted to its desired level by using the data of manufacturing public corporations of Nepal.

The estimated pooled regression results showed the presence of economies of scale with respect to the demand for cash. The results thus contradicts the findings of Friedman, Meltzer, Whalen, De Allessi, and Vogel and Maddala. The results of the study suggest strongly that the demand for cash by corporations is a function of both sales as well as its holdings costs. The interest rate coefficient is statistically significant with a theoretically correct sign. This finding is in consistency with the findings of Selden, De Allessi, Nadiri, and Coates and contradicts the result of Friedman.

The adjustment speed of actual to desired levels of cash has been observed to be much slower. It seems that only 25 percent of the adjustment, of actual to desired level of cash is completed within a year.

The estimated results showed that the inclusion of capacity utilization variable in the model seems to have not contributed much to the demand function for cash. Thus, the capacity utilization as a significant variable affecting the demand for cash is doubtful.

It is to be noticed in the regression equations presented throughout this paper that the sales and interest cost elasticities with respect to cash fluctuated widely especially the interest cost elasticities. The elasticity of sales fluctuated from 0.68 in equation (18) to 0.80 in equation (17). Similarly. the elasticitv of interest cost with respect to cash fluctuated from 0.47 in equation (13) to 2.96 in equation (18). Though the elasticities of sales with respect to cash is less than unity in all the equations, nothing concrete can be concluded regarding the extent of economies of scale associated with the demand for cash. Hence the reliable estimate of elasticities of sales and interest cost with respect to cash would be to obtain the average value of these elasticities noticed in different equations. The average values of sales and interest cost elasticities are observed to be 0.64 and 1.64 respectively. It indicates that holding the interest rate constant, a one percentage point increase in sales led on the average to about 0.64 percent increase in cash holdings. Similarly, holding the sales constant, a one percentage point increase in interest cost led on the average to about a 1.64 percent decline in cash holdings. It all shows that the average elasticity of sales with respect to cash can be regarded as less than unity while the average elasticity of interest cost if more than unity.

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