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The Demand for Money by Firms: The Stability and Other Issues Reexamined

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I. Introduction

INTEREST IN THE BEHAVIOR of the demand for money by firms has been stimulated in recent years, partly because of unsatisfactory empirical results obtained for firms or the business sector (see, e.g., Goldfeld [7], Laumas [10], and Wilbratte [18]). The purpose of this study is to investigate empirically several issues concerning the demand for money by firms in an inflationary environment.

There are two basic models which explain the demand for money by firms. The transactions models, Baumol [3], Miller and Orr [14], relate holdings of money to the costs and level of transactions carried out by the firm, and they predict the existence of economies of scale in the demand for money. The wealth models, Meltzer [13], Friedman [6] view money as an asset among the other assets which comprise the portfolio of the firm. The level of money held is determined by the budget (wealth) constraint and rates of return on assets.

Empirically, it has been difficult to distinguish between these models, since most studies include sales as an indicator for both the level of transactions and a proxy for wealth. Thus, empirical work has been concentrated on examining whether economies of scale exist or not. Meltzer [13] has argued that the elasticity of the demand for money with respect to income is unity. However, when this model was modified to account for differences in firm size, Whalen [17], Vogel and Maddala [16], there was strong evidence that economies of scale exist.

Recent empirical work has tested the stability of the demand for money by firms. Wilbratte [18] and Laumas [10] conclude that the demand for M_1 by firms is not stable. Moreover, the former study finds that the behavior of firms' M_1 balances is not well explained by the demand arguments suggested by monetary theory.

In the present study, continuous cross section data for Israeli firms over a period of 12 years is used, to examine the different issues concerning the demand for money by firms. The results give no support for the existence of economies of scale. Interest rates have a strong significant effect on the demand for M_1 by firms (in sharp contrast to Wilbratte's findings). The stability issue is examined over two substantially different periods. Contrary to Wilbratte's and Laumas' results the demand for money by firms is stable over time.

The form of the equations, the sample and data are discussed in the second section of the paper. The empirical results are presented in the third section. The

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fourth section describes the stability test of the equations, while the role of price effects in the demand for money is tested in the fifth section. The final section is reserved for some conclusions.

II. The Regression Model, Sample and Data

Most studies have included in the demand for money (M) equation interest rates (r), and sales (S) or total assets (W) as a proxy for wealth or the volume of transactions. In estimating the transactions model, it was suggested, Vogel and Maddala [16], that firm size should also be taken into account, inasmuch as interest rates confronting firms of different sizes may differ. Specifically, it is argued that the larger the firm, the lower is its cost of borrowing and therefore the more money it will hold for a given "market" rate of interest. In the empirical analysis total assets are used as a measure of size.

Modifying Meltzer's model, Whalen [17] suggested inclusion of W/S in the demand for money equation as a measure of the intensity of asset use relative to sales. This specification was estimated first with W/S and then with dummy variables which represent different levels of intensity of asset use.¹

The equations implied by these models were estimated in a logarithmic form and a semi-log form (where the interest rate variable enters linearly). In addition, a partial adjustment model was also estimated.

The results reported below are based on a pooled sample of observations for the 16 industrial firms which were continually listed on the Tel-Aviv Stock Exchange during the years 1965–1976, and for which financial statements could be obtained for the entire period. The companies are, by Israeli standards, fairly large enterprises. By virtue of size they are close to the financial community, and have ready access to the money and financial markets.

The basic data— M , S and W —were obtained from the published financial statements of the 16 corporations for the years 1964–1976. The original current price data has been converted to constant price data by division by the consumer price index (1965 = 100). The interest rate (r) is measured by the nominal interest rate on short term bank loans. This series was obtained from the Bank of Israel. Finally, the inflation rate (P), used in Section 5, is computed on the basis of the consumer price index.²

III. The Empirical Results

The equations were estimated by the least squares dummy variables technique (LSDV).³ In this approach, individual shift variables are introduced explicitly

¹ If a logarithmic transformation is used, one cannot distinguish between this specification (S and W/S) and the previous one (S and W). Therefore, the method of dummy variables was also tried.

² The consumer price index is used because it is the most widely used price index in Israel. It also agrees rather closely with the Israeli GNP Implicit Price Deflator for the period studied.

³ An alternative estimation technique is the variance components model (VC) used by Balestra and Nerlove [2]. It can be shown, Maddala [11], that this model is identical to LSDV when: $\theta = \sigma_u^2 / (\sigma_u^2 + T \sigma_a^2) = 0$. (T is the length of the sample period, σ_u^2 , σ_a^2 are the variances of the error term and the constant term of the equations). In our equations θ ranges between .011 and .015 and therefore the LSDV and the VC estimates should be very close to each other.

into the equations to account for firm differences. The rationale of this procedure is that the data contain "other factors" which are specific to the individual firm.⁴

The empirical results are shown in Table I. The coefficients of the independent variables are listed, with their *t*-values beneath them. Following these are the squared multiple correlation coefficient, R^2 (adjusted for degrees of freedom), and the standard error of estimate, *SE*. All coefficients have the expected signs, and are highly significant.

The inclusion of both *W* and *S* in the same equation yielded significant results for *S* but not for *W*, probably due to the problem of multicollinearity. When *W/S* was included in the equation (in addition to *S*), it turned out to be insignificant. In an alternative specification, firms were divided into groups according to the degree of asset use. Different group divisions were tried, and a dummy variable for each group was included in the equation. In all cases the dummy variables were insignificant, implying that the intensity of asset use relative to sales does not affect the firm's money holdings (in contrast to Whalen's [17] findings).

Some evidence on the issue of existence or non-existence of economies of scale in the demand for money can be obtained from Table II, which shows the elasticities of the various variables.⁵ The sales elasticity is close to unity as expected, while the wealth elasticity is about .7, indicating economies of scale. However, all elasticities (of *S* and *W*) are not significantly different from 1.

More surprising is the result obtained regarding the interest elasticity. All interest elasticities are significant and quite high, ranging from -1.05 to -1.66. These results are in sharp contrast to earlier findings by Coates [15] and Wilbratte [18], who found interest rates to be nonsignificant in some cases. Moreover, their estimates for the elasticity of interest rates in the demand for money by firms,

Table I
Demand for Money Functions

Eq. No.	Const.	ln <i>S</i>	ln <i>W</i>	<i>r</i>	ln <i>r</i>	R^2/SE
(1)	-2.40	.936		-0.00786		.617
	-0.92	3.29		-3.20		1.030
(2)	4.50	.964			-1.656	.619
	1.90	3.37			-3.27	1.022
(3)	-0.220		.683	-0.00545		.606
	-0.080		2.41	-2.40		1.045
(4)	4.57		.709		-1.163	.607
	1.75		2.48		-2.51	1.043

Table II
Demand for Money Elasticities

Equation	<i>S</i>	<i>W</i>	<i>r</i>
(1)	.94	—	-1.52
(2)	.96	—	-1.66
(3)	—	.68	-1.05
(4)	—	.71	-1.16

⁴ Statistical tests which were performed for all the equations led to a rejection of the hypothesis that there are no firm differences, and therefore the LSDV method was used.

⁵ The elasticities for the semi-log functions were calculated for the mean value of *R*.

Table III
Demand for Money—Dynamic Functions

Eq. No.	Const.	$\ln S$	$\ln W$	r	$\ln r$	$\ln M_{-1}$	R^2/SE
(5)	-1.91	.729		-0.00562		.235	.635
	-0.66	2.30		-2.59		3.05	1.022
(6)	3.80	.754			-1.37	.233	.636
	1.47	2.36			-2.68	3.02	1.020
(7)	1.33		.361	-0.00421		.250	.625
	.45		1.13	-1.83		3.18	1.034
(8)	5.00		.384		-0.897	.248	.626
	1.75		1.19		-1.90	3.15	1.034

range between +.03 to -.414 in Coates' study, and from +.09 to -.27 in Wilbratte's study. The estimates for Israeli firms imply a much stronger response to changes in interest rates, then is implied by the data for American firms.

The specification of equations (1)–(4) assumes an instant adjustment of actual money holdings to its desired level (as determined by the level of the explanatory variables). Alternatively, a partial adjustment model may be assumed, which leads to the same equations (1)–(4) with a lagged value of the dependent variable as an additional explanatory variable.⁶ The estimates of these dynamic equations are reported in Table III.

The significance of the sales variable suggests that sales are a better scale variable than wealth. The coefficient of $\ln M_{-1}$ indicates a quick adjustment process. About 75% of the gap between the desired money balances and the actual level is closed within a year. The long run elasticities of S and R are virtually the same as in Table II.

IV. Stability Test

To examine the stability of the demand for money function, the sample period was divided into two sub-periods: 1965–1972 and 1973–1976. The turning point 1973 was chosen since during that year and during 1974 the economy suffered from severe external shocks caused by the "Yom-Kippur War" and the rapid rise in the cost of oil and other raw materials. The substantial difference in economic performance between these two sub-periods is summarized below.

Annual average of:	GNP	$\dot{P}$	$\dot{M}$	UNR
1965–1972	8.9	6.6	15.0	5.3
1973–1976	4.2	32.6	23.5	3.1

where:

GNP = percentage change in real GNP

$\dot{P}$ = percentage change in the consumer price index

$\dot{M}$ = percentage change in money supply (currency + demand deposits)

UNR = unemployment rate

⁶ Such a model is described in Goldfeld [7, 8]. He also suggests an alternative form of an adjustment model which leads to the inclusion of a lagged value of nominal money holdings, deflated by the current price level, in the equation. This specification yielded virtually the same results as in Table III.

It is believed that the proposed stability test is a strong one, since other studies which estimated the demand for money in Israel, based upon data until 1973, failed to give good predictions for 1974 and on, Marom [12] and Zilberfarb [19].

To test for the stability of the function a procedure, suggested by Gujarati [9], was employed whereby dummy variables are introduced into both the constant term and the slopes of the equation. This technique gives conclusions that are similar to those of the familiar Chow test [4] with regard to the stability of the function, but additionally, enables us to identify those particular coefficients that are unstable.

The results of the stability test are surprising. In contrast to previous findings relating to American firms, by Wilbratte [18] and Laumas [10], here all the equations (including the dynamic ones) are stable. None of the dummy variables is significant, despite the major changes in the economic environment in the second period.

V. The Role of Price Effects

The role of inflation in the demand for money equation has been a controversial issue, both at the theoretical and the empirical level. Ando and Shell [1] have shown that in a strict transactions view of the demand for money, inflationary expectations have no direct effect but rather an indirect influence through their effect on the nominal interest rate which enters the equation. On the other hand, Santomero [15], using a generalized Baumol-Tobin model, has shown that the expected inflation rate should enter the demand for money equation.

In an attempt to shed more light on this controversy at the empirical level, equations (1)–(8) were reestimated, with the addition of the inflation rate (P) as a proxy for inflationary expectations. The coefficient of the interest rate proved to be negative in all equations and significant in six of them (equations (7) and (8) are the exceptions). The coefficient of the inflation rate has the expected sign in all equations, but it is always insignificant. Thus, the inflation rate does not seem to have a direct significant effect on the demand for money by firms in Israel.⁷ However, the results are not conclusive. The lack of a direct effect of P in the equations may be attributed to the problem of using the actual inflation rate as a proxy for inflationary expectations and to the problem of multicollinearity between P and r . This last argument obtained further support when the equations were reestimated, with the inflation rate replacing the interest rate as an explanatory variable. The coefficient of P has the expected negative sign in all equations and is significant in six of them (again equations (7) and (8) are the exception).

A common assumption in studies of the demand for money is that the demand for money is homogeneous with respect to prices. To test this assumption, equations (1)–(8) were reestimated with the log of the price level as an additional explanatory variable. The coefficient of this variable measures the deviation of the price elasticity from unity. In all the equations this coefficient is insignificantly

⁷ It is interesting to note that studies about the demand for money in Israel (not by firms) have found a significant direct effect. See, Marom [12] and Zilberfarb [19].

different from zero, so that one cannot reject the hypothesis of unitary price elasticity in the demand for money by firms.

VI. Conclusions

The empirical investigation of the demand for money by firms in an inflationary environment suggests that the demand for money by firms is particularly sensitive to changes in the interest rate. This result contradicts findings obtained for U.S. firms, where the effect of interest rates turned out to be mostly negligible or insignificant. A possible explanation for these differences is that firms are more sensitive to changes in the nominal interest rate when the inflation rate is high and prolonged. Economic agents tend then to invest more time and resources in improving their payments' techniques or in finding alternative investment media, thereby reducing the need and desire to hold money balances.

These appear to be no economies of scale in money holdings of individual firms. The sales elasticity is close to unity, while the wealth elasticity is less than 1 but not significantly so. The empirical test also shows that one cannot reject the assumption that the demand for money by firms is homogeneous with respect to prices.

The dynamic equations imply a quick adjustment process, and suggest that sales are a better scale variable than total assets.

The results may indicate that the inflation rate does not have a direct effect on the demand for money, which is additional to its indirect effect through the nominal interest rate. However, the lack of such direct effect in this study may be attributed to the problem of multicollinearity between r and P , and the use of the actual inflation rate as a proxy for inflationary expectations.

Finally, the stability of the demand functions was tested over two substantially different time periods. The results show a stable relationship between the demand for money and the explanatory variables suggested by monetary theory. This contradicts some of the earlier findings for the U.S.

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