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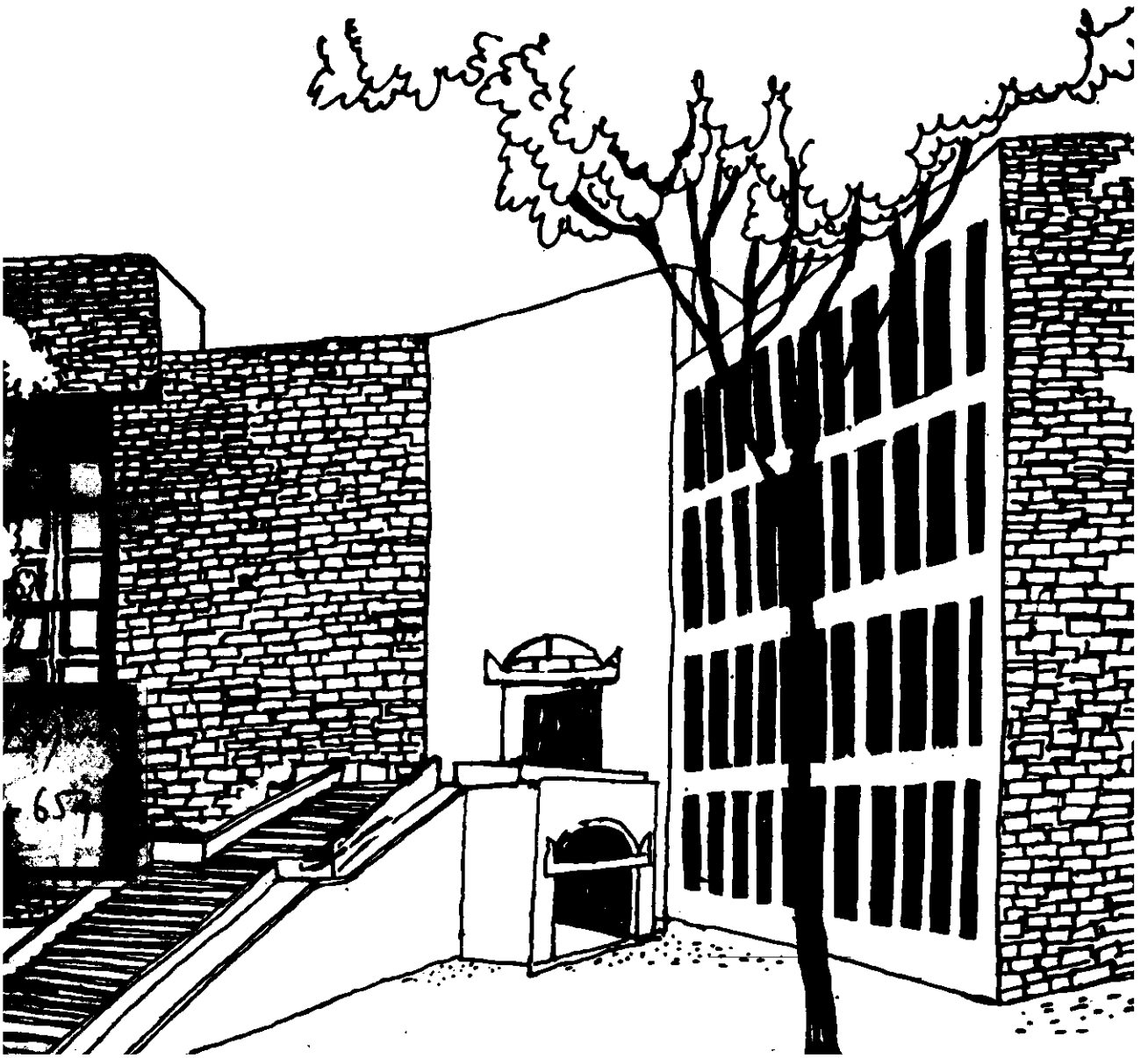

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DEMAND FOR MONEY: AN EMPIRICAL EXAMINATION OF UNSETTLED ISSUES FOR INDIA

By

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The Issues

The lively debates between monetarists and Keynesians, and on the relative effectiveness of monetary and fiscal policies stand partly due to the unsettled issues pertaining to the demand for money function. Further, the issues are purely with regard to the magnitudes of various elasticities of money demand and the stability of the function. While a large volume of empirical evidence exists for countries such as USA, Canada and U.K.[1], not much is available for India or other developing economies. Besides, a few studies which are available in the literature for India,[2] are far from a comprehensive coverage of various issues simultaneously, rendering them less reliable for the purpose. Also, the definition of the narrow concept of money (M_1) has recently undergone a significant change in the official data sources and perhaps there are no studies based on the newly defined concept. The present study is an humble attempt towards filling up these gaps.

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1. For a cross-section of references, see Laidler (1985)

2. See, for example, Mahajan (1979), Trivedi (1980), Sampath and Hussain (1981), Deadman and Ghatak (1981), Paul(1981), Ram and Biswas (1983) and Murty and Paul (1985).

The principal issues pertaining to the demand for money, particularly in the Indian context, are the following:

a. What is the relevant concept of money: narrow (M_1) or wide (M_3)?

b. What is the appropriate concept of income that should be included in the function: measured or permanent?

c. Should income variable be disaggregated into agricultural and non-agricultural income?

d. Should the rate of interest relevant for the money demand function be a short-term rate, a long-term rate or neither?

e. Is the inflation rate an important argument in the function?

f. What are the magnitudes of various elasticities concerning the money demand function?

g. Is the money demand function stable over time?

The Model

The following model was hypothesized for examining the above mentioned empirical issues:

$$\frac{M}{P} = f\left(y, \quad i \quad , \dot{P} \quad , \quad \frac{y_{na}}{y_a} \quad , \quad T\right)$$

$$f_1, f_4, f_5 > 0 > f_2, f_3$$

where

M = nominal money stock (Rs. billions)

P = price level (index, 1970-71 = 100)

y = real income (Rs. billions at 1970-71 prices)

i = interest rate (percent)

$\dot{P}$ = inflation rate (percent)

y_{na} = non-agricultural real income (Rs. billions at 1970-71 prices)

y_a = agricultural real income (Rs. billions at 1970-71 prices)

t = time trend

The two concepts of money were used: narrow and wide. The former consists of currency with public and non-interest bearing deposits with banks (called M_1 by RBI), and the latter M_1 plus interest bearing deposits with banks (called M_3 by RBI). The whole-sale price index was employed both to measure the price level and the inflation rate. The real income variable was defined in four different ways: measured real income (y), permanent real income(y^p), adjusted (for data inaccuracy) real income (y^*) and adjusted permanent real income(y^{p*}). Both the short-term (i_s) and long term interest rates (i_l) were tried in the estimation of the money demand function. The reasury bill rate served as the short-term rate and the yield on govemment bonds as the long-term interest rate. Both the actual ($\dot{P}$) as well as the expected rate of inflation ($\dot{P}^e$) were experimented. The two components of income, viz. y_{na} and y_a were not hypothesized as the separate explanatory variables due to

the usual problem of multicollinearity.

The model needs no rationalisation. Suffice it to point out here, there is a consensus that the desired money holdings are in real terms, that the income is an appropriate scale variable, that interest rate is a good measure of the opportunity cost of holdings money, and that the inflation rate is a relevant argument when there is a high degree of inflation. The two additional variables, viz. y_{na}/y_a and T are hypothesized to influence money holoings, the former to see if the two components of income exert varying influence on the dependent variable under question and the latter to serve as a 'catch all' variable, if needed.

Data and Estimation

Among the variables involved in the function, M_1, M_3, P, y, i_a, i_e, $\dot{P}$, y_{na} and y_a are the observed variables and the rest, viz. y^p, y^*, y^{p*} and $\dot{P}^e$, are the unobserved ones. The data on the former set for the sample period 1954-55 through 1982-83 were obtained from their original sources, i.e. from the publications of the Reserve Bank of India (RBI) andthe Central Statistical Organisation. However, there was a snag with regard to the definiteness of M_1 and M_3: the published series went through definitional changes during the sample period. Since 1977-78, the RBI's definition of M_1 consists of currency with public, ' other ' deposits and banks' savings deposits on which no interest was paid. However, the earlier data on M_1 (unadjusted) includes, in addition to these, banks'

savings deposits on which interest was paid, and the RBI revised its data marginally once more effective 1969-70. Since data constitute the raw-material for an empirical work, they must be uniform to yield meaningful results. Thus, uniform series for M_1 was compiled as follows:

Period	Source and interpolation
1977-78 to 1982-83	RBI Bulletins, latest series
1969-70 to 1976-77	Obtained as the sum of currency (C), 'other' deposits (OD) and demand deposits, where C: RBI Bulletins OD: RBI Bulletins [3] DD: RBI Bulletins data x 0.58
1954-55 to 1968-69	Obtained as C + OD + DD, where C : RBI Bulletins data x 0.996 [4] OD: RBI Bulletins [5] DD: RBI Bulletins data x 1.075 x 0.58

The series on M_3 was obtained as the sum of M_1 and banks' time deposits (TD). For 1977-78 to 1982-83, the data were available directly in RBI Bulletins. For the earlier years, the M_1 data, which were derived as hitherto explained, were used and the series on TD was obtained as the difference between banks' aggregate deposits (AD) and their DD, the

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3. The ratio of adjusted to unadjusted DD in 1977-78, 1978-79 and 1979-80 stood at 0.5873, 0.6000 and 0.6453, respectively, and in March 1978 the banks which had adjusted this data contributed to only 8.1% of total savings bank deposits.

4. The revised C series was about 99.6% of the earlier series during 1969-70 through 1974-75.

5. The revised DD series was about 107.5% of the earlier series during 1969-70 through 1974-75, and for the use of factor 0.58, see footnote 3 above.

former obtained directly from the RBI Bulletins andthe latter compiled as explained in the previous paragraph. Thus, each of the M_1 and M_3 series used in this research is uniform and consistent with the present definition of these concept, though it is subject to our method of interpolation.

The data on unobserved permanent real income were obtained as weighted (exponentially declining) averages of the current and past real incomes, the current period weight being assumed at 0.3 (Trivedi 1980). The adjusted real income series was obtained by adjusting the agricultural income to the period to which it really belongs. The official agricultural income data for the year, say 1982-83, consists of the Kharif crop in 1982-83 and rabi crop in 1982-83, while truly they should consist of rabi crop in 1981-82 and Kharif crop in 1982-83. Since separate data on rabi and Kharif crops were not available, we obtained the adjusted agricultural income (y_a^*) data for the year, say 1982-83, as the simple average of the official figures for 1981-82 and 1982-83. The real income data were then adjusted accordingly. The data on the last income concept, i.e. adjusted permanent income, were derived from y^* data just as y^P series was obtained from y series.

The data on the expected inflation rate were generated on the basis of the adaptive expectation model, which involved the computation of weighted (exponentially declining) averages of current and past inflation rates; the current period was assigned a weight of 0.3 (Trivedi 1980).

The model was estimated through the ordinary least-squares (OLS) method under various alternative specifications:

a. linear and double-log (all variables in log but the inflation rate and the ratio of non-agricultural to agricultural income, which were in linear) functional forms

b. various definitions of the variables

c. various combinations of the explanatory variables

d. full sample period as well as for the first half and the second half of the sample period.

The estimation results for the selected specifications for M_1 definition are presented in Table 1, for M_3 in Table 2 and for some rejected but pertinent equations in Table 3. All the relevant statistics are reported for each equation and these include the coefficient of determination (R^2), residual sum of squares (RSS), Durbin-Watson statistics (DW) and standard error of estimates (SEE). No results of linear specification are included in the tables, for they were inferior to the double-log formulations.

Findings

The empirical findings on the function are quite encouraging. The three variables, viz. income, interest rate and the inflation rate explain upto 96% of the variation in narrow money and 98% of the variation in wide money holdings. The income variable enters with a highly significant and correctly signed coefficient in each and every

Table 1 : Money Demand Functions - I

Dependent Variable : $\log \left(\frac{M_1}{p} \right)$

Equation No.	Sample Period	Coefficients of Independent Variables (and t-ratios) constant	$\log y^p$	$\log y^{p*}$	$\log i_s$	$\dot{p}^e$	R^2 (RSS)	DW	SEE
1	1954-55 to 1982-83	-2.2	1.13 (4.73)		-0.135 (1.12)	-0.020 (4.19)	.958 (.077)	0.75	.06
2	,,	-2.2		1.17 (12.48)	-0.152 (1.41)	-0.020 (5.50)	.962 (.071)	0.76	.05
3	1954-55 to 1967-68	-0.4	0.84 (9.07)		-0.133 (2.10)	-0.010 (2.68)	.937 (.005)	1.70	.02
4	,,	-0.6		0.85 (10.08)	-0.146 (2.52)	-0.011 (3.11)	.940 (.004)	1.66	.02
5	1968 69 to 1982-83	-4.5	1.60 (8.61)		-0.405 (2.07)	-0.014 (2.66)	.941 (.034)	1.14	.06
6	,,	-4.4		1.58 (9.04)	-0.392 (2.12)	-0.014 (2.94)	.946 (.032)	1.16	.05

Table 2 : Money Demand Function - II

Dependent Variable : $\log\left(\frac{M_3}{P}\right)$

Equation No.	Sample Period	Coefficients of Independent Variables (and t-ratios)							R^2 (RSS)	DW	SEE
		Constant	log y	log y^p	log y*	log y^{p*}	log i_s	$\dot{p}^e$			
1	1954-55 to 1982-83	-4.2	1.53 (10.04)				.135 (0.73)	-.020 (3.15)	.958 (.226)	0.99	.09
2	,,	-4.9		1.73 (12.41)			-.014 (0.09)	-.025 (4.56)	.970 (.158)	0.57	.08
3	,,	-4.4			1.60 (11.43)		.056 (0.33)	-.019 (3.45)	.966 (.182)	0.69	.09
	,,	-5.0				1.75 (12.89)	-.030 (0.19)	-.025 (4.84)	.972 (.148)	0.82	.08
5	1954-55 to 1967-68	-0.8	0.95 (4.74)				-.067 (0.42)	-.002 (0.16)	.862 (.032)	2.50	.06
6	,,	-1.8		1.15 (6.02)			-.178 (1.35)	-.007 (0.84)	.903 (.022)	2.05	.05
7	,,	-1.3			1.04 (5.68)		-.095 (0.69)	-.004 (0.47)	.894 (.024)	2.01	.05
8	,,	-1.8				1.17 (6.09)	-.194 (1.48)	-.007 (0.92)	.905 (.022)	1.87	.05
9	1968-69 to 1982-83	-7.7	2.21 (3.74)				-.272 (0.88)	-.008 (0.96)	.947 (.081)	1.67	.09
10	,,	-8.3		2.33 (14.84)			-.285 (1.73)	-.015 (3.38)	.984 (.025)	1.17	.05
11	,,	-8.2			2.29 (11.04)		-.366 (1.62)	-.006 (1.06)	.972 (.043)	1.45	.06
12	,,	-8.0				2.30 (16.39)	-.233 (1.17)	-.016 (4.02)	.986 (.020)	1.13	.04

Table 3 : Money Demand Functions : III

(Sample period : 1954-55 to 1982-83)

Equation No.	Dependent variable	Coefficients of Independent Variables (and t-ratios) constant	$\log y^p$	$\log y^{p*}$	$\log i_s$	$\log i_l$	$\dot{p}^e$	$\frac{y_{na}}{y_{a*}}$	T	R^2	DW	SEE
1	$\log (M_3/p)$	-7.0	2.17 (10.51)		-.221 (1.35)		- .015 (2.39)		-.139 (2.69)	.977	.78	.07
2	,,	-4.3	1.56 (7.14)			.224 (0.80)	-.026 (4.87)			.971	.63	.08
3	,,	-5.0	2.08 (5.26)		-.072 (0.43)		- .020 (3.12)	-.422 (1.16)		.972	.68	.08
4	,,	-4.5		1.62 (7.42)		.148 (0.53)	-.026 (5.06)			.973	.56	.08
5	,,	-6.2		2.00 (7.44)		-.069 (0.25)	-.019 (3.25)		-.106 (2.17)	.977	.61	.07
6	,,	-4.0		1.95 (6.72)		0.272 (0.98)	-.022 (3.92)	-.577 (1.68)		.975	.79	.07
7	$\log (M_1/p)$	-3.5	1.45 (9.92)		-.278 (2.40)		-.013 (2.92)		-.094 (2.55)	.967	1.05	.05
8	,,	-2.2	1.13 (4.73)		-135 (1.12)		-.020 (4.19)	.027 (0.10)		.958	.76	.06
9	$\log (M_3/p)$	-4.2	$\log y$ 1.55 (10.04)	$\log y^*$	.135 (0.73)		-.020 (3.15)			.958	.98	.09
10	,,	-4.4		1.60 (11.43)	.056 (0.33)		-.020 (3.45)			.966	.69	.08

specification attempted, the inflation rate assumes always the a priori signed and usually significant coefficient, and the interest rate appears with generally a correctly signed but insignificant coefficient. The Durbin-Watson statistic often rules out the problem of autocorrelation.

Magnitudes of money demand elasticities depend on the definition of the relevant variables. All the four definitions of income have worked reasonably well in all the functions. However, a scrutiny of the results in Tables 1 through 3 would reveal that the adjusted permanent income provides a slightly better fit than the other income concepts. The preference is in terms of the level of the significance of the regression coefficients, R^2 value and the magnitudes of the residual sum of squares.

Of the two interest rates experimented, the treasury bill rate works much better than the yield on government bonds in the function. The former usually yielded a priori expected sign for its coefficient while quite the opposite was true with regard to the latter. Further, the long-term rate never commanded a significant coefficient in either the M_1 or M_3 functions, in contrast the short-term rate had fairly significant coefficients in many of the M_1 functions and in a few M_3 equations. This finding is consistent with the theoretical foundations of the money demand function.

The principles of economic theory would favour the expected rate of inflation to the actual rate of inflation in the money demand function. But the reliability of the data criterion could argue quite the other way, for while the actual rate is observed, the expected rate is not. To overcome this paradox, both the inflation rates were applied in the estimations. The fit for both the definitions of money turned out to be much better with the expected than with the actual rate of inflation. This again was in terms of the level of significance of the regression coefficients, R^2, RSS and DW.

The remaining two arguments, viz. the ratio of non-agricultural to agricultural income and the trend variable, assumed signs for their coefficients which turned out to be inconsistent with the a-priori reasonings. In view of the increasing monetisation in the economy and incomprehensiveness of any economic function, one could not tolerate negatively signed coefficients for each of these variables.

In view of the foregoing reasonings, equation 2 of Table 1 and equation 4 of Table 2 are the preferred equations for M_1 and M_3, respectively for the sample period as a whole. These indicate the following values for

the various elasticities:

Demand Elasticity for $\frac{M_1}{P}$	Demand Elasticity for $\frac{M_3}{P}$	With Respect to[6]
1.17	1.75	Real adjusted permanent income
-0.152	-0.300	Treasury bill rate
-0.121	-0.151	Expected inflation rate

Thus, the Baumol-Tobin square-root hypothesis for money demand function, which implies economies of scale in money holdings, among other things, does not hold good in case of India. Rather, in Milton Friedman's language, money is a luxury item in India, M_3 more than M_1. The finding with regard to interest elasticity also go against the square-root formula but is consistent with its normal range of 0 to (-) 0.5. People do vary their money holdings in the face of changes in expected rate of inflation, but their sensitivity falls in the inelastic region. These findings are in general agreement with theliterature cited in note 2 above.

Tables 1 and 2 also contain regression results for the two- sub-sample periods, consisting roughly of the first and the second half of the whole sample period. A comparison of the results of the three regression runs,

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6. While the other elasticities were directly available from Tables 1 and 2, the inflation rate elasticities were computed as the product of the corresponding coefficient of $\dot{p}^e$ and the mean value of $\dot{p}^e$ (= 6.07).

based on an identical formulation but different sample periods, would throw some light on the variation in the magnitudes of various elasticities over time. The table below summarises these findings for the chosen formulation for each of the two concepts of money holdings (Table1, equations 2,4 and 6, Table 2, equations 4, 8 and 12):

Sample period	Demand Elasticity for					
	$\frac{M_1}{P}$ with respect to			$\frac{M_3}{P}$ with respect to		
	y^{p*}	i_s	$\dot{p}^e$	y^{p*}	i_s	$\dot{p}^e$
1954-55 to 1982-83	1.17	- .152	- .121	1.75	- .300	- .151
1954-55 to 1967-68	.85	- .146	- .041	1.17	- .194	- .026
1968-69 to 1982-83	1.58	- .392	- .115	2.30	- .263	- .131

These results reveal that there has been a consistent increase in the magnitudes of all money demand elasticities over time in India. Whether the change is significant or not is examined in what follows.

To test statistically the stability of the money demand functions over time, the Chow test was applied to the equations with identical specifications but based on sub-samples and the full sample period.[7] The computed F-value for equations 2,4 and 6 of Table 1 turned out to be 5.1 and that

7. For Chow test, see Gujarati (1978), pp.305-6.

for equations 4, 8 and 12 of Table 2 at 13.3, both of which are greater than the theoretical value of F (degrees of freedom, numerator 4 and denominator 21) at 5% significance level which stands at 2.84. Similar results were obtained when the comparison was attempted among equations 1,3 and 5 of Table 1, and equations 1,5 and 9; 2,6 and 10; and 3,7 and 11 of Table 2. Thus, on this basis, both the money demand functions have been unstable over time in India. However, if the stability of a function is to be judged on the broader basis, which includes not only the stability of the magnitudes of the coefficients, but also the limited number of the measurable explanatory variables, yielding a high degree of the explanatory power (R^2) (Laidler 1982), then the findings are inconclusive on this aspect.

The selected equations were tested for their predictability as well. They explain year to year fluctuations in real money balances during the sample period rather well. The minimum, mean and maximum absolute error as a percentage of the mean of the dependent variable turned to be 0.001%, 0.44% and 1.36% for the selected equation for M_1 (equation 2 of Table 1) and 0.005%, 0.64% and 1.35% for the selected equation for M_3 (equation 4 of Table 2).

Conclusions

The study provides the following empirical evidences for India on the various issues raised in the beginning of the paper:

a. Both the narrow and wide concepts of money are well explained by the well-known and limited number of arguments in the money demand function. Thus, on this criterion, either definition of money is equally acceptable.

b. Permanent income is more relevant than the measured income in the money demand function.

c. The ratio of non-agricultural income to agricultural income was found to be irrelevant argument in the money demand function. This, in some sense, argues against the hypothesis of different money demand elasticities with respect to the two components of aggregate income.

d. Short-term rate of interest has proved to be the relevant interest rate in the money demand function.

e. Inflation rate has been found to be a very significant argument in the demand function for money.

f. Income (permanent) elasticity of demand for narrow money stand at 1.17, interest elasticity at -0.15, and the inflation rate elasticity at -0.12. For the wide money, the said elasticities are 1.75, -0.30, and -0.15, respectively.

g. Money demand function in India has been found to be unstable over time on the narrow definition of stability but inconclusive on its broad definition.

h. Estimated demand function's ability to reproduce history has been found to be excellent.

Needless to say, these conclusions are subject to our methodology, particularly to the derivation of data on unobserved variables.

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