The Short-Period Adjustment of Domestic Prices to Excess Money Supply: Trinidad and Tobago, 1966-1980

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Introduction: This is more of a progress report on an area of research begun in August 1981. It is hoped that sufficient helpful comments will emerge to assist in producing a useful paper eventually. Briefly, an attempt is being made to use quarterly data for Trinidad and Tobago to measure separate money supply and money demand functions and so excess money supply. This will be used to throw some light on the unsettled question of how, if at all, the money supply impacts on the rate of inflation. Because of the openness of the Trinidad and Tobago economy, this exercise should perhaps best relate to domestic prices only. Not only is it the current view that the money supply in this type of economy is endogenous and linked to the balance of payments; the view is also held that the absence of explosive inflation derives from the openness of the economy which makes supply elastic. The novel features in the paper are its use of quarterly data, its attempt to derive separate supply and demand functions for money, and its attempt to separate out the domestic component of inflation from its imported content. It should not be surprising if, at this very initial stage of such an ambitious study, the author were to report that the results to date are far from encouraging.

The context of the study is that there still exists a healthy scepticism, not least among the monetary authorities to whom inevitably blame is imputed, that the lack of effective control over the money supply is the ultimate cause of

inflation in individual economies and the world over. Most attempts at relating monetary variables to the price level assume a stable money demand function and an exogenous money supply in the control of the monetary authorities. Thus the measured supply of money is regarded as observable while the demand for money is taken as implied by a scale factor and one or more opportunity cost variable. The process by which the money supply emerges is not modelled. One of the principal departures from this approach is to regard the money variable measured by the authorities as the public's demand for money which is endogenously determined and which intersects the money supply function at that point. The supply of money we regard as belonging to the province of the banking system, the public's behaviour, and the monetary authorities which may set reserve requirements. These together determine a money multiplier which, given the monetary base, sets the capacity money supply. Inflationary pressures derive from excess money supply, and given the relative elasticity of supply of traded goods should show itself in its impact on the prices of non-traded goods. Hence the need to measure domestic prices rather than the price of a unit of the final bill of goods.

The study is not of the inflationary process per se. A recent comprehensive study by Bynoe [1] and a less exhaustive monetarist paper by London [18] are highly recommended reading. Rather the paper aims to introduce the money supply process into the study of inflation.

The Model: The bare bones of the overall model are presented here. The components will be discussed in turn later in the paper.

Money Supply	$M^S = f_1(H)$	(1)
Demand for Money	$M^D = f_2((Py), i)$	(2)
Domestic Prices	$P = f_3(P^I, P^d)$	(3)
Price Adjustment	$P^d = f_4(M^S, M^D)$	(4)

Here M^S and M^D are money supply and money demand respectively, H is high powered or base money, y is the rate of real output, i an interest rate variable, and P^I, P^d and P respectively import prices, domestic prices and prices of all final purchases. The endogenous variables are M^S, M^D, P^d and i, while exogenous variables are y, P^I and H. Because of the build up of P, from P^I and P^d, it is not being treated as an additional variable. The variable Py, the money value of output, is thus not additional to y, real output, once P is known.

The Money Supply Equation: Early studies of the theoryof the money supply process by Brunner [4,1961], Friedman and Schwartz [13,1963], Teigen [21,1964] Brunner and Meltzer [5, 1968], Burger [7,1971], gave way to a focus on the control of the money supply e.g. by Bain [2,1970], Burger, Kalish and Babb [6,1971]], Burger [8,1972], and subsequently to a

closer focus on the study of the behaviour of the money multiplier e.g. by Bomhoff [3,1977], Frost [14,1977] and Butller and Schiltkmecht [9,1979]. In the context of the small open Caribbean countries, Farrell [11,12,1981] has most recently taken us back to the theoretical basis of money supply processes, emphasising in particular the role of the domestic budget deficit in the money creation process. In all this two crucial issues seem to stand out: firstly the determinants of the supply of high powered money, and secondly the determinants of the money multiplier and in particular whether it can be taken as a parameter.

The approach taken to the money supply was to write, from equation (1)

$$M^S = \mu H \qquad (1,a)$$

$$\mu_1 = \frac{1 + c}{\rho + c} \qquad (1,b)$$

$$\mu_2 = \frac{1 + c + q}{\rho + c + x} = \frac{1 + c + q}{\rho+\sigma+c+x} \qquad (1,c)$$

where μ_1 = narrow money multiplier

μ_2 = broad money multiplier

c = $C|D$, the currency to deposits ratio,

ρ = statutory reserve ratio,

q = $Q|D$, the quasi money (time and savings) to deposits ratio,

x = $E|D$, the excess reserves to deposits ratio,

and r = $BR|D$, the bank reserves to deposit ratio which may exceed ρ.

σ = the secondary reserve ratio set by the Central bank.

We note that in addition to the statutory reserve requirement (ρ), the Central Bank has required of Commercial banks that they maintain a 5 per cent secondary reserve ratio (σ) which might be held in the form of short term Government paper (Treasury Bills) or in the form of Special Deposits (SD) on which a small rate of interest (currently 3 per cent) is paid. Since 1975 there has been no expansion in the stock of Treasury Bills (TB) and as commercial banks' liabilities expanded dramatic changes occurred in the form in which the secondary reserves were held. First Secondary Deposits rose steeply from 1974 as the banks became extremely liquid. Next from 1976 in any event the supply of Treasury Bills were no longer enough to enable the banks to meet their requirements for secondary reserves in the form of Treasury Bills even if they so desired. Thus the excess reserves ratio which would normally be defined as

$$x = r - \rho$$

should properly become

$$x = r - \rho - \sigma_c$$

where σ_c is the secondary reserves necessarily held in cash as Special Deposits. Table I illustrates for end of year data.

Table I: Commercial Banks Liabilities, Treasury Bills and Excess Special Deposits

$ million

Year	Liabilities (L)	.05.L	T.B.	T.B.-.05L	S.D.	Excess S.D.
1970	491.4	24.5	73.6	49.1	1.2	1.2
1971	612.1	30.6	80.8	50.2	15.6	15.6
1972	759.0	38.0	99.8	61.8	3.4	3.4
1973	912.5	45.6	102.8	57.2	3.5	3.5
1974	1178.6	59.6	97.2	37.6	96.3	96.3
1975	1555.9	77.7	101.2	23.5	201.3	201.3
1976	2085.0	104.0	101.2	-2.8	286.3	283.5
1977	2665.4	133.0	101.2	-31.8	203.1	171.3
1978	3475.0	173.5	101.2	-72.3	111.6	39.3
1979	4360.9	218.0	101.2	-116.8	413.4	296.6
1980	5215.9	260.5	101.2	-159.3	333.6	174.3

There seems nevertheless to be, since 1974, a substantial holding of excess reserves in the form of Special Deposits.

In an attempt to estimate the money supply, the first naive approach was to measure $\hat{\mu}_1$ and $\hat{\mu}_2$ by deriving time series of the various components and fitting them together. In general flow variables were taken as represented by the average of their monthly values for the quarter, while stock variables were represented by their end of quarter values. The following definitions were used:

H = NFA + NGB = Net foreign assets plus net government borrowing,

ρ = statutory reserve requirement,

C = currency in the hands of the public,

D = deposit liabilities of commercial banks,

BR = commercial banks reserves with the Central Bank,

Q = quasi money (time and savings deposits),

E = BR - ρD = excess reserves.

The empirical series derived for $\hat{\mu}_1$ and $\hat{\mu}_2$ are given on Fig.I. The basic descriptive statistics for those series are given in Table II, along with those of the component parameters which latter are depicted on Fig.II.

Table II:

	Mean	Std.Dev.	Coefficient of Variation %	Max Value/Date	Min.Value/Date	Range
μ_1				6.7,III/1974	4.9,IV /1980	1.8
μ_2				11.3, IV/1974	4.9,II /1978	6.4
q				.8,III/1973	.675,IV /1978	.125
c				.18, I /1967	.075,III/1975	.105
r				.28, II/1976	.045, IV/1967	.235
ρ				.11, IV/1980	.05,III/1966	.06

Inspection of Figs. I and II indicates gradually rising narrow and broad multipliers up to 1974 when with the increase in ρ and H they both fall. Thereafter $\hat{\mu}_1$ stabilises until late 1979 when

another downward trend begins. By contrast $\hat{\mu}_2$ is extremely unstable with deep troughs at II/1976, II/1978 and I/1980 and jagged peaks at III/1977, IV/1978 and II/1980. Of the component variables, q is stable and shows no trend movement, c exhibits a slight downward trend while r becomes quite volatile after 1973 and exhibits broadly an upward trend. Taken in conjunction with the slight upward trend in ρ, the statutory reserve ratio, excess reserves (x) as measured by $(r - \rho)$ become large and volatile after 1973 and show an upward trend. A crucial question would therefore be to discover the determinants of the banking system for excess reserves. It might simply represent mismanagmment of the country's financial resources, or a surfeit of it, as well as it might be a temporary representation of an excessive flow of high powered money coupled with a slow learning curve by the financial system and high uncertainty as to what the new parametric structure of the system might be.

The objective of the current exercise is to find a multiplier which when applied to H will yield an estimate of the capacity of the financial sector to generate money supply. Were the determinants of this multiplier all behavioural (e.g. c,q,x) it would have been easy to assume some form of learning curve and to assume that the system will generate its optimal multiplier. Up to 1973 it might then have made sense to join the peaks of the $\hat{\mu}$ series and apply these 'capacity'

multipliers to H. But there emerged in 1973 an active reserve requirement policy and this clearly affected the money multiplier parameter. The shift is again discernible between Q III and Q IV, 1974 when the reserve ratio was raised from 7% to 9%, and yet again at the end of 1979 (Q IV) when marginal reserve requirements of 15% were imposed. Thus on the evidence that c and q are fairly stable, the reaction of μ to changes in ρ and x might be studied. Simple functions such as

$$\hat{\mu}_1 = a_1 + b_1\rho \qquad (1,d)$$

$$\hat{\mu}_2 = a_2 + b_2\rho + c_2x \qquad (1,e)$$

might be estimated by regression methods and the reaction coefficients b_1, b_2 and c_2 studied. We would expect <u>a priori</u> that these coefficients all be negative. Time did not permit this to be done, but certainly such an exercise would yield estimates of μ_1 and μ_2 which to apply to H.

The naive experiment of joining the peaks in the <u>a posteriori</u> multiplier series was done and applied to H. This generated a series for M_1^S and M_2^S which were used in the empirical analyses. The results, as reported later in the paper, were not very good. Clearly the estimated multipliers were far too large in the post-1973 period, and the ratio of M^S to M^D too high to make sense.

It was also evident that a more appropriate measure of the base money variable (H) needs to be developed. The net domestic budget deficient is clearly a possible candidate. This was however not attempted as time did not permit. The problems inherent in the use of NFA + NGB as the measure of H were clearly evident in generating extremely high M^S to M^D ratios. After 1973, NFA rises rapidly and NGB is large and negative but not nearly sufficiently large to stabilise H, especially after much of the pre-1975 Government debt had been redeemed and the net new flow of Government paper remained small by comparison to the rapidly increasing size of the other financial variables. Thus the prediction of capacity money supply would have been inadequate both on account of a poorly estimated multiplier and an inappropriate monetary base. Some first attempts of studying the behaviour of μ with respect to changes in ρ and c first theoretically and then for actual changes are given below.

Simulations with $\mu_1 = \frac{1 + c}{\rho + c}$

c	.075	.1	.15	.2	.075	.1	.15	.2	.075	.1	.15	.2
ρ	.050	.05	.05	.05	.07	.07	.07	.07	.09	.09	.09	.09
μ_1	8.6	7.33	5.75	4.8	7.4	6.47	5.23	4.4	6.5	5.79	4.79	4.14

$\mu_2 = \frac{1 + c + V}{+ c + x}$ Simulation of the actual impact of changes in ρ on μ_2.

	IV,1972		III,1974		IV,1979	
$\bar{c}$	.125	.125	.092	.092	.109	.109
$\bar{q}$	.725	.725	.778	.778	.719	.109
x	0	0	.012	.012	.096	.719
ρ	.05	.07	.070	.090	.090	.150
μ_2	10.57	9.49	10.75	9.64	6.20	5.15
% change in μ:	-10		-10		-17	

These analyses show that the impact of the cash ratio on the narrow multiplier is negative as also is the influence on the statutory reserve ratio. The effect of the raising of the statutory reserve requirement in 1972 on the broad money multiplier was an immediate 10% fall in response to a two percentage point (40 per cent) increase in ρ. A similar response occurred in 1974. When ρ was increased from 9 to 15 per cent in 1979 (a 66% increase) the broad money multiplier fell by 17 per cent. It therefore seems that reserve ratio variation impacts immediately on the multiplier but that the impact is comparatively small. If in addition high powered money (H) is expanding, the net effect can be easily nullified. Perhaps both μ and H must be used together, but to the extent that H reflects deficit spending on the domestic budget fiscal and monetary policy must be integrated, as we know.

Domestic Prices: As a first approximation is was assumed that overall the price level, as captured by the index of retail prices, is a combination of import prices and domestic inflationary pressures, and the interaction of the former on the latter. Models of the inflationary process abound and it is not the purpose of this paper to address them. Clearly however imported final goods which enter the consumption basket will have a direct impact on the RPI, and intermediate imported inputs will also impact on the cost of production and generate tendencies to cost push. The perplexing phenomenon with which there has been no satisfactory treatment to date for small open economies is the domestically generated inflationary pressures. Of competing candidates must be excess liquidity, monopolostic pressures (both business monopoly pressure and labour pressure), and internationally generated demonstration effects such as might enter through the popular media.

We write very proximately that

$$P = \alpha P^I + \beta P^d + \gamma (P^I, Pd) \qquad (3a)$$

and assuming that the interaction term cannot be readily measured and that the appropriate weights on import prices (P^I) and domestic prices (P^d) are the import coefficients m = Imports/G.D.P. and the domestic coefficient (1-m), we write the domestic price variable to be

$$p^d = \left[\frac{1}{1-m}\right] P + \left[\frac{m}{1-m}\right] p^I \qquad (3b)$$

Thus using the quarterly index of retail prices (P) and the index of import prices for all sectors excluding mineral fuels (P^I) and the quarterly import coefficients as weights, a series was derived for domestic prices (P^d). It is to be stated that no detailed study of the time shape of this series has been undertaken and so no judgment of its 'reasonableness' can be essayed. This area remains to be investigated.

The Demand for Money: This is a well worn function and for Caribbean type economies in particular there has been a fairly large number of studies in the recent past, including Bourne [SES,1974], London [19], McClean [20], Howard [15],[16], Worrell and Mills [22] to name a few. All these studies suggest a stable and well-behaved demand function for money defined both broadly and more narrowly. No detailed specification of the function is attempted in this study which instead made the orthodox assumption of a log-linear form in a scale variable (quarterly gross domestic product at current prices:Py) derived by interpolation and an opportunity cost variable as measured by the average rate of interest paid on loans and advances by commercial banks. No consideration of price homogeneity is given and we write simply that

$$M^d = A(Py)^{\alpha} i^{\beta} \qquad (2a)$$

For purposes of estimation, seasonal dummy variables and a shift variable (Ap) at 1974: III are included.

The empirical equations were as follows:

$$\log M_1^D = \underset{(0.18)}{0.22} + \underset{(0.04)}{1.15} \log (Py) - \underset{(0.29)}{1.18} \log i$$

$$\underset{(0.02)}{-0.01q_1} + \underset{(0.02)}{0.01q_2} - \underset{(0.02)}{0.02q_3} \qquad (2,e1)$$

$$\bar{R}^2 = .97 \qquad DW = 0.71 \qquad F = 392.77$$

$$\log M_2^D = \underset{(0.19)}{-0.18} + \underset{(0.04)}{1.05} \log (Py) + \underset{(0.29)}{0.07} \log i \qquad (2,e2)$$

+ Similar non-significant quarterly dummies

$$R^2 = 0.97 \qquad DW = 0.37 \qquad F = 418.74$$

The scale variable obviously performs well though it may reflect the strong secular trend in itself and the dependent variable. For narrow money the interest rate is significant and of the correct sign; this was not so for broad money. Serial correlation was a serious problem. In an attempt to cope with this problem, a shift variable (AP) was introduced into the regression with values of zero up to Quarter III of 1974 and unity thereafter, reflective of the changed economic circumstances following the oil crisis. This dummy variable made no impact on the results when narrow money is the dependent variable. When however broad money is the dependent variable Ap has a coefficient of -0.10 and a standard error of 0.042 with t-statistic of -2.45.

But the Durbin-Watson statistic remained at 0.61. The problem of serial correlation must be address, perhaps following other researchers by using a technique such as the Cochrane-Orcutt method.

Domestic Inflationary Pressures: As a very first shot, the methods described were used to generate estimates of capacity money supply and equilibrium money demand which together implied the excess liquidity of the system measured for both narrow money (M_1)and broad money (M_2). Both the index of retail prices (P) and the index of domestic prices (P^d) as computed are used as dependent variables. In order to stabilise the estimated functions, quarterly dummy variables (q_i) and the shift dummy variable (Ap) with zero up to 1974, QIII and unity afterwards were introduced. The form of the function was

$$\log (P|P_{-1}) = \log A + \beta \log (M^S|M^D)$$

The results reported in Table III are uniformly poor. The research to date has not taught us anything. If however, as the author believes, the line of investigation is sound, the results which are all very preliminary and the efforts of only a short research stint, could turn out to be of value. In particular the money supply process must be refined. This is perhaps the weakest area to date. Better specification of the money multiplier is called for, and a

Table III: Price Adjustment Functions

DEPENDENT VARIABLE	CONSTANT	EXCESS MONEY SUPPLY VARIABLE M1	EXCESS MONEY SUPPLY VARIABLE M2	OTHER VARIABLES	R^2	DW
Index of Retail Prices	-.01 (.02)	.015 (.011)		NONE	.19	1.01
	0.0	.012 (.011)		qi,Ap	.37	1.03
	0.03 (0.01)		-0.006 (0.011)	NONE	.08	.96
	0.02 (0.01)		0.002 (0.011)	qi,Ap	.34	1.0
Index of Domestic Prices	-0.11 (0.21)	.065 (.099)		NONE	.09	2.86
	-0.13 (0.21	.080 (.103)		qi,Ap	.28	2.86
	-0.10 (.13)		0.097 (0.099)		.13	2.88
	-0.11 (0.15)		0.103 (0.107	qi,Ap	.29	2.87

more appropriate base money variable, probably the domestic budget deficit, might be chosen. Refinement of the measure of domestic inflation is also a necessity and here perhaps labour costs and the costs of real estate might be candidates. Overall some solace might be taken in the view that negative knowledge is not entirely without value: it could indicate how not to proceed.

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FIG I. $\hat{\mu}_1 = \frac{1+c}{\rho+c}$, $\hat{\mu}_2 = \frac{1+c+x}{\rho+c+x}$

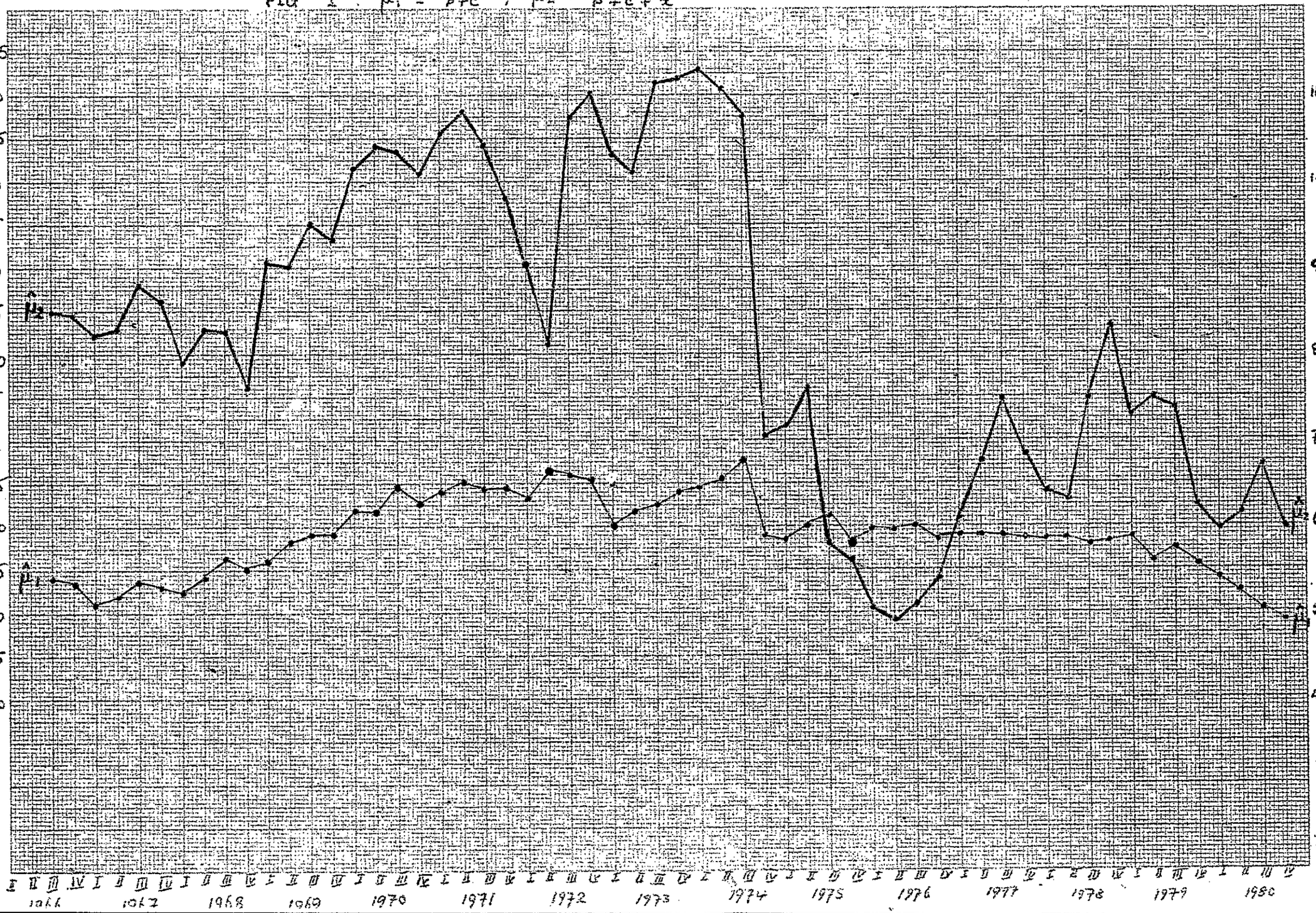

FIG. II : M_2^D/H, M_1^D/H, q, c, T, ρ