The Currency Ratio with Inflation and Economic Growth

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I. Introduction

The public's demand for currency and especially the proportion of currency in the total demand for money have long interested economists. The early interest in the currency ratio, currency divided by an appropriately defined money, seemed to lie in the relationship of the ratio with the business cycle, in which the ratio was considered either as an important indicator of upper turning points in economic activity [Fisher (1912)], or as a primary source of generating business cycles through its effects on bank's ability to extend credit [Hawtrey (1919)]. Later, the currency ratio and the quantity of currency have been studied within the framework of optimal transactions balances; for example, see Cagan (1958), Hess (1971), and Goldfeld (1973). Taking a somewhat different tack, Khazzoom (1966) investigated the relationship of the currency ratio with economic development using annual data on thirty-six developing countries, and in a similar context Vogel and Buser (1976) used the ratio as a qualitative measure of the sophistication of the financial sector of developing economies.

Despite this long history, empirical investigation has been either limited to a few countries or, in the case of a multi-country case study, descriptive in nature. This paper attempts to fill the

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gap in this area by studying the temporal behavior of the currency ratio in both developed, industrial countries (DCs) and developing countries (LDCs). Covering nineteen industrial countries and thirty-six developing countries, we examine the empirical relationship of the currency ratio with inflation and real income. Investigating this particular relationship has several significant implications. First, in the fractional reserve banking system where currency holdings are part of the monetary base, the currency ratio is an important determinant in various money multipliers. Movements in currency demand can affect the currency ratio, which in turn alters the reserve positions of financial institutions and hence their abilities to supply the non-currency component of monetary aggregates. Among many possible explanatory variables,[1] inflation and real income stand out as the most important variable influencing the ratio, and, such being the case, it is quite essential to find out how strongly the relationship holds among various countries. Here the rate of inflation is used as a proxy for the opportunity cost of holding currency relative to demand deposits in individuals' transactions balances. Although some sort of a nominal interest rate is normally utilized as a better measure of the opportunity cost, the lack of cross-country comparability of any particular nominal interest rate selected from a vast array of possible candidates prompted us to choose the rate of inflation as a good proxy variable.

Second, in addition to considerations of opportunity cost, many other channels relating the currency ratio and the inflation rate have been suggested, although the implied direction of the relationship is not the same in every mechanism. An increased effort to evade inflation-induced increases in real tax liabilities via cash transactions and the public's preferences of currency as a means of payment during an inflationary period both imply a positive relationship.[2] Alternatively, suppose inflation increases income inequality. Given that people with lower incomes have a higher currency ratio, inflation would imply a reduction in the aggregate ratio.[3] Further, the physical inconvenience of carrying

[1] A partial list of factors, besides inflation and real income, includes the cost of holding currency, the volume of retail trade, the volume of travel per capita, the degree of urbanization, the rate of tax on trasactions, and the expected default risk on demand deposits; see, for example, Cagan (1958) and Boughton and Wicker (1979).

[2] See Cagan (1958, p.305) and Khazzoom (1966, p.13).

[3] See the detailed discussion in the following section.

and counting bulky sums of currency in a hyper-inflationary period also suggests a negative relationship. Given these inconsistent theoretical implications, the empirical question arises as to whether the positive or negative is dominant. Once obtained, the dominant relationship of each country in our sample can be compared to the associated values of certain variables such as the average inflation rate and the average growth rate of GNP in order to gain the relative validity of the competing hypotheses.

Third, it has been widely conjectured and empirically corroborated that the currency ratio tends to have a negative relationship with economic growth, typically measured by the real per capita income. Not only does the current coverage of developing and industrial countries give more comprehensive evidence on this relationship, but also it yields cross-section data to be used in exploring various relationship among growth rates, development stages, and the responsiveness of the currency ratio to changes in real per capita income.

This paper is organized as follows. Section II sets up a model to be estimated and explains the data and the estimation method. Section III will present the results and analyze their implications. Finally, Section IV summarizes the findings and offers some concluding remarks.

II. The Model

Consider the following conventional formulation of the demand for money:[4]

$$(1) \quad (M/P)_t = a_1 + a_2 Y_t^e + a_3 r_t^e + a_4 \pi_t^e + u_{1t}$$

where

M_t = the narrow money stock (currency (CU) plus demand deposit),
P_t = the price level,
Y_t = real GNP (per capita),
r_t = "the" nominal interest rate,

[4] See Goldfeld (1973, p.213).

π_t = the rate of inflation,
u_{1t} = the random error term,

and the superscript e signifies the expected value of the corresponding variable. The demand for real balances depends on the expected values of real income (GNP) and the nominal interest rate, and the rate of inflation. Invoking the Fisherian relationship with a constant rate of real interest, we rewrite (1) as

$$(2) \quad (M/P)_t = a_1' + a_2 Y_t^e + a_4' \pi_t^e + u_{1t}$$

where $a_1' = a_1 + a_3$ (constant rate of real interest rate) and $a_4' = a_3 + a_4$.[5] This simplification is needed because of the difficulty in finding a comparable measure of the nominal interest rate for all of our sample countries in which almost all developing countries are experiencing various controls of nominal interest rate.[6,7] Thus, in the absence of a separate effect of π_t^e(i.e., $a_4 = 0$), a_4' will be a good proxy for a_3. Otherwise, the coefficient will show the combined effect of the expected rates of inflation and nominal interest. As usual, the equation will be specified in a logarithmic form:[8]

$$(3) \quad \ln(M/P)_t = b_1 + b_2 \ln Y_t^e + b_3 \ln \pi_t^e + u_{1t}.$$

Similarly, we can posit the demand for currency holding as:

[5] The simplistic Fisherian relationship says that the nominal rate of interest is the constant real rate of interest plus the expected rate of inflation. Alternatively, we may regard the real rate of interest as an exogenous process, that is, $r_t = i_t + \pi_t^e$ where i_t is the real rate of interest. By writing i_t = constant + η_t where η_t is white noise, we arrive at equation (2) with $a_1' = a_1 + a_3$ (constant).

[6] See Harberger (1963) for the similar treatment.

[7] Here we interpret r_t as the market rate of nominal interest rather than the official rate of nominal interest because the former is the relevent cost of holding currency; see, for example, Porter and Ranney (1982) for the clear distinction of the two rates of interest used in their macro model, especially the monetary sector. Of course, if the controlled rate follows more or less the market rate, then using official rate still enables us to capture the interest sensitivity of money demand.

[8] We can start from the logarithmic version of equation (1) and still arrive at a form similar to equation (3) using a Taylor expansion of the Fisher equation.

$$(4)\quad \ln(CU/P)_t = c_1 + c_2 \ln Y_t^e + c_3 \ln \pi_t^e + u_{2t}$$

where u_{2t} is another random error term and the Fisherian relationship is already incorporated. Subtracting (3) from (4) we obtain

$$(5)\quad \ln(CU/M)_t = d_1 + d_2 \ln Y_t^e + d_3 \ln \pi_t^e + u_{3t}$$

where $d_i = c_i - b_i$, $i = 1,2,3$, and $u_{3t} = u_{2t} - u_{1t}$. Since Y_t^e and π_t^e are unobservable, they must be replaced by measured variables. Utilizing the standard procedure of adaptive expectations, that is,

$$(6)\quad \ln Y_t^e - \ln Y_{t-1}^e = \gamma (\ln Y_t - \ln Y_{t-1}^e)$$

$$\ln \pi_t^e - \ln \pi_{t-1}^e = \gamma (\ln \pi_t - \ln \pi_{t-1}^e)$$

we can express (5) as

$$(7)\quad \ln(CU/M)_t = e_1 + e_2 \ln Y_t + e_3 \ln(P_t/P_{t-1}) + e_4 \ln(CU/M)_{t-1} + u_t$$

where we substituted $\ln(P_t/P_{t-1})$ for $\ln \pi_t$ to eliminate the undefined values with negative π_t, and $e_i = \gamma d_i$, $i = 1,2,3$, $e_4 = 1-\gamma$, $u_t = u_{3t} - (1-\gamma)u_{3t-1}$.[9,10]

A. Inflation and The Currency Ratio

Inflation tends to increase the currency ratio through essentially three channels.[11] First, during an inflationary period, there

[9] Since there is no convincing reason to believe that income and inflation expectations have different adjustment coefficients, we assumed the same value in (6). This assumption greatly facilitates the analytical tractability of the model.

[10] Although equation (7) is a conventional form for the currency ratio, the authors are not aware of any previous derivation of the equation starting from separate demands for currency and the money. This explicit derivation enables us to see why equation (7) still contains an autocorrelated term. See Subsection *C* below.

[11] See Cagan (1958, p.305 and p.313) and Khazzoom (1966, p.32).

would be a tendency to carry out more transactions in currency. Especially in developing countries, the attempt to hedge against chronic inflation consists largely of step-up efforts to hoard food and invest in gold and real estate, which are paid for in currency rather than in checks. Thus, inflation induces shifts in composition of transactions in favor of those that require currency, which has a wider acceptability as a means of payment.

Second, by increasing the nominal value of a given real income, inflation tends to exacerbate the real burden of an income tax which is progressive and based on the nominal income. This so-called "bracket-creep" may induce people to evade the tax. Since it is easier to conceal transactions financed in currency rather than in deposits, people may be induced to rely more on currency as a means of payment in order to evade the heavier tax burden. Income received, held, and spent without going through banks usually escapes detection. A tax on income thus leads some people to receive income and make expenditure to the greatest possible extent without the use of checks. Thus these inflationary effects are likely to imply upward pressure on the currency ratio.[12]

Third, an increase in the cost of holding currency leads people to substitute deposits for currency. The opportunity cost of holding currency is measured by the current rate of return on deposits, for currency yields no nominal return. Because demand deposits pay either zero or only a token rate of interest fixed at a very low level, higher inflation means a reduction in the net interest paid on demand deposits, and hence results in a higher currency ratio.[13] Moreover, as shown in Hess (1971), there exists a lack of substitution between currency and demand deposits in the sense that interest rates do not have any significant effects on currency whereas demand deposits exhibit the usual inverse dependence. Thus, if interest rate on assets that are alternatives to demand deposits more or less follow the Fisherian relationship, the above nonsubstitutability will strengthen the positive relationship between inflation and the currency ratio. Of course, we are

[12] See Bowsher (1980) for the relationship between currency demanded and the underground economy.

[13] We are assuming that returns on other assets have a positive relationship with inflation. It has to be remembered that what matters is the currency ratio, not the absolute values of currency and demand deposits. Both could decrease while the ratio goes up.

taking for granted that demand deposits show a strong substitute relationship with other assets, which seems reasonable if we consider the negatively significant coefficients on interest rate variables usually obtained in estimated demand deposit equations.[14]

The above arguments indicate that the estimated coefficient on $\ln(p_t/p_{t-1})$ in (7) shoud be positive. In the context of economic development, this relationship is probably what McKinnon (1973) and Shaw (1973) implicitly employed in their analysis of the detrimental effects on economic growth of financial repression caused by inflation. In fragmented, developing countries, self-financing of investment is very important due to a weak financial sector which is frequently repressed due to market-distorting government policies. Various regulations and interventions with a myriad of justifications contribute to a further widening of the existing gap between the demand for and the supply of funds, thereby fanning more inflation via inefficient allocation of scarce resources. Further, unofficial financial markets also tend to become institutionalized, thereby segmenting the economy unnecessarily.

The emphasis on the relationship between inflation and financial repression is quite crucial in the analysis of McKinnon and Shaw. Tendencies to employ expansionary policies in LDCs make inflation develop quite easily and this could cause the real rate of interest on financial assets to be negative, because nominal rates are set at low levels by governments. The ever-weakening financial sector further restrains the development of the real side of the economy contrary to what policy makers hoped to accomplish. Because the currency ratio may be used as a qualitative measure of the financial development of a developing economy as in Vogel and Buser (1976), an empirical investigation of the relationship between inflation and the currency ratio is hoped to shed some light on this issue. If the relationship turns out to be significantly positive across countries, then the McKinnon-Shaw thesis is supported with this specific measure of the financial development.

In contrast with the above arguments for a positive relationship, there exist at least two plausible explanations why the cur-

[14] See Goldfeld (1973).

rency ratio might be negatively related to inflation. According to Khazzoom (1966), to the extent that inflation redistributes income in favor of the wealthier group, the overall currency ratio will decrease because the wealthy people tend to have a smaller currency ratio relative to the poor people. Another explanation for the negative relation is the physical inconvenience associated with carrying and counting currency for everyday transactions. In a highly inflationary country without large denomination bills, it is especially burdensome to make large transactions in currency. This physical inconvenience will induce people to substitute checks for currency whenever possible.

B. Real Income per Capita and the Currency Ratio

Since both demand deposits and currency holdings are functions of real income, we would expect that the currency ratio is also influenced by real income unless demand deposits and currency holdings have the exactly same income elasticity. That is, if $b_2 \neq c_2$ in equation (3) and (4), $d_2 = d\ln(CU/M)_t/d\ln Y_t$ will not vanish in the currency ratio equation (5). More specifically, it is hypothesized that demand deposits are more luxurious than currency ($b_2 > c_2$) and so the currency ratio is inversely related to the income variable.

Checking accounts at reputable banks are not only a convenient method of exchanging money without the risk of transitional loss but also a way to avoid various hazards of holding currency. Currency can be lost, destroyed, or stolen. On the other hand, checking accounts reduce such risks and sometimes eliminate them almost completely with deposit insurance. Moreover, in developing countries personal checks could add a significant social prestige to the account holder. These relative advantages imply that demand deposits are preferred to currency holdings and that the currency ratio will tend to decrease as income increases. This inverse relationship is also consistent with the view that as the economy develops into a more affluent one, there will be relatively more transactions requiring payment by checks than by cash. Financial developments tend to discourage the use of currency. For example, the widespread use of credit cards substitute for cash in an increasing number of transactions.

C. Data and Estimation Method

We estimated equation (7) using annual time series data for each of 55 countries, including 19 industrial countries. The 55 countries are selected on the basis of availability of data from *International Financial Statistics,* with no country having fewer than 15 observations. The inflation rate is measured by the annual percentage change in the most widely available price index, the Consumer Price Index, and the real income is measured by real GNP (or GDP where GNP is unavailable). The narrow definition of money is adopted because it is more comparable among countries we considered.

Although annual data are employed in estimating equation (7) with a lagged dependent variable, samples of OLS (Ordinary Least Squares) estimates revealed the presence of first order serial correlation in the residuals. In fact, this is what the error term u_t in equation (7) indicates explicitly. To correct this problem we employed the iterative maximum likelihood estimation method which is asymptotically efficient and equivalent to the iterative generalized least squares estimation.[15]

III. Results

Table 1 reports the estimation results for each country together with some summary statistics. Asterisks indicate the statistical significance of the estimated coefficients (one for the 10% level, two 5% level). First, we note that the overall goodness of fit is quite satisfactory for both industrial and developing countries. Among the four coefficients only one is expected to have a theoretically unambiguous sign. This is the coefficient of the lagged currency ratio which is shown to equal $(1-\gamma)$ in the equation (7). Since we would expect the speed of adjustment γ to be a positive fraction, the coefficient should be also positive. Among the 55 cases, only five countries (Ireland, Nigeria, Kenya, Jamaica, and Peru) had estimated γ outside the (0,1) interval. In particular, the overaction ($\gamma > 1$) of Ireland and the negative ad-

[15] See Johnston (1972). Since we cannot rule out the existence of simultaneity on theoretical grounds, we experimented with the estimation method developed by Fair (1970) for the simultaneous equation model with lagged endogenous variables and the first order serially correlated errors. The results were a considerable reduction in overall fits with many coefficients showing implausible signs.

Table 1

ESTIMATE OF CURRENCY EQUATION

Countries	Years	Estimated Coefficients[1]					Average Currency Ratio (%)	Income Level (1970 U.S.$)[2]	Average Growth Rate (%) of per capita GNP (GDP)	Average Inflation Rate (%)
		Const.	$\ln Y_t$	$\ln(P_t/P_{t-1})$	$\ln(CU/M)_{t-1}$	$\bar{R}^2$				
Industrial Countries										
Australia	1952-80	−0.484**	0.029	0.801**	0.708**	.879	24.5	2656	2.30	5.5
Austria	1952-80	−0.017	−0.031	−1.250**	0.684	.911	54.0	1730	4.60	4.2
Belgium	1954-80	0.482**	−0.177**	−0.131	0.376	.951	49.7	2417	3.40	4.0
Canada	1952-80	0.100	−0.091	0.962	0.834**	.705	27.2	3266	2.61	3.9
Denmark	1952-80	0.390*	−0.212**	−2.207	0.772**	.972	22.3	2898	3.02	5.9
Finland	1952-80	0.166	−0.168**	−0.268	0.694**	.914	39.3	1998	3.28	6.4
France	1952-81	0.189*	−0.123*	−0.080	0.854**	.995	36.3	2477	3.83	6.1
Germany	1952-81	−0.048	−0.010	0.220	0.940**	.973	39.7	2752	3.90	3.0
Ireland	1952-80	−1.622**	0.012	1.269**	−0.431**	.650	36.3	1249	2.77	7.0
Italy	1961-81	4.040**	−0.615**	0.524	0.628**	.958	22.1	1598	3.23	8.7
Japan	1960-81	−0.613**	−0.017	−0.031	0.665**	.763	23.6	1636	6.70	6.8
Netherlands	1952-80	0.102	−0.118*	0.079	0.808**	.902	39.9	2232	3.33	4.4
New Zealand	1955-80	2.480*	−0.442**	1.180*	0.347*	.498	21.5	2030	1.59	6.5
Norway	1952-80	−0.014	−0.098*	−0.033	0.581**	.664	44.7	2455	3.64	5.3
Spain	1955-79	0.019	−0.101*	−0.001	0.675**	.844	32.9	884	4.32	9.0
Sweden	1952-79	0.059	−0.190**	0.780*	0.239	.505	49.8	3719	2.90	5.1
Switzerland	1952-80	−0.245	−0.225*	1.100**	.747	.747	36.6	2963	2.54	3.1
U.K.	1952-80	−0.374**	0.007	0.093	0.671**	.671	31.9	2014	2.21	4.0
U.S.A.	1949-81	−0.375**	0.080**	0.325*	0.852**	.965	22.3	4289	2.21	4.0
Developing Countries										
Indonesia	1967-80	2.305**	−0.647**	0.000	0.033	.954	55.1	73	5.29	26.4
Iran	1960-77	0.188	−0.213*	0.952*	0.447*	.742	30.6	352	6.00	5.9
Nigeria	1960-77	−0.013	0.005	0.057	1.090**	.957	54.2	135	2.82	8.3
Venezuela	1952-80	0.608	−0.505*	0.145	0.637**	.882	31.5	955	2.04	3.5
Kenya	1967-80	3.945	−0.768*	−0.352	−0.439	.850	28.2	127	2.20	8.3
Morocco	1961-77	−0.118	−0.065	−0.087	0.837	.873	37.7	221	1.53	4.4
South Africa	1952-80	−1.227	0.055	0.501	0.456**	.778	21.8	655	1.67	5.3
Tunisia	1961-80	−1.000**	0.028	−0.265	0.270	.911	36.1	260	4.32	3.9
India	1961-79	−0.235**	−0.643**	−0.043	0.324	.218	61.0	94	1.57	6.5
Korea	1954-80	−0.620**	0.058	−0.023	0.470	.405	55.3	249	4.99	15.3
Pakistan	1961-81	−0.089	0.039	−0.061	0.897**	.834	53.5	165	4.84	7.8
Philippines	1952-81	−0.259**	−0.215**	−0.057	0.322	.765	53.0	224	2.76	6.3
Sri Lanka	1952-80	0.321	−0.051	−0.083	0.895**	.734	49.1	161	2.35	3.9
Thailand	1954-81	−0.150**	0.017	0.018	0.737**	.546	64.2	167	4.05	5.1
Taiwan	1953-77	−0.159	−0.034	0.165	0.749**	.657	39.8	361	5.08	7.2
Egypt	1966-79	0.260	−0.131	−0.144	0.158	.612	63.5	1088	5.49	6.1
Greece	1954-80	−0.067	−0.012	0.071	0.679**	.448	69.3	677	4.74	6.8
Israel	1951-78	0.350	−0.096**	0 064	0.440**	.589	37.2	348	3.26	13.6
Portugal	1954-80	−0.095	−0.246*	1.990**	0.362**	.472	31.3	202	2.73	8.3
Turkey	1952-78	0.337*	−0.488**	0.213	0.278	.795	36.4	1719	4.37	11.3
Argentina	1952-78	0.597	−0.291**	−0.223**	0.226	.846	47.0	1041	2.10	38.1
Bolivia	1951-79	1.466**	−0.181**	−0.049	0.536**	.856	73.3	191	1.43	22.6

Table 1 (continued)

Countries	Years	Estimated Coefficients[1]					Average Currency Ratio (%)	Income Level (1970 U.S.$)[2]	Average Growth Rate (%) of per capita GNP (GDP)	Average Inflation Rate (%)
		Const.	$\ln Y_t$	$\ln(P_t/P_{t-1})$	$\ln(CU/M)_{t-1}$	$\bar{R}^2$				
Brazil	1964-80	−1.100**	−0.146	0.356*	0.193	.500	20.3	464	6.33	31.7
Colombia	1952-79	−0.099	−0.020	0.33688	0.891**	.820	37.7	301	2.23	11.8
Costa Rica	1961-80	1.508	−0.218	−0.073	0.607*	.953	34.2	522	3.22	6.2
Dominican Republic	1951-80	1.153	−0.259**	0.249	0.373*	.518	48.0	337	2.66	4.1
Ecuador	1952-80	0.035	−0.103	−0.837**	0.722**	.935	41.3	236	2.44	5.8
El Salvador	1952-80	−0.034	−0.034	−0.161	0.6588	.615	45.7	274	1.04	4.2
Guatemala	1952-80	0.641	−0.134	−0.243**	0.690**	.918	54.6	343	1.94	3.5
Guyana	1961-76	−1.470	0.192	−1.090**	0.812**	.955	56.3	319	0.65	4.2
Honduras	1951-76	2.570**	−0.442**	−0.442**	0.498*	.952	50.5	266	1.06	3.0
Jamaica	1961-81	−6.080**	0.670*	−0.911**	−0.337	.760	33.8	599	0.59	10.3
Mexico	1952-81	−0.015	−0.127	0.354	0.620*	.900	43.9	632	3.02	8.3
Paraguay	1952-80	0.420*	−0.179**	0.110	0.496*	.763	54.4	230	2.85	11.0
Peru	1964-81	0.632	−0.173	0.288**	1.100**	.989	40.2	293	0.93	21.7
Uruguay	1956-76	1.630	−0.239	0.021	0.514**	.310	58.9	809	0.19	36.5

Notes: 1. Those with* and** are significant at the 10% and 5% levels, respectively.
2. This is the only exception and it comes from *U.N. Statistical Yearbook,* U.N. and all other data are from *International Financial Statistics,* International Monetary Fund.

justment ($\gamma < 0$) of Nigeria and Peru are statistically significant. Considering the large number of cases to fit the skeletal model, this result is not discouraging at all. Moreover, the number of countries deviating from the theoretical expectation is less than what one would expect to obtain in a sample of fifty-five countries with 10% type-I error when the underlying model is in fact consistent with the theory.

A. Inflation and the Currency Ratio

It is argued in the previous section that the relationship between inflation and the currency ratio is theoretically ambiguous. This is borne out in Table 1 where positive coefficients on inflation are just about as frequent as negative ones. In fact, 30 countries show positive relationships between the currency ratio and inflation whereas 25 countries indicate negative relationships. Considering 17 coefficients with at least the 10% level of significance we still have six countries showing the significantly negative relationship with inflation. As a whole this suggests that

the statistical evidence is unambiguously favorable neither to the positive nor to the negative relationship between the currency ratio and inflation. One possibility is that the negative relationship should prevail for the countries with higher than the average rate of inflation. Not only the physical inconvenience but also the adverse income distribution seems to be associated with relatively high inflation.[16] To see this we classified significantly positive and negative relationship along two groups of inflation, the higher and the lower than the average, but the resulting contingency table did not reveal a pattern to support this conjecture.

B. The Currency Ratio and Real Income per Capita

The hypothesized inverse relationship between the currency ratio and the real income per capita is borne out in Table 1 quite strongly. Although twelve countries out of 55 show positive signs on the coefficient of real income per capita, only one country (U.S.A.) has the 5% level of significance for the positive coefficient. Since only 25 countries indicate negative coefficients on the real income variable with the 10% or lower level of statistical significance, the hypothesis of the strictly inverse relationship between the currency ratio and real income may not be accepted. However, if we weaken the hypothesis to that of a nonpositive relationship between two variables, then it cannot be rejected at the 5% level of statistical significance.[17]

The relationship between the currency ratio and real income per capita might be interpreted as that between financial development and economic growth in the sense that the currency ratio tends to decrease as the economy matures. In this case, not only time series data of individual countries but also cross-section data could furnish some additional evidence. Table 1 shows the average currency ratio, per capita income level in 1970 U.S.$, average growth rate of per capita GNP, and the average inflation rate of sample countries. Considering 1970 as a representative year, we obtain a correlation coefficient between average curren-

[16] Income distribution may not be influenced by the anticipated inflation, but, if we consider the variance of inflation as the degree of uncertainty in predicting inflation, the higher the average rate of inflation is, the larger its variance. The sample correlation coefficient between these two turns out to be greater than .9.

[17] This can be shown either by a binomial test or by using the normal approximation to the binomial distribution. See Bickel and Doksum (1977).

cy ratio and per capita income level of -.38 which is statistically different from zero at the 1% level.[18] This provides additional support for the hypothesis of a negative relationship between real income and the currency ratio.[19]

IV. Concluding Remarks

This paper investgated the international evidence on the currency ratio by estimating its relationship with inflation and real income. Results of both time series regression of 55 individual countries and cross-section comparison of the estimates can be summarized as follows;

(1) The hypothesis that the currency ratio is both positively and negatively related to inflation is strongly supported by time series regressions and cross-section comparisons.

(2) The negative relationship between income and the currency ratio is also strong. Although the strictly negative relationship cannot be maintained by the time series data, only one country turned out to have a significantly positive coefficient of income in the currency equation and the rest of 55 countries indicate either zero or significantly negative coefficients. Moreover, the cross-section correlation between the currency ratio and income was significantly negative, thus supporting the hypothesized relationship.

[18] Average currency ratios of sample countries are very close to their 1970 values.

[19] An ordinary least square estimate of cross-section currency equation using the data in Table 1 showed the following result:

$$\ln (CU/M) = 4.46 + .001\pi - .121nY$$
$$(16.75)\ (.25)\quad (-3.19)$$

where numbers in parentheses are t-statistics. Thus, even if we incorporated the effect of inflation on the currency ratio, the relationship between income and the currency ratio is significantly negative.

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