5-1985

Does Inflation Tend to Perpetuate Itself? The Case of Latin America

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DOES INFLATION TEND TO PERPETUATE ITSELF?

THE CASE OF LATIN AMERICA

by

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A dissertation submitted in partial fulfillment
of the requirements for the degree

of

DOCTOR OF PHILOSOPHY

in

Economics

Approved:

UTAH STATE UNIVERSITY
Logan, Utah

1985

Dedicated to my parents - - - -

Azizeh and Rahim Harraf

ACKNOWLEDGMENTS

I would like to take this opportunity to express my appreciation to Dr. L. Dwight Israelsen, my doctoral committee chairman, for his direction and for other valuable help. I also would like to thank the members of my committee, Dr. W. Cris Lewis, Dr. Basudeb Biswas, Dr. Reed Durtschi, and Dr. Keith Taylor for making useful suggestions to improve this study.

At this time, my sincere appreciation also is extended to those individuals who assisted me in different ways. In particular, to my friend, Devulapalli Subba Rao who helped me with the computer work.

I owe my gratitude to Utah State University's Merrill Library, which provided me with a job during my stay at Utah State University. My special thanks are expressed to my parents and my wife, Tabandeh, and my daughter, Solmaz, for their support and encouragement they offered me throughout my study.

Ebrahim Harraf

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ABSTRACT

Does Inflation Tend to Perpetuate Itself?

The Case of Latin America

by

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Utah State University, 1985

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The purpose of this study was threefold: (1) to test the existing theory which explains inflation as a result of its self-generating nature; (2) to investigate the contribution of foreign trade upon inflation; and (3) to test the causal relationship between the rate of inflation and the deficit. A system of four equations has been used to explain the relationship between the price level and the monetary expansion, between the rate of growth of the monetary base and the rate of the monetary expansion, the deficit and the monetary base, and, finally, between the deficit and the price level. As the existing model was exposed to open economy assumptions by introducing foreign reserves as another source of variation of monetary base, the explanatory power of the model increased. That is, as the results suggest, explaining the inflation/deficit chain in the context of a closed economy assumption leaves much of the process unexplained. Even though part of the increase in the monetary base is caused by

foreign trade, a major portion of the expansion in monetary base is caused by the deficit. That is, a government's expenditure exceeds its revenue in any given year, which results in financing that deficit through borrowing from the central bank--that is, monetizing the deficit.

This study suggests that no generality can be made regarding the source of inflation in Latin America. In some countries, the source of inflation is only the deficit, while in others it is only foreign reserves. In most, both factors contribute. Furthermore, when both foreign reserves and deficit contribute to the rate of inflation simultaneously, the effect of foreign reserves is less expansionary. This can be seen from the magnitude of the respective parameter estimates.

In the last part of the study, the Granger test of causality has been used to test the causal relationship between the price level and the deficit. Again, countries exhibit heterogeneous results. In some, inflation apparently causes the deficit, while in others, the deficit is the cause of inflation. In several countries, strong feedback exists between these two variables. As a result, it can be concluded that the extent and sources of inflation for countries under study are different.

In conclusion, a few policies are suggested which could be used to bring both deficits and inflation at least to some acceptable level.

(96 pages)

CHAPTER I

INTRODUCTION

High on the list of Latin America's problems stands inflation. As elsewhere in the world, inflation in Latin America has largely resulted from increases in money and credit touched off by government budgetary deficits, without a corresponding rise in production of goods and services. The deficits occur when governments spend in excess of their revenues. Inflation tends to be self-perpetuating. It feeds on itself. As prices go up, the purchasing power of money goes down. When inflation gets under way, the public soon takes for granted that the trend will continue. Confidence in money as a store of value waves. A search for hedges against inflation begins. Common stocks, real estate, and commodities are the hedges most frequently resorted to. Businessmen convert cash balances into inventory. These purchases drive prices up even faster. There is a strong correlation between the degree of inflation and the degree of government intervention in the market. Fiscal deficits have long been referred to as the principal engine of inflation in Latin America. The ever-increasing government deficits are, in large measure, a consequence of the inflation itself and the lack of flexibility of government revenues. A large portion of the taxes in these countries are excise and import taxes, many of which do not rise in proportion to the increase in prices. Income taxes rise more or less in line with prices and money

incomes; but income taxes account for a minor fraction of Latin American government's revenues, and few of them are collected currently so that this year's tax receipts are based on last year's incomes, with an inevitable lag between revenue and government expenditures.

In spite of an abundance of literature on inflation, there have been few attempts to analyze the relationship between fiscal deficits and inflation. Furthermore, almost all studies are based on a closed economy assumption and no study whatsoever (at least to the knowledge of the present researcher) has been done to analyze this phenomenon in the context of an open economy. This study attempts to fill this gap by empirically testing the level of contribution of foreign trade on the money supply and the price level.

A substantial portion of government expenditures in the high inflation countries goes for subsidies to state enterprises such as electric power and transportation companies. There is also the desire to increase the real volume of government expenditure each year so as to both meet the demand for social services such as education and increase the level of investment in the public sector which accounts for a substantial proportion of the total investment in Latin America. Perhaps the most important underlying cause of inflation in Latin America lies in the tendency on the part of Latin America's governments to make monetary policy a more or less complete servant of their political policy; that is, monetizing deficits by government borrowing from the central bank. Monetizing deficit refers to the practice of printing money by a country's treasury against bonds issued by its own government and sold to its own central bank to finance a budget deficit.

The other factor that accounts for the growth of the money supply and, as a result, the growth of the general price level is foreign exchange reserves. Accumulation of foreign exchange reserves as a result of balance-of-payments surplus could be considered another source of inflation (Diz 1970). The debate over the cause and consequences of inflation in Latin America has largely involved two groups called "structuralists" and "monetarists." Campos (1967) argues that structuralists, if in power, would have to adopt monetarist policies as a short-run measure and that monetarists would, in the long run, accept the primacy of structural change. The monetarist is a "structuralist in a hurry" and the structuralist is a "monetarist without policy-making responsibility" (Campos 1967, pp. 108-9).

The "structuralist" argument is that inflation is inevitable in an economy that is attempting to achieve rapid growth in the presence of structural bottlenecks and constraints which are generally taken to be: (a) the inelastic supply of foodstuffs; (b) the foreign exchange bottleneck; and (c) the financial constraints. The Latin American "monetarist" analysis of inflation is relatively straightforward. Inflation, according to the monetarist view, originates in and is maintained by expansionist monetary and fiscal policies comprised of government deficit spending (coupled with the operation of the inefficient state enterprises and economic pricing policies), expansionist credit policies, and the expansionary exchange operations of central banks.

It is important to note that the "monetarists" do not deny the existence of "structural rigidities and bottlenecks" in less-developed

countries, but they argue that such bottlenecks are not in fact "structural" or "autonomous" in nature. They result from the price and exchange rate distributions which are generated by inflation itself and by government attempts to reduce the rate of price increases. They argue that bottlenecks will be eliminated when inflation is brought under control. Furthermore, with a suitably reformed tax structure and with less inflation and perhaps less government intervention, the private sector would be able to play a larger role in the development process, thus reducing the need for government deficit financing.

The controversy between these two schools of thought reveals its track even among contemporary economists in their attempts to tackle the problem of inflation in less-developed countries. The studies by Edel (1969), Kahil (1973), Harberger (1963), Diaz-Alejandro (1965), Diz (1970), Dutton (1971), Vogel (1974), and Aghevli and Khan (1977) attempt to analyze the inflation phenomenon and its sources and consequences.

Perhaps the study by Harberger (1963) of the inflation in Chile has been the most influential empirical analysis of inflation in the monetarist tradition in Latin America; and subsequent econometric studies by Diaz-Alejandro (1965), Diz (1970), and Vogel (1974) are extensions of the basic Harberger model.

Harberger's (1963) study of Chilean inflation covers the period from 1939 to 1958, during which time inflation was almost continuous and the wholesale price index and the cost of living index increased more than eightfold. The approach is basically a monetarist one, and Harberger tests the hypothesis of a stable demand function for real

balances by regressing the annual rate of price change in the cost of living index upon the percentage change in the money supply during the present year and the preceding year and the percentage change in real income during the present year.

The empirical results obtained by Harberger would appear to support the monetarist interpretation with each of the monetary variables statistically significant and the inclusion of the wages variable failing to increase the overall explanatory power of the monetary variables.

As previously mentioned, the studies by Diaz-Alejandro (1965), Diz (1970), and Vogel (1974) are extensions of the basic Harberger model and, therefore, requires less detailed discussion. In his study of Argentina, Diaz-Alejandro regresses various indices of inflation on four independent variables--money supply, real gross domestic product plus merchandise imports, hourly money wage rates in industry, and exchange rate. He finds that changes in wage rates are highly correlated with subsequent changes in money supply, while changes in money supply do not appear to have a significant influence on subsequent changes in wage rates. He argues that the high rates of inflation combined with the fall in real national product that occurred in several periods reflect the existence of cost-push inflation so that the monetary authority is faced with increasing unemployment if it does not permit the money supply to grow in response to increases in wage rates.

The study by Diz (1970) also examines the experience of Argentina covering the period 1935-62. Two dependent variables used are

wholesale price and cost of living indices, and the independent variables used are: money supply, real income, an index of nominal wages, the official exchange rate, and a measure of price expectations. In the regression results, the money supply, real income, and expectation coefficients are statistically significant and exhibit the expected sign. The wage coefficients are not significant, and the exchange rate coefficients, although significant, suggest a highly inelastic response of prices to change in the exchange rate. Diz interprets his findings that changes in the money supply have a substantial impact on the rate of inflation as evidence in support of the "monetarist" analysis of inflation.

Vogel (1974) has extended the Harberger model to sixteen Latin American countries for the period 1950-69. The dependent variable is the consumer price index, and the independent variables are money supply, real income, and past percentage changes in the rate of inflation. All variables are annual and are expressed as percentage changes. "Structural" variables, such as wage changes and exchange rate changes, are not included in the analysis. The paper reports the results obtained from using pooled data exhibited a high level of overall explanatory power, and the coefficients of independent variables exhibit the correct sign. The results of individual country regression were less favorable, and they revealed considerable differences between countries.

Studies by Lovell (1963), Dutton (1971), and Aghevli and Khan (1977) regarded money supply as an endogenous variable, a function of a government's deficit. As the pioneer of such studies, Lovell states that once it is decided that a given share of real government spending

will be financed by deficit, both the real and nominal money supply must be regarded as endogenous variables. Dutton (1971), in treating money supply as an endogenous variable, reasons that since money supply is related to fiscal deficit, it cannot be an exogenous variable. Aghevli and Khan (1977) state that the expansion in the nominal stock of money increases the demand for goods and services and thus prices but results in increased government deficits which the authorities finance by further money creation. They developed a dynamic model of inflation based on the idea that the rate of inflation tends to increase nominal expenditure faster than revenue. The resultant budget deficit increases the money supply and induces further inflationary pressures.

There also have been studies regarding the welfare cost of inflationary finance in which inflation is regarded as a tax which falls on holders of real cash balances. During inflationary periods, holders of cash balances will try to reduce their portfolio and exchange their cash for goods in kind in order to avoid depreciation of their holdings. Baily (1956) defines this cost as the area under the demand curve for real cash balances, which measures the cost in loss of convenience. He states that even if inflation is fully anticipated, the time cost of exchanging money for goods and barter arrangements still exist. Friedman (1969), regarding this cost, states that the only long-run welfare effect of inflation is a loss in the overall efficiency of the economy resulting from individuals and firms economizing on money balances to hedge against inflation.

This study is divided into two main parts. First, empirical tests regarding the applicability of Dutton's (1971) model to various Latin American countries are conducted; and second, Dutton's model is extended by introducing the foreign sector in order to capture the effect of openness of the economy on the generation of inflation.

Chapter II presents a brief description of the macroeconomic variables that have been used in the empirical study; Chapters III and IV give the basic theoretical framework and results of empirical work for closed and open economy assumptions, respectively. Chapter V notes the main implications of this study and will give suggestions regarding the elimination of the inflation deficit chain.

CHAPTER II

DESCRIPTION OF SOME MACROECONOMIC VARIABLES

The data base of the empirical part of this study is provided by a set of macroeconomic variables, including money supply, net foreign assets, monetary base, gross domestic product, price level, and domestic credit component of the monetary base for the period of 1950-80. A description of the data provides a general picture of the performance of the economy at the main level for the period under study. Most of the data that are used in the empirical study have been taken from yearbooks by the International Monetary Fund (1981). The period of coverage has been chosen on the basis of the availability of a set of homogeneous data.

Money, Income, and Prices

There are several theoretical definitions of money. The definition most commonly used is that which describes money as a medium of exchange, and it includes currency with the people and demand deposits in banks. A second common definition describes money as an asset and includes money in the narrow sense plus time deposits in banks.

For the purpose of this study, money defined narrowly (M_1) has been chosen as the money supply of a country. Money supplies for all countries under study are shown in Table 1. Table 2 names the currency of the countries.

TABLE 1

MONEY STOCK (M_1) IN MILLIONS OF RESPECTIVE COUNTRY'S CURRENCY

Year	Argentina	Boli-via	Brazil	Colom-bia	Costa Rica	Dominican Republic	Ecua-dor	El Sal-vador	Guate-mala	Hon-duras	Venezuela
1950	200	5	80	900	204	41.8	913	128.7	58.9	38.5	1576
1951	200	6	90	1200	224	53.1	845	136.2	60.4	47.5	1646
1952	400	9	100	1320	265	62.1	1051	163.7	63.6	52.5	1909
1953	400	16	120	1550	291	60.2	1088	171.8	76.1	59.4	2085
1954	500	27	150	1840	325	68.6	1273	190.4	77.6	68.6	2169
1955	600	56	180	1910	340	76.5	1193	184.4	86.7	60.6	2414
1956	700	197	220	2380	342	76.9	1358	215.0	103.9	67.2	2756
1957	800	291	290	2700	370	84.4	1412	215.2	116.3	64.3	3649
1958	1200	301	350	3260	399	107.2	1400	202.3	106.8	63.0	4017
1959	1700	386	500	3630	427	91.9	1577	205.7	108.8	65.9	3823
1960	2200	419	690	3980	433	101.9	1732	193.0	105.5	64.3	3574
1961	2400	496	1040	4960	422	104.4	1778	192.5	106.7	65.7	3684
1962	2500	556	1690	5930	480	114.0	2000	192.1	108.7	72.7	3604
1963	3200	665	2780	6690	535	130.2	2241	231.2	121.4	79.1	3840
1964	4600	803	5130	8250	568	116.6	2626	243.6	129.3	89.8	4399
1965	5900	943	9050	9640	598	135.0	2670	250.3	135.6	104.6	4858
1966	7900	1153	10480	11240	622	116.1	3016	259.0	143.0	106.9	5012
1967	10900	1192	14950	13680	832	123.7	3439	264.2	148.3	120.6	5632
1968	13600	1287	21300	15860	890	147.0	4172	281.6	160.1	135.0	6117
1969	12100	1361	27410	19400	1020	153.8	4751	305.6	169.5	156.6	6724

TABLE 1--Continued

Year	Argentina	Boli-via	Brazil	Colom-bia	Costa Rica	Dominican Republic	Ecua-dor	El Sal-vador	Guate-mala	Hon-duras	Venezuela
1970	14500	1532	34740	22400	1103	177.6	5989	316.9	182.8	165.9	7223
1971	19700	1760	44910	25060	1423	198.5	6719	345.1	186.6	177.8	8425
1972	32900	2210	62890	31850	1624	230.5	8376	411.6	222.8	212.4	10077
1973	71400	2969	93780	41650	2020	273.5	11299	496.7	276.7	255.1	12066
1974	120400	4257	125330	49070	2480	377.9	16866	598.2	320.7	252.7	17333
1975	341900	4759	174510	58920	2988	399.5	18343	712.1	374.1	280.4	26056
1976	1373100	6497	241710	79380	3895	402.6	24376	1001.5	527.2	388.1	29584
1977	3216700	7855	330290	103500	4844	475.0	30196	1099.8	667.8	443.0	37093
1978	7484000	8831	465620	133850	6007	495.9	33171	1194.1	739.3	534.5	42889
1979	18545000	10304	799810	166630	6632	643.3	42213	1429.6	843.3	597.6	46901
1980	36158000	14812	1369280	213150	7761	660.6	54143	1568.2	855.2	645.5	54488

SOURCE: Compiled from International Monetary Fund. 1982. International Financial Statistics Yearbook. Washington, D.C.

Note: See Table 2, page 12, for currency of respective country.

TABLE 2

TERMS FOR MONETARY UNITS USED IN COUNTRIES UNDER STUDY

Country	Currency
Argentina	Peso
Bolivia	Peso
Brazil	Cruzeiro
Colombia	Peso
Costa Rica	Colon
Dominican Republic	Peso
Ecuador	Sucre
El Salvador	Colon
Guatemala	Quetzal
Honduras	Lempira
Venezuela	Bolivar

For all countries under study, two price indices are constructed, the wholesale price index and the consumer price index. During the period under study, the base year and weight system were changed several times. The International Monetary Fund has constructed a consistent set of price index numbers for the whole period with 1975 as the base year. For the purpose of this study, the IMF-constructed index numbers have been used. Consumer price index for all countries under study for the period 1950-80 are shown in Table 3.

Gross domestic product in real terms based on 1975 prices is shown in Table 4. Tables 5, 6, and 7 give a summary description of the average annual growth rates of money, prices, and income, respectively, calculated on the basis of data presented in Tables 1, 3, and 4.

TABLE 3

CONSUMER PRICE INDEX (1975 = 100)*

Year	Argentina	Bolivia	Brazil	Colombia	Costa Rica	Dominican Republic	Ecuador	El Salvador	Guatemala	Honduras	Venezuela
1950	0.1	0.2	0.2	5.9	34.9	46.3	31.2	46.1	56.2	48.8	57.4
1951	0.1	0.3	0.2	6.4	37.3	50.2	32.2	53.9	58.7	49.1	61.5
1952	0.2	0.3	0.2	6.3	36.3	50.7	33.3	53.0	57.5	51.7	62.2
1953	0.2	0.7	0.3	6.6	36.5	49.9	33.5	56.5	59.2	53.0	61.3
1954	0.2	1.5	0.4	7.1	37.4	49.0	34.7	58.6	60.8	56.1	61.4
1955	0.2	2.8	0.4	7.2	38.8	49.0	35.2	61.0	61.8	60.8	61.2
1956	0.3	7.7	0.5	7.7	39.2	49.6	33.5	61.9	62.4	58.4	61.7
1957	0.4	16.6	0.5	9.7	40.3	52.0	33.8	59.1	61.8	57.2	60.5
1958	0.5	17.1	0.6	11.3	41.4	51.0	34.3	62.5	62.4	58.8	63.3
1959	1.0	20.6	0.8	12.4	41.5	50.9	34.4	62.1	62.1	59.5	66.5
1960	1.2	23.0	1.1	12.9	41.9	49.1	34.8	62.0	61.4	58.4	68.8
1961	1.4	24.7	1.4	13.8	42.9	47.1	36.3	60.3	61.1	59.4	67.0
1962	1.8	26.1	2.1	14.1	44.0	51.5	37.3	60.4	62.3	60.0	66.7
1963	2.2	26.0	3.6	17.9	45.3	55.9	39.5	61.3	62.4	61.8	67.4
1964	2.7	28.6	6.9	21.0	46.8	57.1	40.9	62.3	62.3	64.6	68.9
1965	3.4	29.4	11.4	22.7	46.5	56.0	42.2	62.7	61.8	66.6	70.0
1966	4.6	31.5	16.1	26.7	46.6	56.1	43.9	62.0	62.2	67.8	71.3
1967	5.9	35.0	21.0	28.5	47.2	56.8	45.6	62.9	62.5	68.3	71.3
1968	6.8	36.9	26.0	30.3	49.0	56.9	47.5	64.5	63.7	71.6	72.2
1969	7.4	37.7	31.5	32.3	50.4	57.4	50.6	64.4	65.1	73.1	73.9

TABLE 3--Continued

Year	Argentina	Bolivia	Brazil	Colombia	Costa Rica	Dominican Republic	Ecuador	El Salvador	Guatemala	Honduras	Venezuela
1970	8.3	39.2	38.5	34.8	52.7	59.6	53.2	66.2	66.6	73.7	75.8
1971	11.2	40.6	48.3	38.7	54.3	62.2	57.6	66.5	66.3	75.3	78.3
1972	17.8	43.3	53.9	45.8	56.8	67.1	62.2	67.5	66.7	79.3	80.5
1973	28.7	56.9	60.8	58.6	65.5	77.2	70.3	71.8	75.8	83.4	83.8
1974	35.4	92.6	77.8	79.7	85.2	87.4	86.7	83.9	88.4	94.1	90.8
1975	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1976	543.2	104.5	141.9	122.9	103.5	110.7	110.7	107.0	110.7	104.8	107.7
1977	1499.6	112.9	203.9	155.7	107.8	121.7	125.1	119.7	124.6	113.6	116.0
1978	4131.4	124.7	282.9	183.2	114.3	126.0	139.6	135.5	134.5	120.6	124.3
1979	10721.4	149.3	232.2	234.1	124.8	137.5	154.0	157.0	150.0	135.7	139.6
1980	21524.0	219.8	790.2	290.8	147.7	160.6	174.1	184.3	166.1	156.9	169.7

SOURCE: Compiled from International Monetary Fund. 1982. International Financial Statistics Yearbook. Washington, D.C.

*All figures are based on 1975 prices.

TABLE 4

GROSS DOMESTIC PRODUCT (1975 PRICES)

Year	Argentina	Boli-via	Brazil	Colom-bia	Costa Rica	Dominican Republic	Ecua-dor	El Sal-vador	Guate-mala	Hon-duras	Venezuela
1950	513400	18238	150000	118630	3756	827.8	24010	1289	1119	908	26350
1951	618000	19523	136000	122330	3809	926.3	24680	1372	1135	948	29440
1952	668000	20116	166700	128700	4322	1023.0	32100	1460	1159	956	31330
1953	714000	18214	185200	136520	4824	1010.1	33120	1498	1201	1014	33260
1954	750000	18592	171400	145970	5125	1068.8	35810	1545	1224	952	36470
1955	869000	19572	200000	151670	5376	1135.0	36740	1612	1254	1008	39700
1956	824000	18413	208300	157820	5512	1248.9	38050	1709	1368	1053	43900
1957	796000	17806	222200	161350	6067	1327.8	40050	1805	1445	1097	45380
1958	860000	18227	245900	165310	6169	1397.7	40970	1824	1513	1158	45960
1959	860000	18171	235300	177250	6373	1406.8	43080	1905	1587	1185	49660
1960	924000	19727	245500	184820	6955	1424.4	45940	1983	1626	1183	51640
1961	988000	19940	265000	194230	6897	1392.5	46650	2053	1696	1216	54190
1962	979000	20468	279000	204740	7459	1629.5	48760	2298	1756	1278	59130
1963	943000	21857	346400	211470	7816	1752.2	50670	2397	1923	1320	63250
1964	920000	22721	356500	224520	8140	1824.0	54610	2620	2012	1398	69350
1965	1027000	23840	439200	232600	8941	1625.5	46560	2761	2100	1542	73540
1966	1131000	25549	455570	245050	9644	1838.6	50300	2959	2216	1633	75370
1967	1139000	27161	478000	235350	10189	1901.0	54280	3120	2307	1709	78250
1968	1178000	32889	531400	270940	11053	1910.3	56810	3221	2509	1833	82080
1969	1235000	34393	584100	288140	11659	2143.5	59100	3333	2628	1839	85740

TABLE 4--Continued

Year	Argentina	Boli-via	Brazil	Colom-bia	Costa Rica	Dominican Republic	Ecua-dor	El Sal-vador	Guate-mala	Hon-duras	Venezuela
1970	1267000	37072	641100	307130	12537	2335.8	62910	3432	2778	1948	93250
1971	1313000	38888	718100	324860	13384	2589.8	66850	3597	2933	2105	96070
1972	1338000	41145	798200	350170	14478	2859.0	76490	3794	3148	2179	99200
1973	1386000	43893	909800	375060	15595	3227.7	95870	3986	3362	2239	105240
1974	1490000	46153	996300	397660	16459	3421.4	102050	4242	3576	2258	111670
1975	1459000	49201	1052100	412830	16805	3599.1	107740	4478	3646	2212	118280
1976	1412000	52201	1154000	431840	17732	3841.3	117680	4655	3915	2366	128220
1977	1483000	54398	1217000	452790	19311	2564.5	125370	4938	4221	2485	136980
1978	1427000	56223	1275200	493340	20522	2619.5	133630	5233	4432	2611	141300
1979	1599000	57254	1360500	518320	21536	2741.6	140420	5155	4641	5901	142530
1980	1622000	57601	1467600	539050	21803	2899.6	147200	4660	4803	2977	140840

SOURCE: Compiled from International Monetary Fund. 1982. **International Financial Statistics Yearbook.** Washington, D.C.

Note: See Table 2, page 12, for currency of respective country.

TABLE 5

AVERAGE ANNUAL PERCENTAGE GROWTH RATE (MONEY STOCK)

Country	1950-80	1950-60	1960-70	1970-80
Argentina	68.42	--	22.56	119.76
Bolivia	34.33	60.33	13.52	24.80
Brazil	38.37	22.19	48.46	43.37
Colombia	19.57	14.82	18.07	24.54
Costa Rica	12.83	7.20	9.36	20.46
Dominican Republic	9.95	9.07	6.69	14.68
Ecuador	14.74	6.42	13.10	16.41
El Salvador	8.83	4.05	4.19	16.41
Guatemala	9.44	5.78	4.89	16.35
Honduras	9.94	5.24	8.92	14.16
Venezuela	12.72	8.21	6.13	21.59

SOURCE: Computed from data presented in International Monetary Fund. 1982. **International Financial Statistics Yearbook.** Washington, D.C.

TABLE 6

AVERAGE ANNUAL PERCENTAGE GROWTH RATE (CONSUMER PRICE INDEX)

Country	1950-80	1950-60	1960-70	1970-80
Argentina	76.17	--	21.45	132.02
Bolivia	30.55	62.67	6.10	18.75
Brazil	35.12	16.85	43.66	43.18
Colombia	13.82	7.62	10.05	22.36
Costa Rica	4.96	1.70	2.20	10.56
Dominican Republic	4.25	0.58	1.53	9.90
Ecuador	5.85	1.02	4.05	11.98
El Salvador	4.77	2.87	0.60	10.23
Guatemala	3.69	0.82	0.64	9.03
Honduras	3.92	1.71	1.98	7.28
Venezuela	3.67	1.70	1.21	7.97

SOURCE: Computed from data presented in International Monetary Fund. 1982. **International Financial Statistics Yearbook.** Washington, D.C.

TABLE 7

AVERAGE ANNUAL PERCENTAGE GROWTH RATE (REAL GROSS DOMESTIC PRODUCT)

Country	1950-80	1950-60	1960-70	1970-80
Argentina	2.91	--	3.70	3.36
Bolivia	3.90	0.85	6.81	4.82
Brazil	7.89	5.00	9.76	8.77
Colombia	5.00	4.13	5.21	5.87
Costa Rica	5.89	5.85	6.38	5.88
Dominican Republic	4.57	5.14	4.99	3.67
Ecuador	6.26	6.33	3.70	8.79
El Salvador	4.29	4.00	5.53	3.20
Guatemala	4.84	3.48	5.24	5.65
Honduras	3.96	2.49	4.66	4.53
Venezuela	5.60	6.37	5.92	4.66

SOURCE: Computed from data presented in International Monetary Fund. 1982. **International Financial Statistics Yearbook.** Washington, D.C.

The nominal quantity of money (M_1), as measured by the sum of currency with the public and demand deposits, increased during 1950-80 at an average annual rate as high as 68.42 percent for Argentina and as low as 8.83 percent for El Salvador. The range of growth rate of money for the period 1950-60 was between 60.33 percent for Bolivia and 4.05 percent for El Salvador. The money growth range was 48.46 percent for Brazil and 4.19 for El Salvador, and 283.53 percent for Argentina and 14.16 percent for Honduras for periods 1960-70 and 1970-80, respectively.

During the period 1950-80, consumer prices increased at an average annual rate as high as 76.17 percent for Argentina and as low as 3.67 percent for Venezuela. The range of average annual growth rate of consumer prices during the 1950-60 period was 62.67 percent

for Bolivia and 0.58 percent for Dominican Republic. For the 1960-70 period, it was 43.66 percent for Brazil and 0.60 percent for El Salvador. The range for the 1970-80 period was 132.02 percent for Argentina and 7.28 percent for Honduras. It is important to point out that the rate of inflation, however, started from a relatively low level and accelerated over time. The rate of acceleration was tremendous during the period 1970-80 almost without exception for all countries under study.

In the meantime, the real gross domestic product at 1975 prices exhibited an average growth of 7.89 percent for Brazil (highest) and 3.90 percent for Bolivia (lowest) per annum in 1950-80. However, within 1950-60, the highest rate was 6.37 percent for Venezuela and the lowest growth rate achieved was Bolivia's 0.85 percent. The highest and lowest for the 1960-70 and 1970-80 periods were 9.76 percent for Brazil and 3.70 percent for Ecuador and Argentina, 8.79 percent for Ecuador and 3.20 percent for El Salvador, respectively.

However, the continuous growth was not uniform for all countries. In most countries, for several years the growth rate of real gross domestic product was negative.

Monetary Base

The factors that account for the growth of the money supply are monetary base and money multiplier. Therefore, variation in base money will have a direct effect upon the stock of money. As already mentioned, financing the government deficit by acquiring credit from the central bank has been a common practice for many Latin American

countries. This form of financing has an effect upon the domestic credit component of the monetary base. An increase in domestic credit will result in an increase in the base money and ultimately in an increase in the money supply.

Data on monetary base is shown in Table 8 for all countries under study. Corresponding annual percentage growth rates of base money can be seen in Table 9.

During 1950-80, the highest average annual percentage base money growth rate belongs to Argentina with 79.42 percent, while the lowest belongs to El Salvador with 9.04 percent. Within 1950-60, Bolivia is the country which exhibits the highest growth rate, 61.92 percent, and the lowest growth rate within that period belongs to El Salvador with 3 percent. The highest and lowest rates for 1960-70 and 1970-80 are as follows: Brazil with 48.68 percent and Venezuela with 4.71 percent; and Argentina with 145.28 percent and Dominican Republic with 13 percent, respectively. Again, it is interesting to point out that almost with no exception the growth rate of the monetary base for all countries under study is accelerated within the 1970-80 period. Another important point is that the total base money in most of these countries grew at a rate almost equal to the rate of growth of the total supply of money. Thus, the growth of the money supply in Latin America seems to have been caused almost exclusively by the growth of the monetary base.

Domestic Credit and Net Foreign Assets

Data on the supply side are required to decompose the monetary

TABLE 8

MONETARY BASE IN MILLIONS OF RESPECTIVE COUNTRY'S CURRENCY

Year	Argentina	Bolivia	Brazil	Colombia	Costa Rica	Dominican Republic	Ecuador	El Salvador	Guatemala	Honduras	Venezuela
1950	300	4	40	600	124	29.4	727	101.3	51.4	22.9	1187
1951	400	5	50	600	144	39.3	675	107.1	52.3	27.4	1236
1952	500	8	60	810	170	45.0	848	124.8	57.1	40.4	1378
1953	600	15	70	910	188	44.8	871	123.4	68.7	44.5	1424
1954	700	28	90	1090	205	56.9	964	131.6	69.7	55.1	1445
1955	800	54	100	1050	209	58.4	932	129.2	75.2	47.7	1555
1956	1000	183	120	1280	210	61.2	1043	144.6	91.1	51.3	1789
1957	600	258	160	1470	233	70.0	1098	143.6	96.5	48.7	2364
1958	900	260	190	1830	251	74.3	1062	138.7	85.4	47.4	2695
1959	1200	347	260	1950	261	71.0	1190	145.1	90.1	47.2	2443
1960	1400	399	370	2040	275	83.5	1266	137.4	88.6	46.8	2421
1961	1400	470	600	2300	268	74.1	1287	146.3	94.6	46.4	2509
1962	1500	505	970	2230	287	87.2	1469	153.1	92.9	50.4	2243
1963	2100	594	1660	3290	319	105.5	1629	180.0	104.8	55.7	2503
1964	3000	727	3050	4420	332	100.8	1938	191.7	112.3	61.5	2635
1965	4100	850	5140	5290	356	127.2	2012	212.1	121.4	69.1	2826
1966	5200	1032	6500	5790	364	117.2	2259	218.9	132.4	71.2	2934
1967	6500	1080	8160	7050	455	117.3	2398	260.4	132.8	83.8	3248
1968	8400	1145	11890	9260	506	137.9	2892	276.4	131.9	94.2	3654
1969	8300	1267	15360	11840	601	161.5	3420	302.0	145.8	109.3	3851

TABLE 8--Continued

Year	Argentina	Bolivia	Brazil	Colombia	Costa Rica	Dominican Republic	Ecuador	El Salvador	Guatemala	Honduras	Venezuela
1970	10000	1414	18280	13700	602	180.9	4505	316.7	164.7	119.2	3973
1971	12900	1679	23920	15360	771	211.0	4986	346.6	173.2	129.9	4943
1972	18500	1974	29120	18920	933	229.3	6456	412.8	220.4	144.6	5562
1973	126600	2768	44120	24810	1095	288.0	9115	480.1	262.4	167.6	6925
1974	202400	3668	58910	30100	1249	421.8	12934	568.7	303.6	156.8	9647
1975	551100	4348	76320	37750	1668	388.8	12875	682.5	361.5	183.0	13656
1976	2511100	6315	116300	53430	2238	389.8	17492	955.7	555.6	255.9	16214
1977	3610600	7884	172390	74840	3265	499.7	19832	1047.4	665.6	301.4	19431
1978	7035100	8836	245540	115940	3251	541.7	23031	1000.4	724.4	377.0	21809
1979	13213000	9832	452040	149490	5006	587.3	29478	1218.9	785.5	428.6	24600
1980	23599000	13734	412980	193120	5975	565.9	34845	1323.2	775.8	421.0	26213

SOURCE: Compiled from International Monetary Fund. 1982. International Financial Statistics Yearbook. Washington, D.C.

Note: See Table 2, page 12, for currency of respective country.

TABLE 9

AVERAGE ANNUAL PERCENTAGE GROWTH RATE (MONETARY BASE)

Country	1950-80	1950-60	1960-70	1970-80
Argentina	79.42	--	22.15	145.28
Bolivia	34.79	61.92	13.77	24.76
Brazil	38.64	22.96	48.68	42.82
Colombia	21.32	12.35	20.18	29.41
Costa Rica	14.05	7.66	8.16	24.29
Dominican Republic	10.81	10.53	9.61	13.02
Ecuador	13.99	5.54	13.17	24.19
El Salvador	9.04	3.01	7.54	14.88
Guatemala	9.71	5.45	5.78	17.16
Honduras	10.53	7.83	8.95	13.65
Venezuela	11.11	7.18	4.71	19.62

SOURCE: Computed from data presented in International Monetary Fund. 1982. **International Financial Statistics Yearbook.** Washington, D.C.

base into foreign exchange reserve and domestic credit component. The net foreign asset consists of the gross holding of international reserves (including Special Drawing Rights, reserve position in the International Monetary Fund, foreign exchange, and gold) and other foreign claims less foreign liabilities--mainly in the form of foreign deposits. The net domestic assets consist of the sum of central banks' claims on government, commercial and cooperative banks, and other financial institutions, less the sum of government deposits and capital accounts. The net domestic assets correspond to the domestic credit component of the monetary base, while the net foreign assets correspond to the theoretically-defined foreign exchange reserve. These two constitute the monetary base.

Data on the domestic credit component and net foreign assets for countries under study are shown in Tables 10 and 11, respectively. The domestic credit component of the monetary base has been rising for most of the countries in the study. The highest growth rate for the 1950-80 period was in Venezuela with 177.34 percent, and the lowest was in Guatemala with -29.83 percent. However, the rate of growth of the domestic credit component is not homogenous within different periods of time. During 1950-60, Dominican Republic's rate was the highest with 156.61 percent and El Salvador with 7.73 percent was the lowest. The highs and lows for 1960-70 and 1970-80 were Brazil with 48.45 percent and Venezuela with -83.95 percent; and Venezuela with 351.46 percent and Colombia with -60.77 percent, respectively. Based on information in Table 3, it is important to note that these countries are not following some target for the growth of their domestic credit component. This supports the assumption that governments use monetary base to offset their balance budget deficits or surpluses. The average annual percentage growth rate for domestic credit component for all countries under study here is shown in Table 12. The growth of the domestic credit component of the monetary base has been caused by reserve banks' financing of the budget deficits of the government.

The growth rates for net foreign assets are shown in Table 13. As seen from this table, there is a wide variation between these countries and even within the country in different periods of time. For most of the countries, net foreign assets were negative for quite a few years, and sometimes for the whole period under study. Within

TABLE 10

DOMESTIC CREDIT IN MILLIONS OF RESPECTIVE COUNTRY'S CURRENCY

Year	Argentina	Bolivia	Brazil	Colombia	Costa Rica	Dominican Republic	Ecuador	El Salvador	Guatemala	Honduras	Venezuela
1950	N/A	2	50	363	69	-2.1	169	-7.3	13.2	-13.2	30
1951	N/A	2	60	397	71	-6.0	225	-5.0	12.6	-22.4	64
1952	N/A	6	70	500	63	0.4	208	7.8	13.4	-11.0	-6
1953	N/A	11	80	530	66	5.6	329	6.7	26.7	-7.0	-102
1954	N/A	24	100	650	88	1.3	407	8.0	29.3	1.6	-76
1955	N/A	50	120	860	67	19.0	542	16.7	18.7	4.0	-112
1956	N/A	289	150	960	115	28.0	626	39.1	19.0	11.4	-1172
1957	N/A	318	190	1720	135	42.6	627	26.5	25.4	19.0	-2149
1958	1000	359	240	1970	104	50.9	559	21.8	39.0	26.7	-622
1959	1100	461	330	1890	173	73.9	592	34.4	47.3	25.3	263
1960	1200	542	470	1990	263	70.0	724	74.5	40.2	26.3	531
1961	1150	583	700	2420	317	95.8	878	106.2	50.1	33.0	681
1962	1200	662	1070	3060	295	107.1	841	96.8	61.5	36.4	433
1963	2200	671	2660	4420	317	109.6	808	81.0	62.5	42.0	224
1964	3100	618	5450	5660	385	139.1	1031	90.7	73.4	40.7	-473
1965	3900	595	6640	6120	297	131.6	1325	87.8	87.5	38.1	-139
1966	5000	708	7600	7180	421	149.9	1317	119.9	108.4	37.9	73
1967	5300	855	9260	8360	377	155.6	1284	168.1	97.2	49.7	-57
1968	7000	924	14390	10530	367	172.6	1947	170.4	93.8	39.4	105
1969	6800	1027	16060	13040	250	178.6	2494	208.5	98.2	62.3	252

TABLE 10--Continued

Year	Argentina	Boli-via	Brazil	Colom-bia	Costa Rica	Dominican Republic	Ecua-dor	El Sal-vador	Guate-mala	Hon-duras	Venezuela
1970	7300	1118	17680	15060	430	191.9	3224	185.6	88.2	95.8	-31
1971	11600	1441	14120	18410	491	215.4	4449	217.1	85.2	97.1	-1099
1972	19200	1266	4020	18400	603	214.1	3354	230.4	86.3	87.2	-1578
1973	125200	2544	5120	19800	606	264.3	3510	348.3	52.9	102.0	-3304
1974	198900	1166	18710	34370	1118	412.8	5673	418.4	116.5	126.7	-17836
1975	535000	2687	35620	36610	1470	357.0	7002	410.0	66.8	115.8	-24084
1976	2239500	3430	47000	33290	1547	401.2	7287	498.9	51.8	131.1	-17959
1977	2143200	4972	77590	20610	1658	449.2	5352	536.2	4.6	78.3	-14958
1978	2881400	8382	51840	31730	1875	574.1	7395	411.3	-8.4	82.5	-6958
1979	7832000	12392	167940	3500	4489	627.1	12911	902.9	85.3	150.4	-10275
1980	26808000	18930	472080	-21410	6511	726.6	12173	1480.4	332.9	242.2	-5479

SOURCE: Compiled from International Monetary Fund. 1982. **International Financial Statistics Yearbook.** Washington, D.C.

Note: See Table 2, page 12, for currency of respective country.

TABLE 11

NET FOREIGN ASSETS OF RESPECTIVE COUNTRY'S CURRENCY

Year	Argentina	Boli-via	Brazil	Colom-bia	Costa Rica	Dominican Republic	Ecua-dor	El Sal-vador	Guate-mala	Hon-duras	Venezuela
1950	N/A	2	-10	237	55	31.5	558	108.6	38.2	36.1	1157
1951	N/A	3	-10	203	73	45.3	450	112.1	39.7	49.8	1172
1952	N/A	2	-10	310	107	44.6	640	117.0	43.7	51.4	1384
1953	N/A	4	-10	380	122	39.2	542	116.7	42.0	51.5	1526
1954	N/A	4	-10	440	117	55.6	557	123.6	40.4	53.5	1511
1955	N/A	4	-20	190	142	39.4	390	112.5	56.5	43.4	1667
1956	N/A	-106	-30	320	95	33.2	417	105.0	72.1	39.9	2962
1957	N/A	-60	-30	-250	98	27.4	471	117.1	71.1	29.7	4506
1958	-100	-135	-50	-140	147	23.4	503	116.9	46.7	20.7	3317
1959	100	-114	-70	60	88	-2.9	598	109.7	42.8	21.9	2180
1960	200	-143	-100	50	12	13.3	542	62.9	48.4	20.5	1890
1961	250	-113	-100	-120	-49	-2.1	409	40.1	44.5	13.4	1828
1962	300	-157	-100	-830	-8	-19.9	628	56.3	31.4	14.0	1810
1963	-100	-77	-1000	-1130	2	4.1	821	99.0	42.3	13.7	2279
1964	-100	109	-2400	-1240	-53	-38.3	907	101.0	38.9	20.8	3108
1965	200	225	-1500	-830	59	-4.4	687	124.3	33.9	31.0	2965
1966	200	324	-1100	-1390	-57	-32.7	942	99.0	24.0	33.3	2861
1967	1200	225	-1100	-1310	78	-38.3	1114	92.3	35.6	34.1	3305
1968	1400	221	-2500	-1270	139	-34.7	945	106.0	38.1	54.8	3549
1969	1500	240	-700	-1200	251	-17.1	926	93.5	47.6	47.0	3599

TABLE 11--Continued

Year	Argentina	Bolivia	Brazil	Colombia	Costa Rica	Dominican Republic	Ecuador	El Salvador	Guatemala	Honduras	Venezuela
1970	2700	296	600	-1360	172	-11.0	1281	131.1	76.5	23.4	4004
1971	1300	238	9800	-3050	280	-4.4	537	129.3	88.0	32.8	6042
1972	-700	718	25100	520	330	15.2	3103	182.4	134.1	57.4	7140
1973	1400	224	39000	5010	489	23.7	5605	131.8	209.5	65.6	10229
1974	3500	2502	40200	-4270	131	9.0	7261	150.3	187.1	30.1	27483
1975	16100	1661	40700	1140	198	31.8	5872	272.5	294.7	67.2	37740
1976	271600	2885	69300	20140	691	-11.4	10205	456.8	503.8	124.8	34173
1977	1467400	2912	94800	54230	1607	50.5	14480	511.2	661.0	223.1	34689
1978	4153700	454	193700	84210	1376	-32.4	15636	589.1	732.8	294.5	28767
1979	5381000	-2560	284100	145990	517	-39.8	16567	316.0	700.2	278.2	34875
1980	-3209000	-5196	240900	214530	-536	-160.7	22672	-157.2	442.9	178.8	31692

SOURCE: Compiled from International Monetary Fund. 1982. **International Financial Statistics Yearbook.** Washington, D.C.

Note: See Table 2, page 12, for currency of respective country.

TABLE 12

AVERAGE ANNUAL PERCENTAGE GROWTH RATE (DOMESTIC CREDIT)

Country	1950-80	1950-60	1960-70	1970-80
Argentina	82.93	--	20.92	154.89
Bolivia	50.67	96.03	8.75	40.42
Brazil	48.54	23.08	48.45	70.05
Colombia	-8.18	18.44	21.18	-60.77
Costa Rica	20.71	17.30	12.77	39.58
Dominican Republic	99.67	256.61	9.71	14.77
Ecuador	17.30	15.79	17.95	19.72
El Salvador	15.56	7.73	21.11	24.61
Guatemala	-29.83	15.43	6.84	-108.62
Honduras	19.66	27.32	15.22	18.11
Venezuela	177.34	231.31	-83.95	351.46

SOURCE: Computed from data presented in International Monetary Fund. 1982. **International Financial Statistics Yearbook.** Washington, D.C.

TABLE 13

AVERAGE ANNUAL PERCENTAGE GROWTH RATE (NET FOREIGN ASSET)

Country	1950-80	1950-60	1960-70	1970-80
Argentina	95.65	--	28.68	198.94
Bolivia	-68.71	231.08	-8.05	49.93
Brazil	101.19	27.23	80.75	164.21
Colombia	84.13	-26.66	28.57	234.87
Costa Rica	-121.69	0.38	-370.08	16.03
Dominican Republic	-77.44	-61.45	-137.17	-73.66
Ecuador	26.33	1.50	10.28	65.06
El Salvador	2.82	-3.62	7.14	4.20
Guatemala	12.04	3.91	9.20	27.55
Honduras	12.59	-3.47	6.20	27.60
Venezuela	15.67	8.61	6.56	28.79

SOURCE: Computed from data presented in International Monetary Fund. 1982. **International Financial Statistics Yearbook.** Washington, D.C.

1950-80, the growth rate for net foreign asset climbs as high as 101.19 percent for Brazil and falls as low as -121.69 percent for Costa Rica.

It is interesting to note that for most of the countries, whenever net foreign assets are negative, the domestic credit component of base money has increased.

During 1950-60, the highest growth rate of net foreign assets is attributed to Brazil with 27.23 percent and the lowest is Bolivia with -231.08 percent. Within 1960-70, the maximum growth rate remains in Brazil with 80.75 percent, and the lowest goes to Costa Rica with -370.08 percent growth rate. In the period of 1971-80, only Dominican Republic has a negative growth rate (-73.66 percent) for net foreign assets. Of course, within the whole period under study, the average annual growth rate was negative for Dominican Republic, while countries like Venezuela, Guatemala, Ecuador, Brazil, and Argentina had positive growth rates for the entire period.

The government budget seems to have played a significant role in the growth of the money supply in Latin American economies. For this reason, instead of using the International Monetary Fund's (1982) calculated deficit, the increase in the domestic credit component of base money has been used as a proxy variable for the deficit. This follows the assumption that almost 100 percent of the deficit is being financed by increasing government indebtedness to the central bank. Consequently, it is hypothesized that the growth of the domestic credit component of the monetary base was largely caused by the continuous deficit in the government budget. Again, another point that

must be mentioned is that Latin American countries, at least most of them, use domestic credit as a last resort for financing their huge deficits. That is, whenever they are faced with a balance-of-payments surplus, they finance a major part of their fiscal deficit with these reserves. When they run a balance-of-payments deficit, they finance this deficit as well as the fiscal deficit through borrowing from the central bank. This form of policy--that is, monetizing the deficit--creates tremendous inflationary pressures and faces the country with a huge rate of inflation.

CHAPTER III

SELF-GENERATING NATURE OF INFLATION: CLOSED ECONOMY CASE

The inflationary financing of budget deficits has long beena common practice for many Latin American countries. The model which will be presented below attempts to show the extent of the effects of deficit and inflation upon each other.

The financing of deficits through money creation creates tremendous inflationary pressures in the economy. The expansion in the nominal money stock increases the demand for goods and services and, thus, increases prices. The increase in prices leads to an increase in nominal government expenditures and, therefore, an increase in the budget deficit leading to a vicious cycle of inflation and deficit. This self-generating process causes inflation to spiral higher and higher until, in some cases it reaches the stage of near hyperinflation. In order to summarize the whole process, let us assume that a government has an initial deficit which results in an increase in the monetary base. The increase in the monetary base causes an increase in the stock of money which, in turn, results in an increase in the price level. The increase in the price level increases government's expenditures and, therefore, it has a deficit and the process repeats itself.

The Model

A demand function similar to Cagan's (1956) is used for real per capital money balances:

$$\ln\left(\frac{M}{np}\right)_t = \gamma - \alpha E_t + q \ln\left(\frac{Y}{n}\right)_t$$

where E_t is expected rate of price change; P is price level; N is population; Y is gross domestic product; M is nominal money supply; and γ, α, and q are constants.

Since E_t is the expected rate of price change, it is a nonobservable variable. Using geometrically declining weights will help in writing it as a function of observable variables. The following relationship is used to write E_t in terms of an observable variable:

$$\Delta E_t = B(\Delta \ln P_{t-1} - E_{t-1})$$

where expected rate of price change, i.e., E_t is some positive proportion (β) of the difference between the previous years' actual and expected rates of price change, and,

$$\Delta E_t = E_t - E_t - 1$$

$$\Delta \ln_{pt-1} = \ln P_{t-1} - \ln P_{t-2} \cdot$$

The following procedure has been used to generate the first equation of the model. Starting with the demand equation:

$$\ln\left(\frac{M}{NP}\right)_t = \gamma - \alpha E_t + q \ln\left(\frac{Y}{N}\right)_t$$

$$\ln(M)_t - \ln(N)_t - \ln(P)_t = - \alpha E_t + q \ln\left(\frac{Y}{N}\right)_t$$

$$\ln(P)_t = \ln M_t - \ln N_t - + \alpha E_t - q \ln\left(\frac{Y}{N}\right)_t \qquad (1a)$$

Lag equation (1a) by one period:

$$\ln(P)_{t-1} = \ln M_{t-1} - \ln N_{t-1} - \gamma + \alpha E_{t-1} - q \ln\left(\frac{Y}{N}\right)_{t-1} \qquad (1b)$$

Since γ is constant, therefore,

$$\gamma = \ln M_t - \ln N_t - \ln P_t + \alpha E_t - q\ln\left(\frac{Y}{N}\right)_t$$

or

$$\gamma = \ln M_{t-1} - \ln N_{t-1} - \ln P_{t-1} + \alpha E_{t-1} - q\ln\left(\frac{Y}{N}\right)_{t-1} \quad (1c)$$

Subtract (1b) from (1a) and substituting (1c) in (1b) yields

$$\begin{aligned}\ln P_t - \ln P_{t-1} &= \ln M_t - \ln N_t - \ln M_{t-1} + \ln N_{t-1} - \gamma + \ln M_{t-1} \\ &\quad - \ln N_{t-1} - \ln P_{t-1} + \alpha E_{t-1} - q\ln(Y/N)_{t-1} + E_t \\ &\quad - \alpha E_{t-1} - q\ln\left(\frac{Y}{N}\right)_t + q\ln(Y/N)_{t-1}\end{aligned}$$

$$\Delta\ln P_t = \Delta\ln\left(\frac{M}{N}\right)_t - \gamma + \ln\left(\frac{M}{N}\right)_{t-1} - \ln P_{t-1} + \alpha E_t - q\ln\left(\frac{Y}{N}\right)_t \quad (1d)$$

Since $E_t = \Delta E_t + E_{t-1}$, equation (1d) becomes:

$$\Delta\ln P_t = \Delta\ln\left(\frac{M}{N}\right)_t - \gamma + \ln\left(\frac{M}{N}\right)_{t-1} - \ln P_{t-1} + \alpha\Delta E_t + \alpha E_{t-1} - q\ln\left(\frac{Y}{N}\right)_t \quad (1e)$$

Since $\Delta E_t = \beta(\Delta\ln P_{t-1} - E_{t-1})$, equation (1e) becomes:

$$\Delta\ln P_t = \Delta\ln\left(\frac{M}{N}\right)_t - \gamma + \ln\left(\frac{M}{N}\right)_{t-1} - \ln P_{t-1} + \alpha\beta\Delta\ln P_{t-1} - \alpha\beta E_{t-1} + \alpha E_{t-1} - q\ln\left(\frac{Y}{N}\right)_t \quad (1f)$$

or

$$\Delta\ln P_t = \Delta\ln\left(\frac{M}{N}\right)_t - \gamma + \ln\left(\frac{M}{N}\right)_{t-1} - \ln P_{t-1} + \alpha\beta\Delta\ln P_{t-1} + \alpha E_{t-1}(1 - \beta) - q\ln\left(\frac{Y}{N}\right)_t \quad (1g)$$

from equation (1c)

$$\alpha E_{t-1} = q\ln\left(\frac{Y}{N}\right)_{t-1} + \gamma + \ln P_{t-1} - \ln\left(\frac{M}{N}\right)_{t-1} \quad (1h)$$

Substitute equation (1h) in equation (1g)

$$\begin{aligned}\Delta\ln P_t &= \Delta\ln\left(\frac{M}{N}\right)_t - \gamma + \ln\left(\frac{M}{N}\right)_{t-1} - \ln P_{t-1} + \alpha\beta\Delta\ln P_{t-1} \\ &\quad + (1 - \beta)q\ln\left(\frac{Y}{N}\right)_{t-1} + (1 - \beta)\gamma + (1 - \beta)\ln P_{t-1} \\ &\quad - (1 - \beta)\ln\left(\frac{M}{N}\right)_{t-1} - q\ln\left(\frac{Y}{N}\right)_t \quad (1i)\end{aligned}$$

or

$$\Delta \ln P_t = \Delta \ln\left(\frac{M}{N}\right)_t - \gamma + \ln\left(\frac{M}{N}\right)_{t-1} - \ln P_{t-1} + \alpha\beta\Delta \ln P_{t-1}$$
$$+ q\ln\left(\frac{Y}{N}\right)_{t-1} - \beta q \ln\left(\frac{Y}{N}\right)_{t-1} + \gamma - \beta\gamma + \ln P_{t-1} - \beta \ln P_{t-1}$$
$$- \ln\left(\frac{M}{N}\right)_{t-1} + \beta \ln\left(\frac{M}{N}\right)_t - q\ln\left(\frac{Y}{N}\right)_t$$

which follows equation (1) of the model:

$$\Delta \ln P_t = -\beta\gamma + \Delta \ln\left(\frac{M}{N}\right)_t + \alpha\beta\Delta \ln P_{t-1} + \beta(\ln(M/N)_{t-1} - \ln P_{t-1})$$
$$- q\ln(Y/N)_t + q(1 - \beta)\ln(Y/N)_{t-1} \qquad (1)$$

where $0 < \beta < 1$ is speed of adjustment of expected price change to the actual rate.

It is assumed that the speed of movement in the price level is so fast that it makes desired and actual rates of per capita balances equal. Equation (1), the first equation of the model, expresses the relationship between the rate of change in the price level and the rate of monetary expansion.

Since governments try to increase the money supply by increasing base money, equation (2) will express the relationship between money supply and base money.

If there is an increase in monetary base either due to an increase in bank reserves or through money printing, an increase in the actual reserve to deposit ratio above the desired level will result. Banks operating in a fractional reserve system will respond to this inequality by creating new demand deposits. An increase in demand deposits will cause an increase in the money supply. Of course, this process is not instantaneous, and only after some specific period of time can it be felt in the economy. It is assumed that the rate of change in money stock is a geometric function of current and past rates of changes in the monetary base.

Starting with the following functional form equation:

$$\Delta \ln M_t = \lambda \sum_{i=0}^{\infty} (1 - \lambda)^i \Delta \ln B_{T-i} \tag{2a}$$

equation (2a) can be expanded:

$$\Delta \ln M_t = \lambda \Delta \ln B_T + \lambda(1 - \lambda)\Delta \ln B_{T-1} + \lambda(1 - \lambda)^2 \Delta \ln B_{T-2} + \lambda(1 - \lambda)^3 \Delta \ln B_{T-3} \tag{2b}$$

lag equation (2b) by one period

$$\Delta \ln M_{t-1} = \lambda \Delta \ln B_{T-1} + \lambda(1 - \lambda)\Delta \ln B_{T-2} + \lambda(1 - \lambda)^2 \Delta \ln B_{T-3} + \lambda(1 - \lambda)^3 \Delta \ln B_{T-4} \tag{2c}$$

multiply both sides of equation (2c) by $(1 - \lambda)$

$$(1 - \lambda)\Delta \ln M_{t-1} = \lambda(1 - \lambda)\Delta \ln B_{T-1} + \lambda(1 - \lambda)^2 \Delta \ln B_{T-2} + \lambda(1 - \lambda)^3 \Delta \ln B_{T-3} + \lambda(1 - \lambda)^4 \Delta \ln B_{T-4} \tag{2d}$$

Subtract equation (2d) from (2b)

$$\Delta \ln M_t - (1 - \lambda)\Delta \ln M_{t-1} = \lambda \Delta \ln B_T$$

or

$$\Delta \ln M_t = \lambda \Delta \ln B_t + (1 - \lambda)\Delta \ln M_{t-1} \tag{2}$$

which is equation (2) of the model.

The government finances its deficit by selling securities to the central bank. this form of financing increases currency both outside banks and bank reserves. The increase in domestic credit will result in an increase in the monetary base. The following relationship expresses the result:

$$\Delta B_t = a + bD_t \tag{3a}$$

where B_t is the monetary base; D_t is the deficit; and a and b are constants.

"a" represents parameters other than deficit which contributes to an increase in the monetary base. "b" represents the proportion of

the deficit which is financed by selling securities to the central bank; it is assumed that "b" is positive.

By solving equation (3a) for the total base, equation (3) of the model can be derived:

$$\Delta B_T = a + bD_T$$

since

$$\Delta B_T = B_T - B_{T-1}$$

or

$$B_{T-1} = B_T - \Delta B_T$$

$$B_{T-1} = B_T - (a + bD_T)$$

$$B_{T-2} = B_{T-1} - \Delta B_{T-1}$$

$$B_{T-2} = B_T - (a + bD_T) - (a + bD_{T-1})$$

$$B_{T-3} = B_{T-2} - \Delta B_{T-2}$$

$$B_{T-3} = B_T - (a + bD_T) - (a + bD_{T-1}) - (a + bD_{T-2})$$

$$\vdots \qquad \vdots$$

$$B_0 = B_T - (a + bD_t) - (a + bD_{t-1})$$

$$B_{(-1)} = B_T - \sum_{i=0}^{t} a + bD_i$$

$$B_{(-1)} = B_T - a(t + 1) - b \sum_{i=0}^{t} D_i$$

$$\Longrightarrow B_T = B_{(-1)} + a(t + 1) + b \sum_{i=0}^{t} D_i$$

Since $\Delta \ln B_T = \frac{\Delta B_T}{B_T}$

$$\Longrightarrow \Delta \ln B_T = \frac{a + bD_T}{B_{(-1)} + a(t+1) + b\sum_{i=0}^{t} D_i}$$

where $B_{(-1)}$ is initial base, which expresses the relationship between the deficit and the rate of growth of the money supply. The relationship specifies the rate of change in the monetary base as a function of current and past rates of nominal government expenditure since the initial period.

The nominal deficit in year t is defined to be equal to nominal government expenditures, G_t, minus the nominal value of tax collection, T_t.

It is assumed that the level of real government expenditure for year t is fixed at f_t and expected nominal expenditures for the year, G_t^e, are $P_{t-1}f_t$. In addition, it is assumed that at the beginning of the year, the nominal value of taxes, T_t, is set equal to some positive fraction of expected nominal expenditure, i.e., the government does not account for inflation in setting tax liabilities. It follows that the real value of the nominally fixed tax assessment declines as prices rise, causing the real deficit to vary directly with the rate of price change. Therefore, with a positive rate of price change, the nominal deficit at the end of the year exceeds the planned nominal deficit because: (1) the price level at the end of the year is higher than it was at the beginning of the year; and (2) the real deficit increases because actual nominal expenditures, G_t, exceeds planned nominal expenditures, G_t^e, while nominal taxes remain fixed.

In order to derive the fourth equation of the model, the following steps have been taken. Let,

$$D_t = G_t - T_t \tag{4a}$$

where $G_t = P_t f_t$ if f_t; fixed level of real government expenditure is spent on end of the year; and $G_t = P_{t-1} f_t$ if entire f_t is spent on beginning of the year.

Therefore, nominal government expenditures during year t, G_t, will be given by evaluating the line integral of the price level function along the time path of real government expenditures:

$$G_t = \int_{ft(x)} P_{t-1} e^{x \Delta \ln P_t} df_t(x) \tag{4b}$$

where $0 < x < 1$ is the length of the period over which expenditure is made in one year.

$$0 \leq f_t(x) \leq f_t$$

$$f_t(x) = f_t \cdot x$$

or

$$x = \frac{f_t(x)}{f_t}$$

$$\Longrightarrow G_t = \int_0^{ft} P_{t-1} e^{\frac{f_t(x)}{f_t} \cdot \Delta \ln P_t} df_t(x)$$

$$= P_{t-1} \frac{f_t}{\Delta \ln P_t} e^{f_t(x) \cdot \frac{\Delta \ln P_t}{f_t}} \Bigg|_0^{f_t}$$

$$= f_t \left[(P_{t-1}) \frac{e^{\Delta \ln P_t} - 1}{(\Delta \ln P_t)} \right] \tag{4c}$$

Note: $e^{\Delta \ln P_t} = \frac{P_t}{P_{t-1}}$.

equation (4c) becomes

$$G_t = f_t \left[(P_{t-1}) \frac{(P_t - P_{t-1})/(P_{t-1})}{(\Delta \ln P_t)} \right] \tag{4d}$$

It is assumed that payment of government expenditures take place one year after the time of contract, therefore, equation (4d) becomes:

$$G_t = f_{t-1} \left[(P_{t-2}) \frac{(P_{t-1} - P_{t-2})/(P_{t-2})}{(\Delta \ln P_{t-1})} \right] \tag{4e}$$

By substituting equation (4e) into (4a), it follows that

$$D_t = f_{t-1} \left[(P_{t-2}) \frac{(P_{t-1} - P_{t-2})/(P_{t-2})}{(\Delta \ln P_{t-1})} \right] - T_t \tag{4f}$$

Now let

$$T_t = P_{t-2} t_i$$

where T_t is nominal tax; t_i is fixed real tax; and let

$$\frac{(P_{t-1} - P_{t-2})/(P_{t-2})}{(\Delta \ln P_{t-1})} = U_t \ .$$

Equation (4e) becomes

$$D_t = (f_{t-1})(P_{t-2})U_t - P_{t-2}t_i = (P_{t-2})U_t(f_{t-1} - \frac{t_i}{U_t}) \tag{4g}$$

where $(P_{t-2})U_t$ is an average price level over the year t, $\bar{P}_t$ and $(f_{t-1} - \frac{T_i}{U_T})$ is an average real deficit over the year t, $\bar{g}_t$. Note that $U_t = 1$ if there is no change in price, and $U_t > 1$ if there is change in price. Therefore, it is assumed that $U_t \geq 1$. Now the equation becomes:

$$D_t = g_1 \left| (P_{t-2}) \frac{(P_{t-1} - P_{t-2})/(P_{t-2})}{(\Delta \ln P_{t-1})} \right| \qquad (4)$$

which is equation (4) of the model.

Note that in determining equation (4), the following assumptions have been made:

1. Real government expenditures are undertaken evenly over the year
2. The current expenditures are based on obligations incurred one year before.

This equation expresses the link between the nominal deficit and the rate of change in the price level. We can now write the system of four equations which explain: (1) the rate of change in the price level; (2) the rate of change in the money stock; (3) the rate of change in the monetary base; and (4) the rate of deficit expenditures.

From this model follows the self-generating nature of inflation:

$$\Delta \ln P_t = -\beta\gamma + \Delta \ln\left(\frac{M}{N}\right)_t + \alpha\beta\Delta \ln P_{t-1} + \beta\left(\ln\left(\frac{M}{N}\right)_{t-1} - \ln P_{t-1}\right) - q \ln(Y/N)_t + q(1 - \beta)\ln(Y/N)_{t-1} \qquad (1)$$

$$\Delta \ln M_t = \lambda\Delta \ln \beta_t + (1 - \lambda)\Delta \ln M_{t-1} \qquad (2)$$

$$\Delta \ln B_t = \frac{a + bD_t}{B_{(-1)} + a(t + 1) + b \sum_{i=0}^{t} D_i} \qquad (3)$$

$$D_t = g_1 \left[(P_{t-2}) \frac{(P_{t-1} - P_{t-2})/(P_{t-2})}{(\Delta \ln P_{t-1})} \right] \qquad (4)$$

where $\Delta \ln P_t$, $\Delta \ln M_t$, $\Delta \ln B_t$, and D_t are endogenous and $\Delta \ln P_{t-1}$, $\Delta \ln M_{t-1}$,

D_{t-1}, P_{t-1}, and P_{t-2} are logged endogenous; and only t, Y, and N are exogenous variables.

We assume that demand for real per capita money balances is a random variable of the following form:

$$\ln\left(\frac{M}{NP}\right)_t = \gamma - \alpha E_t + q\ln\left(\frac{Y}{N}\right)_t + E_{1t} \qquad (1a)$$

where $E_{1t} \sim (0, \sigma_1)$. And, since $\Delta E_t = \beta(\Delta \ln P_{t-1} - E_{t-1})$, equation (1) becomes

$$\Delta \ln P_t = -\beta\gamma + \Delta\ln\left(\frac{M}{N}\right)_t + \alpha\beta\Delta\ln P_{t-1} + \beta\left(\ln\left(\frac{M}{N}\right)_{t-1} - \ln P_{t-1}\right) - q\ln\left(\frac{Y}{N}\right)_t + q(1-\beta)\ln\left(\frac{Y}{N}\right)_{t-1} + E^*_{1t} \qquad (1b)$$

where $E^*_{1t} = (1-\beta)E_{1t-1} - E_{1t}$. For the purpose of estimation, equation (1b) has been written in the following form:

$$\Delta\ln\left(\frac{NP}{M}\right)_t = -\beta\gamma + \alpha\beta\Delta\ln P_{t-1} + \beta\left(\ln\left(\frac{M}{N}\right)_{t-1} - \ln P_{t-1}\right) - q\ln\left(\frac{Y}{N}\right)_t + q(1-\beta)\ln\left(\frac{Y}{N}\right)_{t-1} + E^*_{1t} \qquad (1)$$

which expresses the dependent variable as $\Delta\ln\left(\frac{NP}{M}\right)_t$. Since our dependent variable has been written in terms of all exogenous or lagged endogenous variables, application of ordinary least-squares method for estimating the parameters is permissible.

For estimating the rate of change in the money stock, the following form has been undertaken:

$$\Delta\ln M_t = \lambda \sum_{i=0}^{\infty} (1-\lambda)^i \Delta\ln B_{t-1} + E_{2t} \qquad (2a)$$

where $E_{2t} \sim N(0, \sigma_2^2)$.

With the application of a Koyok transformation, equation (2a) becomes:

$$\Delta\ln M_t - \Delta\ln M_{t-1} = \lambda(\Delta\ln B_t - \Delta\ln M_{t-1}) + E^*_{2t} \qquad (2)$$

where $E^*_{2t} = -(1-\lambda)E_{2t-1} + E_{2t}$.

For the purpose of estimation, the dependent variable is now $\Delta \ln M_t - \Delta \ln M_{t-1}$. Since equation (2) of the model has been writen in terms of endogenous variables, application of ordinary least-squares is not permissible. Two-stage least-squares has been used to estimate the parameter of the equation.

The third equation expresses the variation in base money as a function of the deficit. Here, because of the closed economy assumption, the effect of the foreign sector has been ignored. Since the deficit itself is a dependent variable, the two-stage least-squares method has been used in order to estimate the parameters of the equation, i.e.,

$$\Delta B_t = a + bD_t + E_{3t} \tag{3a}$$

where $E_{3t} \sim N(0, \sigma_3^2)$.

As shown in the derivation of equation (3), equation (3a) has been used to derive the third equation of the model. The following relationship has been used to generate $\Delta \ln B_t$:

$$\Delta \ln \hat{B}_t = \frac{\Delta \hat{B}_t}{B_{(-1)} + a(t+1) + b \sum_{i=0}^{t} \hat{D}_i} .$$

Equation (4) expresses the relationship between the rate of deficit and the price level. It is:

$$D_t = g_1 \left[(P_{t-2}) \frac{(P_{t-1} - P_{t-2})/(P_{t-2})}{\Delta \ln P_{t-1}} \right] + E_{4t}^*$$

where

$$E_{4t}^* = (P_{t-1}) \frac{(P_t - P_{t-1})/(P_{t-1})}{\Delta \ln P_t} \cdot (E_{4t}) .$$

Again, since the rate of deficit has been expressed in terms of all lagged endogenous variables, ordinary least-squares have been used to estimate parameter g_1. Changes in the domestic credit component have been used in the study as a proxy variable for the rate of deficit for two reasons: (1) the major part of the deficit is financed by borrowing from the central bank, and (2) explicit data regarding the rate of deficit is not available for all countries. Ordinary least-squares method of estimation has been used to estimate the parameters of equations (1) and (4). Because of the existence of dependent variables on the right-hand side, two-stage least-squares was determined to be the appropriate estimation method for equations (2) and (3).

E^*_{1t} in equation (1) is not an independently distributed random variable but is serially correlated. Therefore, least-squares estimation of the parameters in equation (1) is inefficient. It was not possible to express the error term as a simple first-order autoregressive scheme, and, therefore, no procedure is available to obtain efficient estimates. Furthermore, since $\Delta \ln P_{t-1}$ and $\Delta \ln(\frac{M}{N})_{t-1}$ are correlated with the disturbance term E^*_{1t}, the least-squares estimates of α, β, and q also are biased and inconsistent. E^*_{2t} in equation (2) is serially correlated, which introduces inefficiency and correlation between $\Delta \ln M_{t-1}$ and E^*_{2t} introduce inconsistency. The least-squares estimate of g_1 in equation (4) is consistent but inefficient because E^*_{4t} is heteroskedastic.

Furthermore, in order to avoid the statistical problems, i.e., negative R^2, a constant term has been added to equations (2) and (4)

regardless of whether it is specified. However, in empirical results, the estimates of constant terms for these equations have not been reported.

Empirical Results

In this section, the estimated parameters of equations of the model are reported under the closed economy assumption for the countries under study.[1] Table 14 illustrates the first equation of the model which expresses the relationship between the rate of change in the price level and the rate of monetary expansion. Again, for purposes of estimation, equation (1) has been written in the following form:

$$\Delta \ln\left(\frac{NP}{M}\right)_t = -\beta\gamma + \alpha\beta\Delta \ln P_{t-1} + \beta\left(\ln\left(\frac{M}{N}\right)_{t-1} - \ln P_{t-1}\right) - q \ln\left(\frac{Y}{N}\right)_t + q(1-\beta)\ln\left(\frac{Y}{N}\right)_{t-1} \quad (1)$$

Table 15 reports the second equation of the model which relates the rate of monetary expansion to the rate of increase of the monetary base. For purposes of estimation, equation (2) of the model has taken the following form:

$$\Delta \ln M_t - \Delta \ln M_{t-1} = \lambda(\Delta \ln B_t - \Delta \ln M_{t-1}) \quad (2)$$

The third equation of the model has been summarized in Table 16. Equation (3) of the model demonstrates the effect of an increase in the deficit on the rate of growth of the monetary base. Equation (3) has the following form:

$$\Delta B_t = a + bD_t \quad (3)$$

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[1] Countries have been chosen on the basis of availability of homogenous data.

TABLE 14

ESTIMATED PARAMETERS OF FIRST EQUATION OF MODEL: CLOSED ECONOMY

Country	Const.	$\alpha\beta$	β	q	$q(1-\beta)$	R^2	F	DW
Argentina	7.49	0.25*	0.38*	-0.30	-0.42	0.35	1.96	1.30
	(5.13)	(0.11)	(0.17)	(0.75)	(0.84)			
	(1.46)	(2.21)	(2.23)	(-0.40)	(-0.50)			
Bolivia	4.16*	0.15	0.55*	-0.17	-0.43	0.44	4.40	1.75
	(1.52)	(0.10)	(0.18)	(0.51)	(0.52)			
	(2.72)	(1.44)	(2.98)	(-0.33)	(-0.82)			
Brazil	-0.06	0.84*	-0.11	-0.30	0.31	0.76	17.93	1.75
	(0.59)	(0.12)	(0.17)	(0.37)	(0.39)			
	(-0.11)	(6.20)	(-0.59)	(-0.82)	(0.80)			
Colombia	1.99*	0.89*	0.16	-0.33	0.05	0.66	11.24	2.50
	(0.71)	(0.16)	(0.09)	(0.33)	(0.33)			
	(2.80)	(5.65)	(1.64)	(1.00)	(0.17)			
Costa Rica	5.60*	0.89*	0.32*	-0.80	0.07	0.57	7.56	2.17
	(1.46)	(0.25)	(0.12)	(0.40)	(0.43)			
	(3.83)	(3.55)	(2.60)	(-1.99)	(0.17)			
Dominican Republic	2.10	-0.26	0.60*	-0.07	-0.23	0.30	2.42	2.21
	(1.17)	(0.54)	(0.21)	(0.21)	(0.19)			
	(1.79)	(-0.48)	(2.80)	(-0.32)	(-1.15)			
Ecuador	0.31	0.11	-0.005	-0.65*	0.61*	0.22	2.00	2.96
	(1.52)	(0.54)	(0.11)	(0.28)	(0.27)			
	(0.20)	(0.19)	(-0.04)	(-2.32)	(2.21)			

TABLE 14. Continued

Country	Const.	$\alpha\beta$	β	q	$q(1-\beta)$	R^2	F	DW
El Salvador	1.78*	0.41	0.10	-0.54	0.27	0.26	2.00	2.17
	(0.86)	(0.50)	(0.16)	(0.39)	(0.41)			
	(2.06)	(0.82)	(0.54)	(-1.38)	(0.67)			
Guatemala	1.50	-0.50	0.34*	-2.24*	2.04*	0.52	6.31	1.81
	(1.07)	(0.33)	(0.13)	(0.54)	(0.58)			
	(1.41)	(-1.48)	(2.62)	(-4.18)	(3.53)			
Honduras	2.70	1.31*	-0.004	-0.31	-0.12	0.27	2.15	1.94
	(2.04)	(0.64)	(0.15)	(0.46)	(0.48)			
	(1.32)	(2.07)	(-0.02)	(-1.67)	(-0.24)			
Venezuela	2.78	0.66	0.04	-0.50	0.17	0.14	1.00	1.17
	(1.78)	(0.86)	(0.11)	(0.80)	(0.80)			
	(1.56)	(0.77)	(0.33)	(-0.63)	(0.22)			

Notes: 1. All tests of hypothesis in this study have been done at the 5 percent level of significance.

2. The first terms in parentheses are the standard erros of the regression coefficients, and the second ones are the corresponding t values. This practice of reporting regression equations has been maintained throughout this study.

TABLE 15

ESTIMATED PARAMETERS OF SECOND EQUATION OF MODEL: CLOSED ECONOMY

Country	λ	R^2	F	DW
Argentina	0.21 (0.17) (1.22)	0.10	1.50	2.05
Bolivia	0.06 (0.07) (0.85)	0.03	0.72	2.29
Brazil	0.006 (0.01) (0.49)	0.01	0.24	2.52
Colombia	-0.005 (0.03) (-0.17)	0.02	0.31	2.55
Costa Rica	0.012 (0.05) (0.23)	0.002	0.05	3.15
Dominican Republic	1.10* (0.20) (5.47)	0.57	30.00	1.98
Ecuador	0.95* (0.19) (5.02)	0.53	25.21	1.97
El Salvador	0.51* (0.18) (2.72)	0.24	7.36	2.08
Guatemala	0.41* (0.18) (2.17)	0.17	4.74	1.89
Honduras	0.79* (0.18) (4.35)	0.45	18.94	1.95
Venezuela	0.38* (0.16) (2.40)	0.20	5.78	1.97

TABLE 16

ESTIMATED PARAMETERS OF THIRD EQUATION OF MODEL: CLOSED ECONOMY

Country	Const.	b	R^2	F	DW
Argentina	0.37048E + 06	0.60*	0.92	217.40	1.21
	(0.17808E + 06	(0.04)			
	(2.08)	(14.745)			
Bolivia	118.50	0.55*	0.71	62.80	1.61
	(99.11)	(0.07)			
	(1.19)	(7.92)			
Brazil	3887.70	1.20*	0.88	193.78	0.70
	(4384.70)	(0.09)			
	(0.89)	(13.92)			
Colombia	5117.10*	-2.20*	0.94	432.97	1.74
	(581.80)	(0.11)			
	(8.80)	(-20.80)			
Costa Rica	30.09	0.77*	0.65	48.72	2.23
	(52.87)	(0.11)			
	(0.57)	(6.98)			
Dominican Republic	8.61	0.39	0.06	1.70	2.01
	(10.12)	(0.29)			
	(0.85)	(1.30)			
Ecuador	-339.93	3.64*	0.78	93.30	2.83
	(231.25)	(0.38)			
	(-1.47)	(9.66)			
El Salvador	23.64	0.36*	0.31	11.43	1.90
	(12.42)	(0.11)			
	(1.90)	(3.38)			
Guatemala	18.66*	0.62*	0.19	6.14	0.96
	(7.92)	(0.25)			
	(2.36)	(2.48)			
Honduras	2.62	1.20*	0.38	15.64	1.42
	(4.37)	(0.31)			
	(0.60)	(3.95)			
Venezuela	1112.90*	1.10*	0.40	16.83	1.07
	(189.34)	(0.28)			
	(5.90)	(4.10)			

Table 17 summarizes the result of the estimation of the fourth equation of the model which demonstrates the link between the nominal deficit and the rate of change in the price level. Equation (4) has the following form:

$$D_t = g_1 \left[P_{(t-2)} \frac{(P_{t-1} - P_{t-2})/(P_{t-2})}{\Delta \ln P_{t-1}} \right] \qquad (4)$$

The ordinary least-squares method has been used to estimate parameters of the first equation of the model. As Table 14 shows, the estimated parameter of λ, the speed of adjustment of expected price change to actual rate, meets our priori assumption regarding its value. It seems equation (1) captures well the relation between the rate of change in prices and the rate of monetary expansion for countries such as Brazil, Colombia, Costa Rica, and Guatemala. For countries like Argentina, Bolivia, and Dominican Republic, on average only 40 percent of the variation in price level is caused by monetary expansion. However, it appears that monetary expansion is not the engine behind increasing price levels in Ecuador, El Salvador, Honduras, and Venezuela, or at least the existing variables in our equation fail to show such a relationship.

Because of the existence of an endogenous variable on the right-hand side of the second equation of the model, parameters are estimated using the two-stage least-squares method. Again, whenever the parameter λ is significant, it satisfies our priori assumption of its value, i.e., $0 < \lambda < 1$. This equation does well for Dominican Republic, Ecuador, and Honduras in describing the relationship between monetary expansion and the rate of increase of the monetary base.

TABLE 17

ESTIMATED PARAMETERS OF FOURTH EQUATION OF MODEL: CLOSED ECONOMY

Country	g_1	R^2	F	DW
Argentina	2628.50*	0.97	610.50	1.51
	(106.38)			
	(24.71)			
Bolivia	33.69*	0.66	51.31	1.11
	(4.70)			
	(7.16)			
Brazil	639.42*	0.56	32.45	1.12
	(112.25)			
	(5.70)			
Colombia	-103.56*	0.42	18.19	2.15
	(24.28)			
	(-4.26)			
Costa Rica	17.12*	0.50	25.51	1.35
	(3.39)			
	(5.05)			
Dominican Republic	0.83*	0.30	11.22	2.60
	(0.25)			
	(3.35)			
Ecuador	13.80	0.13	3.63	2.20
	(7.24)			
	(1.90)			
El Salvador	4.55*	0.54	29.70	1.56
	(0.84)			
	(5.45)			
Guatemala	1.34*	0.32	12.11	1.09
	(0.38)			
	(3.48)			
Honduras	0.54*	0.20	6.41	1.28
	(0.22)			
	(2.53)			
Venezuela	27.40	0.02	0.77	1.60
	(31.30)			
	(0.88)			

Parameter λ is statistically significant except for Argentina, Bolivia, Brazil, Colombia, and Costa Rica, and the F-statistic exhibits poor explanatory power of variables for these countries. That is, the increase in money supply is caused by sources other than the monetary base. Introducing the open economy assumption could introduce additional sources which might be responsible for the increase in money supply. Equation (3) of the model relates the fiscal deficit to the rate of growth of the money supply. Since the rate of deficit is one of the endogenous variables in the model, for estimation of parameters of the third equation, the method of two-stage least-squares is appropriate. It seems for all countries under study except Dominican Republic, the increase in the rate of growth of the monetary base mainly has been caused by deficits. Except in the case of Colombia, the parameter b satisfies the priori assumption of nonnegativity.

The link between the price level and the nominal deficit has been summarized by the fourth equation of the model. Except for Ecuador and Venezuela, the equation exhibits a significant relationship between our endogenous and exogenous variables. The estimated parameter of g_1 for Colombia, even though significant, fails to exhibit the appropriate sign regarding our priori assumption, i.e., $\frac{\partial D_t}{\partial \Delta \ln P_t} > 0$. That is, as prices go up, the deficit decreases for this country, or, in other words, government gains from inflation. This could be explained in terms of an increase in the nominal value of progressive taxes.

The result of empirical testing reveals that, even though the countries under study experience inflation, the source of inflation is

not homogenous. The following generality can be made:

1. Except for Guatemala and Ecuador, the coefficient of real per capita gross domestic product at the same year is insignificant. That is, an increase in real gross domestic product will take some time, one or more years, in order to be felt in the economy. Therefore, people's demand for money balances in year t is independent of real per capita gross domestic product in the same year. An estimate of the parameter lagged period shows some significance in a few countries. That could be expected if people form their expectations adaptively and their demand for real per capita cash balances increases when the impact of increase in real GDP is felt in the economy.
2. Almost whenever the coefficient of last year's prices is significant, it has the appropriate sign, suggesting that people's demand for real per capita money balances is affected by last period's prices.
3. The speed of adjustment of expected price change to the actual rate varies from country to country. That could be due to differences in information in the countries under study and how the information is transmitted to the public.
4. When the variation in the money stock is not explained by variation in the monetary base, it could be due to changes in the money multiplier.
5. In most countries, an increase in the deficit caused base money to increase. When this phenomenon does not appear, it could be explained in terms of the effect of the other component of the

monetary base, net foreign assets. This could occur in the cases when the constant term, a, is large and significant and parameter b is either insignificant or very low.

6. In some countries where the price level does not cause the deficit, the deficit may cause prices to increase. This could explain the insignificance of parameter g_1 in equation (4) for a few countries.

In the next chapter, by introducing an open economy model and a foreign sector variable along with a test of causality between the deficit and the price level, some of these phenomenon will be answered.

CHAPTER IV

SELF-GENERATING NATURE OF INFLATION: OPEN ECONOMY CASE

In order to capture the effect on inflation of being an open economy, it is necessary to decompose the monetary base into a foreign exchange reserve and a domestic credit component (see Dornbusch 1980, chapter 1). These two constitute the sources of the monetary base. That is,

$$B = DC + NFA$$

where B is monetary base, DC is domestic credit, and NFA is net foreign assets.

In the model of Dutton (1971) money supply has been considered from the uses side. However, in the model of the present study, money supply is taken from the source side. That is,

$$B = DC + NFA \ .$$

Hence, the inflationary phenomenon and real income are considered to be exogeneous. In the model the following can be postulated:

$$M = f(y)$$

where M is import, and y is real gross domestic product.

Based on the exogeneity nature of y, M also is exogeneous. Further, the capital account of the balance of payment is ignored for simplification, and, since export is exogeneous, NFA can be defined as:

$$NFA = X - M \ ,$$

and so NFA is considered to be exogeneous in the system.

The growth rate of monetary base can be attributed to either the domestic credic component or to net foreign assets. An increase in the domestic credit component could be caused by monetizing the deficit, that is, financing government's deficit by borrowing from the central bank. An increase in net foreign assets is due to a balance of payment surplus; that is, an accumulation of foreign reserves in the country due to either an increase in exports or a reduction in imports. Hence:

$$NFA = X + R - M ,$$

where X is exports, R is net transfer receipts, and M is imports. Therefore, variations in exports and imports have a direct relationship with foreign assets and ultimately with the monetary base and the money stock.

It is important to outline the possible reasons which can cause variations in net foreign assets. As already mentioned, a change in net foreign assets could be positive. That would happen when the rate of growth of exports exceeds the rate of growth of imports when, for example, currency has been either devaluated or depreciated. Many Latin American countries have used devaluation policies in order to achieve a favorable balance of payments. When currency is devaluated, domestically produced goods are attracted to foreign countries; at the same time, foreign goods become expensive in terms of domestic currency. Devaluation of currency under a fixed exchange rate increasaes exports and decreases imports. Under the satisfaction of the Marshall-Lerner condition, another approach which has been used, especially by countries with floating exchange rates, is currency depreciation.

Both of these approaches increase exports and ultimately lead to accumulation of foreign reserves. An increase in reserves increases the monetary base and ultimately the money supply.

The model presented in Chapter III does not take into account the effect of the foreign trade sector due to its assumption of a closed economy. In this chapter, the effect of foreign trade will be incorporated into the model in order to be able to capture more realistically the monetary process and its impact on the rate of inflation.

The Model

Equation (1), the demand for real per capita money balances, and equation (4), the relationship between the deficit rate and prices, have not been affected by exposing the model to the open economy assumption. However, equation (3) of the model now takes the following form:

$$B_t = a + b\Delta DC_t + C\Delta NFA_t + e_{3t} \qquad (3)$$

where B_t is the monetary base in year t; ΔDC_t is the deficit at year t;[2] NFA_t is net foreign assets at year t; and a, b, and c are parameters, and both b and c are positive. Equation (2) of the model will not change. However, due to the existence of $\Delta \ln B_t$ as one of the explanatory variables, it will be estimated again. In order to calculate $\Delta \ln B_t$, the following relationship has been used:

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[2] Again, ΔDC has been taken as a proxy variable for the rate of deficit.

$$\Delta \ln B_t = \frac{a + b\Delta DC_t + C\Delta NFA_t}{B_{(-1)} + a(t+1) + b\sum_{i=0}^{t} \Delta DC_i + C\sum_{i=0}^{t} \Delta NFA_i}$$

Therefore, the value of $\Delta \ln B_t$ in the open economy model will be different than the one used in Chapter III. Equation (2) is

$$\Delta \ln M_t - \Delta \ln M_{t-1} = \lambda(\Delta \ln B_t + \Delta \ln M_{t-1}) + e_{2t} \ .$$

Now the complete model which describes the effect of both foreign trade and domestic policies upon inflation becomes:

$$\Delta \ln(NP/M)_t = -\beta\gamma + \alpha\beta(\Delta \ln P_{t-1}) + \beta(\ln(M/N)_{t-1} - \ln P_{t-1}) - q\ln(Y/N)_t + q(1-\beta)\ln(Y/N)_{t-1} + e_{1t} \qquad (1)$$

$$\Delta \ln M_t - \Delta \ln M_{t-1} = \lambda(\Delta \ln B_t - \Delta \ln M_{t-1}) + e_{2t} \qquad (2)$$

$$\Delta B_t = a + bD_t + C\Delta NFA_t + e_{3t} \qquad (3)$$

$$D_t = g_1 \left[(P_{t-2}) \frac{(P_{t-1} - P_{t-2})/(P_{t-2})}{\Delta \ln P_{t-1}} \right] + e_{4t} \qquad (4)$$

where ΔNFA_t is added to our list of exogenous variables.

Empirical Results

This section reports the results of estimated parameters of equations (2) and (3) which have been affected by exposing the model to the open economy assumption. In estimating both equations, the two-stage least-squares method has been chosen as the appropriate estimation technique. Tables 18 and 19 summarize the results.

Exposing the model to the open economy assumption has increased the explanatory power of the equation. However, parameter for Argentina has been changed from being insignificant in the closed model to being significant in the open model. Equation (3) in the

TABLE 18

ESTIMATED PARAMETERS OF SECOND EQUATION OF MODEL: OPEN ECONOMY

Country	λ	R^2	F	DW
Argentina	1.40*	0.70	34.48	2.15
	(0.24)			
	(5.87)			
Bolivia	0.10	0.06	1.56	2.23
	(0.08)			
	(1.25)			
Brazil	0.05	0.03	0.62	2.50
	(0.06)			
	(0.78)			
Colombia	0.014	0.02	0.52	2.53
	(0.02)			
	(0.72)			
Costa Rica	-0.002	0.0007	0.002	3.17
	(0.06)			
	(-0.04)			
Dominican Republic	0.82*	0.64	41.10	1.92
	(0.13)			
	(6.41)			
Ecuador	0.94*	0.63	39.92	1.80
	(0.15)			
	(6.32)			
El Salvador	0.59*	0.30	9.63	1.96
	(0.19)			
	(3.10)			
Guatemala	0.79*	0.65	41.97	1.74
	(0.12)			
	(6.48)			
Honduras	0.84*	0.64	41.50	2.45
	(0.13)			
	(6.44)			
Venezuela	0.48*	0.36	13.08	1.87
	(0.13)			
	(3.62)			

TABLE 19

ESTIMATED PARAMETERS OF THIRD EQUATION OF MODEL: OPEN ECONOMY

Country	Const.	b	C	R^2	F	DW
Argentina	0.18373E+06	0.80*	0.50*	0.98	407.75	1.88
	(98560.00)	(0.04)	(0.07)			
	(1.86)	(22.04)	(6.83)			
Bolivia	109.07	0.58*	0.08	0.71	31.18	1.47
	(100.66)	(0.08)	(0.10)			
	(1.08)	(6.96)	(0.77)			
Brazil	6040.30	1.40*	-0.55*	0.93	159.30	0.84
	(3548.80)	(0.08)	(0.14)			
	(1.70)	(17.22)	(-3.95)			
Colombia	4785.90*	-2.02*	0.06	0.95	212.20	2.03
	(764.37)	(0.33)	(0.09)			
	(6.26)	(-6.19)	(0.68)			
Costa Rica	35.52	0.75*	-0.08	0.66	23.87	3.35
	(53.76)	(0.12)	(0.14)			
	(0.60)	(6.44)	(-0.56)			
Dominican Republic	4.43	0.68*	0.48*	0.26	4.50	2.24
	(9.27)	(0.29)	(0.18)			
	(0.48)	(2.35)	(2.63)			
Ecuador	-251.02	2.94*	0.26*	0.81	53.86	2.75
	(223.80)	(0.49)	(0.11)			
	(-1.12)	(5.91)	(2.35)			
El Salvador	19.837	0.47*	0.16	0.36	6.90	2.19
	(12.50)	(0.13)	(0.11)			
	(1.59)	(3.63)	(1.40)			
Guatemala	10.16*	0.79*	0.46*	0.84	65.44	2.53
	(3.70)	(0.11)	(0.05)			
	(2.75)	(6.94)	(10.05)			
Honduras	1.53	1.12*	0.42*	0.80	49.95	2.74
	(2.52)	(0.18)	(0.05)			
	(0.61)	(6.34)	(7.28)			
Venezuela	976.48*	1.13*	0.13*	0.58	17.23	1.15
	(165.85)	(0.24)	(0.04)			
	(5.88)	(4.75)	(3.34)			

open economy model reveals some interesting results. Except for Bolivia, Colombia, Costa Rica, and El Salvador, the coefficient of net foreign asset, i.e., C, is significant. Variation in monetary base is caused by not only deficits but also by net foreign assets. However, the weight of change in the domestic credit component in variation of the monetary base exceeds the net foreign asset component.

The model presented in this chapter, though simple, helps to explain the monetary process in Latin American countries. Empirical results, even though different from country to country, suggest that both sources of the monetary base, that is, domestic credit component and foreign reserves, have been themain engine behind the increase in the money stock and eventually the rate of inflation. In a few countries where the estimated coefficient of these variables are not significant, the variation in base money could be attributed to either some structural changes in the country over time or to the existence of multicolinearity between the domestic credit component and net foreign assets. Furthermore, whenever the coefficient of the monetary base is not significant, i.e., the data does not show any relationship between the monetary base and the money stock, variation in the money stock could be explained in terms of changes in the money multiplier. The money multiplier for countries under study during 1950-80 is shown in Table 20. In those countries in which coefficients of both domestic credit component and foreign reserves are significant, without exception the magnitude of the domestic credit coefficient exceeds the foreign reserves coefficient. Thus, the major source of variation in the monetary base is domestic credit. In other words,

TABLE 20

MONEY MULTIPLIER (1950-80)

Year	Argentina	Bolivia	Brazil	Colombia	Costa Rica	Dominican Republic	Ecuador	El Salvador	Guatemala	Honduras	Venezuela
1950	0.67	1.25	2.00	1.50	1.65	1.42	1.26	1.27	1.15	1.68	1.33
1951	0.50	1.20	1.80	2.00	1.56	1.35	1.25	1.27	1.15	1.73	1.33
1952	0.80	1.10	1.67	1.63	1.56	1.38	1.24	1.31	1.11	1.30	1.39
1953	0.67	1.07	1.71	1.70	1.55	1.34	1.25	1.39	1.11	1.33	1.46
1954	0.71	0.96	1.67	1.69	1.59	1.21	1.32	1.45	1.11	1.25	1.50
1955	0.75	1.04	1.80	1.82	1.63	1.31	1.28	1.45	1.15	1.27	1.55
1956	0.70	1.07	1.83	1.86	1.63	1.26	1.30	1.49	1.14	1.31	1.54
1957	1.33	1.13	1.81	1.84	1.59	1.25	1.29	1.50	1.21	1.32	1.54
1958	3.00	1.16	1.84	1.78	1.59	1.44	1.32	1.46	1.25	1.33	1.49
1959	1.42	1.11	1.92	1.86	1.64	1.29	1.33	1.42	1.21	1.40	1.56
1960	1.57	1.05	1.86	1.95	1.57	1.22	1.37	1.40	1.19	1.37	1.48
1961	1.71	1.06	1.73	2.16	1.57	1.41	1.38	1.32	1.13	1.42	1.47
1962	1.67	1.10	1.74	2.66	1.67	1.31	1.36	1.35	1.17	1.44	1.61
1963	1.52	1.12	1.67	2.03	1.68	1.23	1.38	1.28	1.16	1.42	1.53
1964	1.53	1.10	1.68	1.87	1.71	1.16	1.36	1.27	1.15	1.46	1.67
1965	1.44	1.11	1.76	1.82	1.68	1.06	1.33	1.18	1.12	1.51	1.72
1966	1.52	1.12	1.61	1.94	1.71	0.99	1.34	1.18	1.08	1.50	1.71
1967	1.68	1.10	1.83	1.94	1.83	1.05	1.43	1.01	1.12	1.44	1.74
1968	1.62	1.12	1.79	1.71	1.76	1.07	1.44	1.02	1.21	1.43	1.67
1969	1.46	1.07	1.78	1.64	1.70	0.95	1.39	1.01	1.16	1.43	1.75
1970	1.45	1.08	1.90	1.64	1.83	0.98	1.33	1.00	1.11	1.39	1.82
1971	1.53	1.05	1.88	1.63	1.85	0.94	1.35	0.99	1.08	1.37	1.70
1972	1.78	1.12	2.16	1.68	1.74	1.00	1.30	0.99	1.01	1.47	1.81

TABLE 20. Continued

Year	Argentina	Bolivia	Brazil	Colombia	Costa Rica	Dominican Republic	Ecuador	El Salvador	Guatemala	Honduras	Venezuela
1973	0.56	1.07	2.13	1.68	1.84	0.95	1.24	1.03	1.05	1.52	1.74
1974	0.59	1.16	2.13	1.63	1.93	0.89	1.30	1.05	1.06	1.61	1.80
1975	0.62	1.09	2.29	1.56	1.79	1.03	1.42	1.04	1.03	1.53	1.91
1976	0.55	1.03	2.08	1.49	1.74	1.03	1.39	1.05	0.95	1.52	1.82
1977	0.89	0.99	1.92	1.38	1.48	0.95	1.52	1.05	1.00	1.47	1.88
1978	1.06	0.99	1.90	1.15	1.85	0.92	1.44	1.19	1.02	1.42	1.97
1979	1.40	1.05	1.77	1.11	1.32	1.09	1.43	1.17	1.07	1.39	1.91
1980	1.53	1.08	1.92	1.10	1.30	1.17	1.55	1.18	1.10	1.53	2.08

SOURCE: Computed from data presented in Tables 1 and 8.

monetizing the deficit by borrowing from the central bank is more expansionary than an increase in balance-of-payment surplus. Therefore, inflation is caused mostly by changes in the domestic credit component. Having a balance of payment in surplus could ease the deficit financing of the country by use of the credit component. It has been argued that money creation domestically is a function of foreign reserves. That is, a country finances the deficit by borrowing from the central bank if and only if the deficit exceeds the foreign reserves or when the balance of payments is in deficit. But due to existence of a time lag (usually one year) to generate information regarding balance of payments, deficits which occur during the year mostly are financed by borrowing from the central bank. Meanwhile, if a country, in the same year, experiences a favorable balance of payments, the result will be a monetary base which exceeds the desired level.

As already mentioned, devaluation helps a country in the short run in generating sufficient funds to offset its expenditures. However, in the long run, a favorable balance of payments due to devaluation may become a major problem through the inflow of foreign reserves and, as a result, an increase in demand for importable goods and exhaustion of the country's foreign reserves. One way to ease this problem is investing in import substitute goods and cutting back the level of imports.

Another problem which these countries are tied to is the difference between domestic and world prices. Due to their expansionary monetary policies, usually the domestic price exceeds the world price, causing an incentive to import or an increase in the demand for

importable goods. Since, by assumption, it is monetizing the deficit which causes an upward pressure in the price level, it is important to analyze the relationship between the price level and the deficit in order to be able to identify appropriate policy prescription. One way to analyze and understand the relationship between P and D is by conducting a causality test. This well-known test not only could help explain the process of money creation but also could help explicate the cases where equation (4) of the model has insufficient explanatory power.

Causality Between Deficit and Price

In using equation (4) of the model, one has to know whether causality runs from deficit to prices or from prices to deficit. With the introduction of the notion of Granger-Causality (Granger 1969), it is now argued that "tests for causality are indeed tests for exogeneity" (Greenberg and Webster 1983, p. 154) since the statistical properties of an exogenous variable are exactly those of a causality prior variable.[3] So a causality test of whether P causes D or D causes P may throw some light on the model.

One of the practical statistical tests of causality is the Granger test.[4] According to the definition of causality in a

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[3]Though on a philosophical ground, Zellner makes a distinction between causality and exogeneity; tests of causality yield some information about exogeneity.

[4]Among the three widely used tests of causality, viz., Granger test, Sims test, and modified Sims test, the Granger test has been confidently recommended to the practitioner by Guikey and Salemi (1982) on the basis of their study of small sample performance tests for causal ordering of bivariate time-series in the sense of Granger.

bivariate time-series model given by Granger (1969), D causes P if and only if P is better predicted by using the past history of D than by not doing so, with the past history of P being used in either case. The causality runs from P to D in the like way if and only if D is better predicted by using the past history of P than by not doing so, with the past history of D being used in either case.

There can be four possible cases. First, if D causes P and P does not cause D, it is said that causality exists from D to P. Second, in the opposite case, if P causes D and D does not cause P, causality exists from P to D. Third, if D does not cause P and P does not cause D, P and D are statistically independent. Fourth, if D causes D and P also causes D, it is said that feedback exists between P and D.

As an alternative, Geweke (1982) suggests a test of the Granger definition which directly utilizes ordinary least-squares regression on levels of series. That is, to test causality running from P to D, one can use the following specifications:

$$D_t = a_{10} + \sum_{J=1}^{P} a_{1j} D_{t-j} + e_{1t}$$

$$D_t = a_{20} + \sum_{j=1}^{P} a_{2j} D_{t-j} + \sum_{k=1}^{P} b_{2k} P_{t-k} + e_{2t}$$

where e_{1t} and e_{2t} are residuals, a_{1j} and a_{2j} are parameters relating D_t and its lagged values and b_{2k} are parameters relating D_t and past values of P_t.

Similarly, to test causality running from D to P, the following specification can be used:

$$P_t = a'_{10} + \sum_{j=1}^{P} a'_{1j} P_{t-j} + e'_{1t} \qquad (1)$$

$$P_t = a'_{20} + \sum_{j=1}^{P} a'_{2j} P_{t-j} + \sum_{k=1}^{q} b'_{2k} D_{t-k} + e'_{1t} \qquad (2)$$

The direct Granger test based on equations (1) and (2) is equivalent to testing the following null hypothesis:

$$b_{21} = b_{22} = \ldots b_2 = 0$$

$$b_{21} = b_{22} = \ldots b_2 = 0$$

which can be carried out with the following statistic:

$$F = \frac{SSE_1 - SSE_2}{q} \Big/ \frac{SSE_2}{N - p - q - 1}$$

where SSE_1 and SSE_2 refer to the sum of squared residuals from ordinary least-squares regressions on equations (1) and (2), respectively; and N is the number of time-series observations. Under the null hypothesis, F is distributed as F with (q, N - p - q - 1) degrees of freedom. For suitably large values of f, reject the hypothesis that p does not cause D using equations (1) and (2), and D does not cause p using equations (1') and (2'). A summary of tests for causality between D and p is presented in Tables 21 through 31 for countries under study for the period of 1950-80.

The results of the tests do, in fact, explain the shortcoming of equation (4) of the model in the case of a few countries. In countries such as Argentina, Brazil, Bolivia, and Costa Rica, there is a strong feedback effect between the rates of deficit and inflation; that is, p affects D and D affects p.

TABLE 21

TEST OF CAUSALITY BETWEEN D AND P IN ARGENTINA (1950-80)

Number of Lags	For Causality from P to D: Sum of Squared Residuals — In Constrained Equation	In Unconstrained Equation	Test Statistic	Status of the Null Hypothesis of no Causality
1	.456875E+14	.0943375E+14	$F^{1}_{18}=70.89$	Rejected
2	.462804E+14	.019613E+14	$F^{2}_{15}=169.47$	Rejected
3	.498508E+14	.00744719E+14	$F^{3}_{12}=215.42$	Rejected

Number of Lags	For Causality from D to P: Sum of Squared Residuals — In Constrained Equation	In Unconstrained Equation	Test Statistic	Status of the Null Hypothesis of no Causality
1	.J97313E+07	.4206T	$F^{1}_{18}=7.56$	Rejected
2	.28350E+07	308415	$F^{2}_{15}=61.44$	Rejected
3	.25478E+07	8813.78	$F^{3}_{12}=1152.18$	Rejected

SOURCE: Computed from data presented in Tables 3 and 10.

TABLE 22

TEST OF CAUSALITY BETWEEN D AND P IN BOLIVIA (1950-80)

Number of Lags	For Causality from P to D: Sum of Squared Residuals — In Constrained Equation	In Unconstrained Equation	Test Statistic	Status of the Null Hypothesis of no Causality
1	.275461E+08	.181163E+08	$F^{1}_{26}=13.53$	Rejected
2	.120786E+08	.0876119E+08	$F^{2}_{23}=4.35$	Rejected
3	.661665E+07	.315231E+07	$F^{3}_{20}=7.33$	Rejected

Number of Lags	For Causality from D to P: Sum of Squared Residuals — In Constrained Equation	In Unconstrained Equation	Test Statistic	Status of the Null Hypothesis of no Causality
1	3175.80	2006.60	$F^{1}_{26}=15.15$	Rejected
2	2910.24	935.107	$F^{2}_{23}=24.29$	Rejected
3	2597.48	896.280	$F^{3}_{20}=12.65$	Rejected

SOURCE: Computed from data presented in Tables 3 and 10.

TABLE 23

TEST OF CAUSALITY BETWEEN D AND P IN BRAZIL (1950-80)

Number of Lags	For Causality from P to D: Sum of Squared Residuals In Constrained Equation	In Unconstrained Equation	Test Statistic	Status of the Null Hypothesis of no Causality
1	.415923E+11	.294546E+11	$F^{1}_{26}=10.71$	Rejected
2	.399599E+11	.042505E+11	$F^{2}_{23}=97.27$	Rejected
3	.332939E+11	.0321089E+11	$F^{3}_{20}=62.46$	Rejected

Number of Lags	For Causality from D to P: Sum of Squared Residuals In Constrained Equation	In Unconstrained Equation	Test Statistic	Status of the Null Hypothesis of no Causality
1	227620	13878.3	$F^{1}_{26}=400.43$	Rejected
2	19754	2513.48	$F^{2}_{23}=78.88$	Rejected
3	19739	729.841	$F^{3}_{20}=173.64$	Rejected

SOURCE: Computed from data presented in Tables 3 and 10.

TABLE 24

TEST OF CAUSALITY BETWEEN D AND P IN COLOMBIA (1950-80)

Number of Lags	For Causality from P to D: Sum of Squared Residuals, In Constrained Equation	In Unconstrained Equation	Test Statistic	Status of the Null Hypothesis of no Causality
1	.185122E+10	.116696E+10	$F^{1}_{26}=15.24$	Rejected
2	.181929E+10	.0948359E+10	$F^{2}_{23}=10.57$	Rejected
3	.163841E+10	.0770386E+10	$F^{3}_{20}=7.52$	Rejected

Number of Lags	For Causality from D to P: Sum of Squared Residuals, In Constrained Equation	In Unconstrained Equation	Test Statistic	Status of the Null Hypothesis of no Causality
1	311.365	265.395	$F^{1}_{26}=4.50$	Rejected
2	310.443	261.163	$F^{2}_{23}=2.17$	Failed to reject
3	291.216	259.696	$F^{3}_{20}=0.81$	Failed to reject

SOURCE: Computed from data presented in Tables 3 and 10.

TABLE 25

TEST OF CAUSALITY BETWEEN D AND P IN COSTA RICA (1950-80)

Number of Lags	For Causality from P to D: Sum of Squared Residuals In Constrained Equation	In Unconstrained Equation	Test Statistic	Status of the Null Hypothesis of no Causality
1	.619323E+07	.453687E+07	$F^{1}_{26}=9.49$	Rejected
2	.615090E+07	.387337E+07	$F^{2}_{23}=6.76$	Rejected
3	.613768E+07	.22405E+07	$F^{3}_{20}=11.59$	Rejected

Number of Lags	For Causality from D to P: Sum of Squared Residuals In Constrained Equation	In Unconstrained Equation	Test Statistic	Status of the Null Hypothesis of no Causality
1	504.787	396.167	$F^{1}_{26}=7.13$	Rejected
2	399.944	287.276	$F^{2}_{23}=4.15$	Rejected
3	228.888	148.312	$F^{3}_{20}=3.62$	Rejected

SOURCE: Computed from data presented in Tables 3 and 10.

TABLE 26

TEST OF CAUSALITY BETWEEN D AND P IN DOMINICAN REPUBLIC (1950-80)

Number of Lags	For Causality from P to D: Sum of Squared Residuals In Constrained Equation	In Unconstrained Equation	Test Statistic	Status of the Null Hypothesis of no Causality
1	46124.7	25199.6	$F^{1}_{26}=21.6$	Rejected
2	43098.8	20966.0	$F^{2}_{23}=12.14$	Rejected
3	42083.9	16103.1	$F^{3}_{20}=10.76$	Rejected

Number of Lags	For Causality from D to P: Sum of Squared Residuals In Constrained Equation	In Unconstrained Equation	Test Statistic	Status of the Null Hypothesis of no Causality
1	317.902	305.002	$F^{1}_{26}=1.10$	Failed to reject
2	304.514	286.164	$F^{2}_{23}=0.74$	Failed to reject
3	295.716	132.337	$F^{3}_{20}=8.23$	Rejected

SOURCE: Computed from data presented in Tables 3 and 10.

TABLE 27

TEST OF CAUSALITY BETWEEN D AND P IN ECUADOR (1950-80)

Number of Lags	For Causality from P to D: Sum of Squared Residuals — In Constrained Equation	In Unconstrained Equation	Test Statistic	Status of the Null Hypothesis of no Causality
1	.446846E+08	.371751E+08	$F^{1}_{26}=5.25$	Rejected
2	.225718E+08	.112637E+08	$F^{2}_{23}=11.55$	Rejected
3	.217768E+08	.0879325E+08	$F^{3}_{20}=11.55$	Rejected

Number of Lags	For Causality from D to P: Sum of Squared Residuals — In Constrained Equation	In Unconstrained Equation	Test Statistic	Status of the Null Hypothesis of no Causality
1	145.075	144.768	$F^{1}_{26}=0.06$	Failed to reject
2	115.796	115.518	$F^{2}_{23}=0.03$	Failed to reject
3	109.868	83.5417	$F^{3}_{20}=2.10$	Failed to reject

SOURCE: Computed from data presented in Tables 3 and 10.

TABLE 28

TEST OF CAUSALITY BETWEEN D AND P IN EL SALVADOR (1950-80)

Number of Lags	For Causality from P to D: Sum of Squared Residuals In Constrained Equation	In Unconstrained Equation	Test Statistic	Status of the Null Hypothesis of no Causality
1	425733	251891	$F^{1}_{26}=17.94$	Rejected
2	397097	168364	$F^{2}_{23}=15.62$	Rejected
3	306351	158128	$F^{3}_{20}=6.25$	Rejected

Number of Lags	For Causality from D to P: Sum of Squared Residuals In Constrained Equation	In Unconstrained Equation	Test Statistic	Status of the Null Hypothesis of no Causality
1	257.462	247.259	$F^{1}_{26}=1.07$	Failed to reject
2	243.216	211.883	$F^{2}_{23}=1.70$	Failed to reject
3	216.228	187.441	$F^{3}_{20}=102.0$	Failed to reject

SOURCE: Computed from data presented in Tables 3 and 10.

TABLE 29

TEST OF CAUSALITY BETWEEN D AND P IN GUATEMALA (1950-80)

Number of Lags	For Causality from P to D: Sum of Squared Residuals, In Constrained Equation	For Causality from P to D: Sum of Squared Residuals, In Unconstrained Equation	Test Statistic	Status of the Null Hypothesis of no Causality
1	62420.5	42445.6	$F^{1}_{26}=12.24$	Rejected
2	62329.6	31410.1	$F^{2}_{23}=11.32$	Rejected
3	45798.9	16798.2	$F^{3}_{20}=11.51$	Rejected

Number of Lags	For Causality from D to P: Sum of Squared Residuals, In Constrained Equation	For Causality from D to P: Sum of Squared Residuals, In Unconstrained Equation	Test Statistic	Status of the Null Hypothesis of no Causality
1	218.253	216.149	$F^{1}_{26}=0.25$	Failed to reject
2	145.762	133.076	$F^{2}_{23}=1.10$	Failed to reject
3	140.512	123.304	$F^{3}_{20}=0.93$	Failed to reject

SOURCE: Computed from data presented in Tables 3 and 10.

TABLE 30

TEST OF CAUSALITY BETWEEN D AND P IN HONDURAS (1950-80)

Number of Lags	For Causality from P to D: Sum of Squared Residuals In Constrained Equation	In Unconstrained Equation	Test Statistic	Status of the Null Hypothesis of no Causality
1	15228.7	12727.9	$F^1_{26}=5.11$	Rejected
2	13483.1	11047.8	$F^2_{23}=2.53$	Failed to reject
3	9827.89	8997.47	$F^3_{20}=0.62$	Failed to reject

Number of Lags	For Causality from D to P: Sum of Squared Residuals In Constrained Equation	In Unconstrained Equation	Test Statistic	Status of the Null Hypothesis of no Causality
1	196.784	158.586	$F^1_{26}=6.26$	Rejected
2	175.625	117.343	$F^2_{23}=5.71$	Rejected
3	168.324	110.598	$F^3_{20}=3.48$	Rejected

SOURCE: Computed from data presented in Tables 3 and 10.

TABLE 31

TEST OF CAUSALITY BETWEEN D AND P IN VENEZUELA (1950-80)

Number of Lags	For Causality from P to D: Sum of Squared Residuals In Constrained Equation	In Unconstrained Equation	Test Statistic	Status of the Null Hypothesis of no Causality
1	.387968E+09	.369053E+09	$F^{1}_{26}=1.33$	Failed to reject
2	.384693E+09	.335099E+09	$F^{2}_{23}=1.70$	Failed to reject
3	.363723E+09	.322468E+09	$F^{3}_{20}=0.85$	Failed to reject

Number of Lags	For Causality from D to P: Sum of Squared Residuals In Constrained Equation	In Unconstrained Equation	Test Statistic	Status of the Null Hypothesis of no Causality
1	204.661	181.374	$F^{1}_{26}=3.34$	Failed to reject
2	175.326	132.263	$F^{2}_{23}=3.74$	Rejected
3	125.597	105.863	$F^{3}_{20}=1.24$	Failed to reject

SOURCE: Computed from data presented in Tables 3 and 10.

In Venezuela, the causality test does not show any relationship between D and p. In Guatemala, El Salvador, and Ecuador, causality runs from the rate of inflation to the deficit. In Colombia, the test shows feedback between p and D when the number of lags is one. As the number of lags increase, causality runs from p to D. Dominican Republic is different. Up to two lags has a causal effect, but for more than two lags there is a feedback between price level and deficit. In the case of Honduras, the test shows feedback between D and p for one lag, but as the number of lags increases beyond one, the test shows causality from D to p.

Except for Colombia, the results of the causality test correspond with the statistical significance of our estimated coefficients in equation (4) of the model. When the coefficient of g_1 is significant, causality is shown to run from p to D, and when causality is from D to p, the estimated coefficient of the variable is not significant. The test of causality implies the self-generating nature of inflation for those countries in which strong feedback exists between p and D.

The process implied when causality runs from D to p is that the country finances its deficit by borrowing from the central bank (if the change in foreign reserve is less than the rate of deficit) which causes an increase in the monetary base. An increase in the monetary base causes an increase in the money supply and ultimately an increase in the rate of inflation. Of course, a balance-of-payment surplus could ease the pressure on the monetary base. In those countries where causality runs from price level to deficit, the process can be explained in terms of an increase in government's annual expenditures

due to an increase in the rate of inflation. When nominal expenditures exceed government revenue, monetizing the deficit becomes unavoidable, and, therefore, the domestic credit component increases.

As has already been mentioned, in countries where there exists a strong feedback between rate of inflation and deficit, self-perpetuating inflation is implied. In those cases, an increase in the deficit is financed by borrowing from the central bank, which causes an increase in the monetary base. An increase in the monetary base increases the money stock and, ultimately, the rate of inflation. An increase in the rate of inflation has two effects: an increae in government expenditures, and an increase in the demand for importable goods. The country's reaction to these phenomena is, again, borrowing from the central bank to offset the deficit, and the process starts all over again.

As seen from the empical results, it is not possible in the context of this model to generalize regarding the self-generating nature of inflation in Latin America. In only a few countries from among those under study is the self-generating hypothesis supported. Therefore, it is the belief of the researcher that in some of the countries, factors other than those incorporated in the model, such as the capital account, might be causing the chronic rate of inflation in these countries, which is beyond the scope of the present study.

CHAPTER V

SUMMARY AND CONCLUSION

The argument that budget deficits are the main forces behind inflation has been widely accepted in economic literature. This study has tested the existing theory and has identified some shortcomings of that theory with the help of empirical data. The study is divided into three main parts. First, testing of the theory of the self-generating nature of inflation in Latin America; second, testing the contribution of foreign trade to the monetary process; and third, testing for causality between the deficit and the rate of inflation.

It is concluded that the government budget deficit plays an important role in determining the rate of inflation. Furthermore, the results from the open economy model suggest that it is not only the deficit which contributes to the rate of growth of the money supply and, ultimately, the price level but that the balance of payments and its variation also is a source of variation in the monetary base. However, it is important to note that the effect of an increase in the domestic credit component in order to finance the deficit is much more expansionary than is the effect of an increase in foreign revenues.

Another important conclusion of this study is that no generality can be made regarding the rate of inflation and its sources with respect to Latin American countries. In some countries the source of variation is only the domestic credit component while in others it is

only foreign reserves. In most, both contribute. Therefore, it appears that a balance-of-payments surplus helps these countries in two ways: (1) it eases the necessity of funding the deficit by borrowing from the central bank, and (2) it causes an induction of the production of the domestically produced goods. This is accomplished when the balance-of-payments surplus causes an increase in the income and this leads to an increase in the demand for both tradable and nontradable goods which, in turn, induces production of domestically produced goods.

It seems that the closed economy model explains fairly well inflation in a majority of countries tested. The results suggest that the major reason underlying ever-incresaing inflation is government's continuous borrowing from the central bank in order to offset its fiscal deficits. However, introducing net foreign assets to the second equation of the model (that is, exposing the model to the open economy assumption) increases both the explanatory power of the model and the F-statistics of the respective equations.

The test of causality between deficit and price level reveals interesting implications. The test shows a strong feedback between these two variables for some countries. In others, causality exists from price to deficit while in the remainder, causality runs from deficit to price. The causality test results support the statement already made that any generality regarding the self-generating nature of inflation in Latin America is wrong. Each of these economies suffer from inflation, but its extent and sources are different.

Policy Implications

The analysis and results of this study lead to the following suggested policies designed to bring both deficit and inflation at least to moderate levels:

1. Change in domestic component has been taken as the proxy for deficit. If change in base money is less than change in domestic credit, it follows that a part of the deficit has been financed by drawing down foreign exchange reserves. In a simple case, government can finance part of its deficit by selling gold to the public. This reduces money supply with the public and decreases the rate of inflation. Then as a policy prescription, it can be said that financing deficit by drawing down international reserves is contractionary.

2. The avoidance of inflation in Latin America will depend mainly upon the elimination of government deficit financed by central bank credit. In most of these countries public utilities, transportation, etc., are being subsidized by government. In order to reduce pressure on government expenditure, these entities should be required to charge actual full costs for services in order to operate without subsidization.

3. As above results suggest, financing deficit by borrowing from the central bank is much more expansionary than financing through foreign reserves. Therefore, an increase in the domestic credit component for the purpose of financing government's deficit should be considered only as a last resort.

4. Excess demand for goods and services as a result of too much money in the economy (actual money balances in excess of desired level) could be eased by increasing the production of goods and services in the economy. In many Latin American countries, as in other underdeveloped countries, the economy operates well below its capacity. Therefore, production can be increased with minimum cost by simply utilizing the available resources.

5. Since using domestic credit as a last resort requires a balance-of-payments surplus, policies directed to that, such as investing in import-substitute goods and export subsidies, should prove in reducing rates of inflation.

6. In many developing countries, including Latin American ones, governments rely heavily on indirect taxes as a major source of revenue. This could be the reason their revenue falls short of their annual expenditures. Since variation in the domestic credit component comes from variation in budget deficits, and given the latter as the most significant source of inflation (as this study suggests), the governments in these countries should formulate policies which insure balance of their budgets.

In conclusion, it should be noted that the stylized version of inflationary process as described above is an abstraction from reality in Latin American countries. A more elaborate model incorporating the capital account of balance of payments and/or making net foreign asset component of monetary base an endogenous variable might give a better explanation of the inflation process of these countries.

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