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MACROECONOMIC INSTABILITY OF THE LESS DEVELOPED COUNTRY ECONOMY WHEN BANK CREDIT IS RATIONED

by

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ABSTRACT

During the early 1980s, many less developed countries (LDCs) experienced a phenomenon which is not readily explicable using conventional macroeconomic theory: accelerating inflation coupled with output contraction. Moreover, arguments based on supply shocks do not adequately explain the performance of the LDCs over this period. In explaining the apparent anomaly of accelerating inflation coupled with output contraction, the model developed here assigns an important role to the availability of bank credit.

In many LDCs, the government fixes interest rates on bank deposits and loans. If rates on loanable funds are set below market clearing levels, this leads to credit rationing. Generally, firms must pay wages to workers in advance of the receipts from sales. Bank credit is needed to finance the hiring of labor when there are few alternative sources of finance. Loan availability can thus have a crucial impact on the supply of output. The credit constraint is exacerbated when the government's fiscal deficit instigates inflationary pressure. In response, households reduce deposit holdings leading to a contraction in loan availability and recession.

Initially, the fiscal deficit and the money supply are assumed to be exogenously determined. Later, the analysis examines a feedback effect of inflation leading to increases in the fiscal deficit and further inflationary pressure. As inflation accelerates, individuals try to shift out of money balances and into inflation hedges contracting the real money supply, real loan availability, and output. Thus the model suggests an explanation for the vicious circle of accelerating inflation and declining output which is observed in many LDCs.

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David F. Spigelman*

1. Introduction

The inflation rates of the advanced industrial countries slowed significantly in the early 1980s from the high rates established during the 1970s. Paradoxically, inflation accelerated dramatically in many less developed countries even as the world economy moved into recession and inflation decelerated in the industrial countries. Moreover, a drop in the demand for the exports of the less developed countries (LDCs) by the industrialized countries coupled with a rapid rise in both nominal and real (ex post) interest rates on their foreign debt represented a precarious situation for many countries.

The performance of different LDCs in the wake of these shocks was not at all uniform. Some countries managed to continue servicing their foreign debt and maintained reasonably high rates of growth despite these adverse developments, while others experienced severe dropoffs in their growth rates, accelerating inflation, and an inability to maintain the smooth servicing of foreign debt.

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As an example of diverging economic performances, the experience of many of the Latin American economies can be contrasted with that of the East Asian countries over this period. It is well known that several of the Latin American countries were unable to maintain their scheduled debt service obligations during 1982 and 1983. These countries were also subject to slow and even negative growth rates at times, while inflation accelerated rapidly. In contrast, a number of East Asian countries maintained substantially higher rates of growth with lower inflation, and were able to continue servicing foreign debt on schedule.

This research addresses a subset of these phenomena. In particular, it develops an analytical framework for an understanding of the factors that can lead to a situation of accelerating inflation coupled with output contraction in LDC economies. The model places emphasis on the importance of the availability of bank credit to finance investment in working capital when alternative sources of finance are limited and inputs to the production process must be paid for in advance of sales.

The process which generates fiscal deficits is also analyzed. The model suggests how large and persistent fiscal deficits can set off a contraction of the economy coupled with accelerating inflation when the productive sector is unable to produce the economy's notional demand for output due to a shortfall in credit availability.

Section two of this paper attempts to characterize the economic performance of the Latin American and East Asian countries during the early 1980s in order to develop an understanding of what the model should explain. Section three develops a structural model of the

LDC economy under credit rationing and examines the response of the economy to perturbations when the fiscal deficit and the money supply are determined exogenously. Section four examines the response of the LDC economy to shocks when the fiscal deficit increases in response to inflationary pressure and is financed through money creation. Finally, a synthesis of the theory with recent historical experience is presented in section five to test the compatibility of the theory with the evidence.

2. Performance of the Latin American and East Asian Countries During the Early 1980s

The early part of the 1980s was a period of severe recession for the world economy, led by a decline in economic activity in the industrial countries, especially the United States. Many less developed countries experienced a decline in the terms of trade for their exports as well as a rise in interest rates on their mainly dollar-denominated debt. As has been suggested above, the East Asian countries performed better in the wake of these shocks than the Latin American countries as a group.

This section of the paper examines the relative economic performance of the two regions. Particular attention is paid to the three major Latin American countries that experienced debt service interruptions during the early 1980s: Argentina, Brazil and Mexico. Their economic performance is contrasted with three East Asian countries which were also highly indebted and beset by adverse shocks: Korea, Indonesia, and Thailand. These countries were broadly representative of the other countries in their respective regions with respect to their experience over this period. However, the analysis presented here is not intended to suggest that economic performance is a region-specific characteristic, but instead is related to governmental policy and the ability to maintain fiscal balance in the face of inflationary pressure. This will be further developed in the theoretical part of the paper, section three.

Table 1 shows that annual real GDP growth was much higher, on average, for a group of five East Asian countries than for a comparable group of five Latin American countries during 1981-82. The Latin American countries show an average real growth rate of -1.4 percent, while the East Asian economies show an average real growth rate of 5.2 percent. From Table 2, one can see that this trend continued into 1983 (and 1984 where data are available) comparing the East Asian countries of Indonesia, Korea, and Thailand with Mexico, Brazil, and Argentina.

Annual inflation was much lower in the East Asian economies than in the Latin American economies over the years 1979 to 1984. In Table 1, we find that for the period from 1979 to 1983, the average inflation rate among the five Latin American countries was 57 percent, whereas the East Asian economies averaged only about 13 percent. Moreover, Table 2 shows that the Latin American countries experienced a rapid acceleration of inflation over this period, while the East Asian countries saw stable or declining inflation rates.

An important difference between the two groups of countries can be seen in Table 3. The East Asian countries had significantly smaller budget deficiets as a percentage of GDP, and their deficits were less susceptible to widening in response to the adverse shocks which they experienced over this period. The East Asian countries had an average budget deficit of 3 percent of GDP during 1979-80. This increased slightly to about 4 percent during 1981-83. The Latin American countries under consideration averaged about 7 percent during 1979-80, increasing by about 5½ percentage points to 12½ percent of GDP during 1981-83.

Another interesting difference between the East Asian and Latin American countries over the early 1980s can be seen in movements in the real availability of commercial bank credit (Table 4). Argentina, Brazil, and Mexico all saw a dropoff of the real availability of bank credit in 1982 and 1983, while the East Asian countries experienced increases in the availability of bank credit over the 1980s as inflation slowed in these countries and their real money supplies grew.

We have provided here an overview of the experiences of these countries over the period of the early 1980s. At this point we turn to the development of the theoretical model which attempts to give some insight into the economic histories of these two regions.

TABLE 1

Country	Annual Real GDP Growth (Percent per year) (1981-82)	Annual Inflation (Percent per year) (1979-82)
Argentina	-5.6	130.5
Brazil	-0.3	83.6
Chile	-4.8	24.1
Mexico	3.6	32.0
Venezuela	0.2	14.8
Average	-1.4	57.0
Indonesia	5.1	15.5
Korea	6.2	18.6
Malaysia	6.4	6.4
Philippines	3.2	14.7
Thailand	5.2	11.8
Average	5.2	13.4

Source: **IMF International Financial Statistics.**

TABLE 2

Real GDP Growth Rates
(percent per year)

	1979	1980	1981	1982	1983	1984
Indonesia	6.2	9.9	7.9	2.3	4.2	7.6
Korea	7.3	-2.9	6.9	5.5	9.5	7.9
Thailand	6.1	5.7	6.3	4.1	5.9	6.0
Argentina	6.8	0.9	-6.3	-4.8	3.3	2.5
Brazil	6.4	7.2	-1.6	1.0	-3.2	4.4
Mexico	9.1	8.3	8.0	-0.6	-4.7	3.5

Inflation Rates
(rate of change in the CPI in percent per year)

	1979	1980	1981	1982	1983	1984
Indonesia	21.9	18.5	12.2	9.5	11.8	10.4
Korea	18.3	28.7	21.3	7.3	3.4	2.3
Thailand	10.0	19.6	12.7	5.2	3.7	0.9
Argentina	159.4	100.8	104.5	164.7	343.8	626.7
Brazil	52.8	82.8	105.6	98.0	142.0	196.7
Mexico	18.1	26.4	27.9	59.0	101.9	65.5

Source: **IMF International Financial Statistics**

TABLE 3

Fiscal Deficit as a Percentage of GDP

	1979	1980	1981	1982	1983
Indonesia	3.8	3.2	2.9	5.4	5.5
Korea	1.4	4.1	3.4	5.0	3.9
Thailand	2.4	3.4	2.5	4.9	4.1
Argentina	7.3	8.4	14.1	14.5	15.6
Brazil	N.A.	5.9	7.2	10.5	N.A.
Mexico	7.1	7.5	14.9	17.7	8.2

Source: Balassa and McCarthy (1984), based on data from the IMF and World Bank Data banks. Data for Brazil is from the World Bank, **Brazil: Economic Memorandum**, and includes the deficit of public enterprises.

TABLE 4

Real Commercial Bank Credit Availability Index
(1980 = 100)

	1980	1981	1982	1983	1984
Argentina	100	82	18	23	34
Brazil	100	99	94	68	75
Mexico	100	121	102	82	90
Indonesia	100	118	127	144	173
Korea	100	115	142	167	180
Thailand	100	108	135	163	210

Bank credit availability is calculated by taking money plus quasi-money minus required reserves from the IMF **International Financial Statistics**, and dividing by the wholesale price index, except for Indonesia for which the CPI was used due to data limitations. Note that the above numbers should only be interpreted as index numbers which are useful in examining trends in bank credit availability.

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3. Theoretical Development

This section of the paper presents a model of the response of the LDC economy to various disturbances in the presence of rationing of bank credit. This model can be contrasted with the predictions generated from more conventional macroeconomic analysis. It offers an explanation for why we observe output contracting at the same time inflation is accelerating in many LDCs.

Some earlier work has addressed this issue. McKinnon (1973) suggests how the credit constraint can impinge on the supply capability of the economy and aggravate inflationary pressure in less developed countries attempting orthodox stabilization programs (McKinnon, ch. 7). Blinder (1985) formalizes the notion of a credit constraint on effective supply. He utilizes a "credit multiplier" whereby banks are assumed to reduce excess reserves and increase loans as the economy expands to get the dynamics of his model. As will be seen, the model presented here employs a different approach where individuals allocate their portfolio in a rational expectations framework and this, in turn, determines credit availability.

The following assumptions give the model its basic character:

1) Households hold wealth in the form of only two assets: money/time deposits and the single good produced in the economy which is both a consumption good and serves as a hedge against inflation. Since we are not trying to model the capital accumulation process here, we can assume that there is no equity or, alternatively, that there is a fixed distribution of the ownership of firms which does not affect households' portfolio decisions.

2) The government sets the maximum rate of interest payable on time deposits as well as the maximum rate of interest on bank loans. These interest ceilings are assumed to be binding; the interest rate on bank loans is a non-market clearing rate of interest and there is an excess demand for bank loans. Thus, there are no interest rate effects on output as long as this type of credit rationing obtains.[1]

3) Production requires both fixed capital and labor. Labor is assumed to be in excess supply at institutionally fixed real returns.[2] Moreover, labor must be paid prior to the receipts from final sales.[3]

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[1]The model developed here would also be applicable if Stiglitz-Weiss (1981) type credit rationing obtains wherein the interest rate set by banks does not clear the market for loans and an excess demand for loans can persist. Their argument for why banks might set a non-market clearing interest rate is based on problems of moral hazard and adverse selection among borrowers.

[2]One can think of these fixed real returns as being either the wage which industrial workers are able to attain for themselves through bargaining or possibly a minimum subsistence wage.

[3]Alternatively, one could imagine a two-sector economy; one sector in which labor does not require payment in advance (the "unorganized" sector), and an "organized" sector wherein labor must be paid in advance. Supposing the organized sector offered greater rates of return than the unorganized sector, it would be desirable for all production to take place in the organized sector. Hence, the efficiency of the economy would be related to the availability of credit to finance production in the organized sector. While tis model might add a touch of realism to the story we are trying to tell, the results should be similar to the single sector model developed here.

4) The economy is endowed with a stock of fixed capital which is not utilized to its full capacity as long as the availability of credit is a binding constraint on the production of output.

5) Capital markets are assumed to be poorly developed and thus all borrowing takes place through the commercial banking system.[4]

6) Firms are assumed to distribute all profits at the end of each production period. Thus, firms do not retain earnings and must borrow through the commercial banking system to finance the hiring of labor.[5]

7) Production is roundabout in the sense that the production process takes time and inputs employed in this period produce output next period.[6]

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[4]This assumption could be relaxed to allow for some firms to have access to the organized non-bank capital markets or to include a "curb market" for credit alongside bank credit (e.g., moneylenders, loan sharks, private credit pools). In practice, the organized capital markets in less developed countries are small and underdeveloped. With regard to the curb market for credit, it should be possible to construct models which include this market and still yield similar results to those to be presented here, as long as either transaction/information costs are high in the curb market and/or access to curb market lending is not accessible to all asset holders in the economy. It was decided to make the assumption of no curb market to maintain simplicity.

[5]This assumption is made to emphasize the effect of the credit constraint on output in the starkest manner possible.

[6]The assumption of a time lag in production is not critical. What is necessary is that payments to labor must be made in advance of sales, if only instantaneously.

8) The notional supply curve of output is infinitely elastic at prevailing prices as long as output is below potential output and the economy is operating with excess capacity in production and excess supplies of labor at fixed real returns. The effective supply of output, on the other hand, is constrained by the availability of bank credit to finance labor inputs.

9) Economic agents are assumed to form expectations rationally taking into account all information available at the time expectations are formed.

Consider an economy with underdeveloped capital markets and only two assets which are held by households:

1) money/time deposits, M, which pay a rate of interest, n, which we shall assume is constant in the short run and is fixed by the government, and,

2) inflation hedges, H, which pay no interest. The real value of inflation hedges is invariant to changes in the price level.

The demand for money can be represented as follows:

(1) $$\left(\frac{M}{P}\right)_t^d = M\,(\underset{+}{n - E_t\pi_{t+1}},\ \underset{+}{Y_t})$$

Money demand is a function of the difference between the nominal rate of interest on money holdings, n, and the expected rate of inflation from time to to time t+1, $E_t\pi_{t+1}$, with expectations taken at time t. (π_t is defined as $\frac{P_t - P_{t-1}}{P_{t-1}}$, where P_t represents the price level at time t). Expected inflation here represents the opportunity cost of holding money when the alternative asset is an inflation hedge.[7] Money demand is also positively related to real income at time t.

The notional demand for wealth is given by:

$$(2) \qquad W_t^d = W_{t-1}^a + sY_t = (\frac{M}{P})_{t-1} + H_{t-1} + sY_t$$

where W_t^d is the notional demand for wealth at time t, W_{t-1}^a is actual wealth at time t-1 ($(\frac{M}{P})_{t-1} + H_{t-1}$), and s is the (constant) marginal propensity to save out of current income.[8] Thus, households would like to add to their wealth by a constant fraction of current income in each period. The demands for the two assets must sum to the notional demand for wealth:

$$(3) \qquad (\frac{M}{P})_t^d + H_t^d = W_t^d$$

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[7]In LDCs which do not have well developed bond markets, the alternative asset to money holdings cannot be represented as bond holdings, as in conventional macro models. Real goods tend to be the primary alternative store of wealth to money holdings.

[8]Note that wealth here is really a measure of liquid wealth and does not include equity holdings.

This can be rewritten as:

(4) $$H_t^d = W_t^d - (\frac{M}{P})_t^d$$

The notional demand for output (Q_t) is modeled as a simple consumption function plus the difference between desired inflation hedges and actual inflation hedge holdings last period. This last term is incorporated into notional demand because inflation hedges represent a demand for the single commodity produced in the economy. Thus:

(5) $$Q_t = A_t + b\, Y_t + H_t^d - H_{t-1}$$

where A_t represents a shock to notional demand which can come from either fluctuations in autonomous consumption expenditures or in the size of the government's fiscal deficit, b is the constant marginal propensity to consume out of current real income, and H_t^d represents desired inflation hedge holdings at time t.

As discussed earlier, the single good produced in the economy requires the use of labor and fixed capital in the production process. Since the economy is characterized by excess capacity and there is a lag in production, output at time t is a function of real expenditures on labor inputs (L) at time t-1:

(6) $$Y_t = \alpha\, L_{t-1}$$

$\alpha > 1$ can be assumed to hold at all times because firms utilize both fixed capital and labor in production. Labor would not be hired at all if the value of production doesn't cover the wage bill.[9]

If credit is rationed in the sense that there is an excess demand for loans at current interest rates, the credit constraint becomes the binding constraint on the hiring of labor inputs. In this situation, there is an identity between the hiring of labor and real loan availability.

Assuming for the time being that there is no discounting by the central bank, the balance sheet for the commercial banking system can be represented as follows:

Assets	Liabilities
Required reserves (rM)	Deposits (m)
Loans (C) = M (1-r)	

where r represents the average required reserve ratio on bank deposits, C represents the nominal value of bank loans in the system, and M represents nominal money/time deposits. The real employment of labor in the rationed regime is given by:

$$L_t = (\frac{C}{P})_t = (1 - r)\ (\frac{M}{P})_t \tag{7}$$

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[9]It is not necessary to assume a fixed output/input ratio to get the results to be presented here. The assumption of a constant alpha is made to simplify the exposition.

Combining (6) and (7) we get:

(8) $$Y_t = \alpha\,(1 - r)\,(\frac{M}{P})_{t-1}$$

Thus, in the credit-rationed regime output at time t is determined by the real money supply at time t-1.

The rate of inflation at time t is postulated to be a function of the difference between the notional demand for output at time $t(Q_t)$ and the effective supply of output at time t (Y_t):

(9) $$\pi_t = \beta\,(Q_t - Y_t)$$

In other words, if notional demand is greater than the effective supply of output, inflation jumps to equate actual demand with effective supply. It should be noted that this equation is not intended to suggest that there is any kind of steady state trade-off between output and inflation. This should become obvious when the model is further developed. In fact, higher levels of inflation will be associated with lower output levels in equilibrium under credit rationing.

Substituting (4) and (5) into (9) one gets:

$$\pi_t = \beta\,[A_t + b\,Y_t + W_t^d - (\frac{M}{P})_t^d - H_{t-1} - Y_t]$$

Using (2) this can be rewritten:

(10) $$\pi_t = \beta\,\{A_t - [(\frac{M}{P})_t^d - (\frac{M}{P})_{t-1}] + (b + s - 1)\,Y_t\}$$

Since b is the marginal propensity to consume and s is the marginal propensity to save, $b + s < 1$.[10] Increases in the inflation rate can be seen to arise from three factors: 1) increases in the demand shock term, A_t, 2) money demand falling below the level of real money balances last period, (as people try to switch out of money holdings and into inflation hedges they bid up the price level), and 3) decreases in output, (holding real money demand equal to last period's real money supply). If output drops, aggregate demand tends to decline as well, but not proportionally, leading to an imbalance between supply and demand forces and higher inflation.

Using (8), (20), and (1), we find the partial derivative of inflation at time t with respect to real money balances at time t - 1:

$$(11) \quad \frac{\partial \pi_t}{\partial (\frac{M}{P})_{t-1}} = \beta \, \alpha \, (1 - r) \, [\, b + s - 1 - \frac{\partial M}{\partial Y_t} + \frac{1}{\alpha \, (1 - r)} \,]$$

Increases in the money supply affect both the supply side and the demand side of the economy. Raising the real money supply can be inflationary or deflationary depending on the sign of this partial derivative. This depends on the responsiveness of money demand to changes in income as well as the magnitude of the marginal propensities to save and consume and the productivity of labor. It should be noted here that this ambiguous sign is at odds with more conventional macro models which generally suggest that increases in the money supply are

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[10] In an economy with a positive marginal tax rate $b + s + t = 1$, where t is the marginal tax rate.

unambiguously inflationary. The reason that money can be deflationary in this model is because the size of the real money supply is directly related to bank credit availability and output in the credit rationed economy. Any move that eases the credit constraint increases real output and tends to be deflationary.

If we estimate values for the parameters in (11), our presumption is that the partial derivative is positive. Suppose b + s = 0.75, (the sum of the marginal propensities to consume and save being 0.75 implies a marginal tax rate of 0.25). $\frac{\partial M}{\partial Y}$ can be approximated as M/Y if the income elasticity of the demand for real money balances is one. We estimate the value of M/Y as being 0.25, a typical figure for developing countries. We choose a value of 1.5 for α, which may seem high but biases the estimate against our presumption of the partial derivative being positive. Finally, required reserve ratios can be estimated at 20 percent of deposits. Substituting into (11), we find that the sign of the partial derivative is positive: $0.75 - 1 - 0.25 + 0.83 = 0.33 > 0$. Note that a positive value is not crucial to the analysis, but estimating a value for this partial derivative does lend to the ease of exposition.

Assuming that the parameters b, s, and α are constant as well as the exogenously fixed required reserve ratio, r, and the rate of interest on bank deposits, n, we can log-linearize equation (10) (the algebraic details are worked through in the appendix):

$$(12) \qquad p_t = \mu_1 E_t p_{t+1} + \mu_2 p_{t-1} + \delta_1 a_t + \delta_2 m_{t-1}$$

where $0 < \mu_1 < 1$, $\mu_2 \gtreqless 0$, $\delta_1 > 0$, and $\delta_2 \gtreqless 0$. Lower-case letters indicate the logs of variables.

The signs of μ_2 and δ_2 depend on the sign and magnitude of the partial derivative in equation (11). Using the presumption that the partial derivative is positive, we can further restrict the parameter values for μ_2 and δ_1 to be: $0 < \mu_2 < 1$ and $0 < \delta_1 < 1$. (See appendix).

In equation (12), a_t represents a shock to notional demand emanating either from shocks to the autonomous component of consumption expenditures or the government's fiscal deficit.

Money growth can be characterized as follows:

$$m_t = m_{t-1} + v_t$$

where v_t represents an exogenous shock to money growth.

We guess a solution to (12) of the following form:

$$p_t = \zeta\, p_{t-1} + \eta\, m_{t-1} + \Phi\, a_t + \sigma\, v_t \qquad (13)$$

We can solve the difference equation by advancing (13) one period, taking expectations and making the appropriate substitutions into (12).[11] When we solve this equation for the coefficients one gets:

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[11] See appendix for a fuller algebraic presentation.

$$\zeta = \frac{1 \mp \sqrt{1 - 4(\mu_1)(\mu_2)}}{2\mu_1} \qquad \sigma = \frac{\mu_1 \eta}{1 - \mu_1 \zeta - \mu_1 \rho_2}$$

(14)

$$\Phi = \frac{\delta_1}{1 - \mu_1 \zeta - \mu_1 \rho_1} \qquad \eta = \frac{\delta_2}{1 - \mu_1 \zeta - \mu_1}$$

Consider the homogeneous part of the difference equation (13). The characteristic polynomial is given by:

$$\lambda - \zeta = 0 \text{ , which implies } \zeta_1 = \lambda_1 \text{ , } \zeta_2 = \lambda_2$$

where λ_1 , λ_2 are the roots of the characteristic polynomial. Suppose $|\lambda_1| > 1$ and $|\lambda_2| < 1$. In this case, the difference equation would have a unique solution similar to that of a saddlepath solution in many continuous time rational expectations models. The unique solution is found by setting the initial condition associated with the unstable root equal to zero.

We can represent demand shocks and money shocks as infinite order moving averages of a serially uncorrelated random disturbance term as follows:

$$a_t = \sum_{i=0}^{\infty} \theta_{1i} \varepsilon_{t-i} \qquad v_t = \sum_{i=0}^{\infty} \theta_{2i} \varepsilon_{t-i}$$

Persistence in the disturbance term can be characterized as: $\theta_{1i} = (\rho_1)^i$, and similarly for money shocks: $\theta_{2i} = (\rho_2)^i$ We can also represent the other variables in (13) as infinite order moving averages in the disturbances as follows:

$$p_t = \sum_{i=0}^{\infty} \gamma_i \, \varepsilon_{t-i} \qquad p_{t-1} = \sum_{i=0}^{\infty} \gamma_i \, \varepsilon_{t-i-1}$$

We also note that $m_{t-1} = m_{t-2} + v_{t-1} = m_{t-3} + v_{t-2} + v_{t-1} \cdots\cdots$ In the limit this goes to: $m_{t-1} = \sum_{j=1}^{\infty} v_{t-j}$.

By substituting the moving average representations for p_t, p_{t-1}, v_t, and a_t into (13) and equating coefficients, we arrive at the following set of equations:

(15) $$\gamma_0 = \Phi \, \theta_{10} + \sigma \, \theta_{20}$$

(16) $$\gamma_i = \zeta \, \gamma_{i-1} + \eta \, (\theta_{20} + \cdots\cdots + \theta_{2i-1}) + \Phi \, \theta_{1i} + \sigma \, \theta_{2i} \qquad i = 1, 2, \ldots$$

Finding the solution for the γ_i terms gives us the elasticity of the response of the price level to disturbances at various lags. For example, $\gamma_0 = \frac{dp_t}{d\varepsilon_t}$ and $\gamma_s = \frac{dp_{t+s}}{d\varepsilon_t}$.

Using the tools we've developed so far, we can analyze the response of the economy to various exogenous disturbances. The following examples utilize guesses for the parameters of the model and suggest the path that the economy will follow in response to a demand shock and a monetary shock.

EXAMPLE ONE: A one percent increase in the autonomous component of notional demand which is temporary and unanticipated. (The fiscal deficit and money supply are assumed to be exogenously determined. We also assume that we start from a position of credit-rationed equilibrium; i.e. output is below the full employment level of output and there is an excess demand for credit at the exogenously fixed interest rate on loans.)

In this example, $\theta_{10} = 1$, $\theta_{1i} = 0$ for $i > 0$, $\theta_{2i} = 0$ for all i. Equations (15) and (16) become:

$$\gamma_0 = \Phi\,\theta_{10} = \Phi$$

$$\gamma_{i+1} = \lambda_2\,\gamma_i = \zeta_2\,\gamma_i \qquad i = 0, 1, 2, \ldots..$$

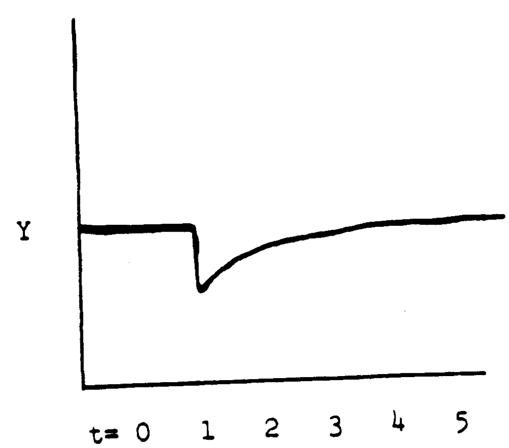
We recall that $0 < \mu_1 < 1$, and $0 < \mu_2 < 1$ and $0 < \delta_1 < 1$ are reasonable approximations for the reduced form parameters. Suppose the parameters are as follows:

$$\mu_1 = \frac{1}{2}\ , \qquad \mu_2 = \frac{1}{5}\ , \qquad \delta_1 = 0.8$$

By substituting into (14), we find that $\zeta_2 = \lambda_2 = .23$ and $\Phi = 0.90$. The γ_i terms are computed to be the following:

	i = 0	1	2	3	4	5
γ_i	0.90	0.20	0.05	0.01	0.00	0.00

With the fiscal deficit and money supply exogenously determined, and with the estimated values for the parameters, a rise in the level of the autonomous component of demand causes a rise in the price level for a few periods. Because the increase in demand is expected to be temporary, rational agents in the economy expect the price level to return to its previous level. The expected deflation leads individuals to increase their demand for money. People try to sell off their inflation hedges to acquire money balances and this drives down the price level and leads to an increase in the real money supply back toward its initial level. In the credit-rationed regime, we find that output decreases at first (after the one period lag) due to the drop in the real money supply when the price level increases, but eventually the economy returns to the initial equilibrium level of output as the price level returns to its initial level. (The path of output over time is graphed below):



EXAMPLE TWO: An unanticipated temporary increase in the rate of growth of the nominal money supply. Again the fiscal deficit and money supply are assumed to be exogenously determined, and we assume that we are starting from a position of equilibrium under credit rationing.[12]

As in example one, if a stable credit rationed equilibrium exists, it is uniquely determined by equation (1), the money demand function. Since expected inflation is equivalent to actual inflation in equilibrium and output depends on real money balances, there is a unique level of money balances (and thus output) associated with each steady state rate of inflation.

Thus with rational expectations, a temporary increase in the growth rate of nominal money should lead to the same expected equilibrium level of output as the initial equilibrium, if the system is stable. A temporary disturbance to money growth should have at most a transitory impact on real output levels.

In this example, we impose the condition that the only equilibrium which is possible under credit rationing is the initial equilibrium level of output. For the parameter values which we utilize here, this means that $\delta_2 = 0.30$.

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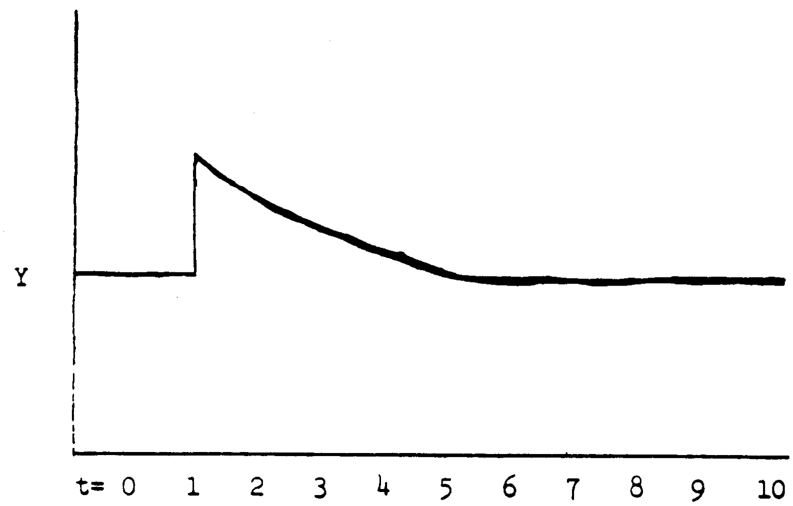
[12]In this example, the assumption that the fiscal deficit and the money supply are exogenously (and independently) determined must mean that the central bank expands the money supply through discounting to member banks, since reserve requirements are assumed constant. We make the simplifying assumption that the central bank requires reserves on discounts in the same proportion as deposits. Thus discounting leads to the same expansion of credit availability as would an increase in deposits.

Persistence in the disturbance term is characterized as: $\theta_{2i} = \rho_2^i$. ($\theta_{1i} = 0$ for all i). We also suppose $\rho_2 = 0.5$.

Using (14), we find that: $\eta \doteq 0.78$ $\sigma \doteq 0.61$. Substituting into (15) and (16), we can calculate the values for the γ_i terms. The γ_i terms, which represent the effect of the shocks on the price level at various lags, are listed below, as are the cumulated shock terms which represent the percentage growth in the money stock. One can see that in this case, the increase in the money supply causes the price level to rise at the time of the money shock, and continues to rise until the price level converges to a new higher level. It turns out that the real money supply increases slightly at the time of the shock, since the price level does not increase as much the nominal money supply, but then decreases until the economy converges to the original level of the real money supply. Output movements can be deduced by subtracting the γ_i terms from the cumulated growth of the nominal money supply below. We find that real output increases after a lag of one period, since the real money supply increases at the time of the shock, and later converges to the initial equilibrium value. The movement of real output over time is also graphed below.

	i=0	1	2	3	4	5	6	7	8	9	10
γ_i	0.61	1.21	1.57	1.79	1.89	1.94	1.98	1.99	2.00	2.00	2.00

	i = 0	1	2	3	4	5	6	7	8	9	10
$\Sigma\theta_{2i}$	1.00	1.50	1.75	1.87	1.94	1.97	1.98	1.99	2.00	2.00	2.00



We've shown a couple of examples of how the price level, the real money supply, and output respond to money and demand shocks when shocks are exogenously determined. Under reasonable assumptions for the parameter values, the economy tends toward a stable equilibrium. In the next part of the paper, we consider the response of the economy to shocks when there is a tendency for the fiscal deficit to increase with inflation and the deficit is financed through money creation.

4. Macroeconomic Instability when the Fiscal Deficit Increases with Inflation

In industrial countries, real government tax revenues typically increase when inflation pushes income earners into higher tax brackets. However, in less developed countries, the response of real tax receipts to an increase in the price level tends to be quite different.

First, LDCs tend to raise more of their revenues through value-added taxes and other non-income tax revenues. Second, lags in tax collections can lead to the erosion of real tax revenues when tax collection systems are close to unit elastic with respect to price increases. For example, if taxes are levied as a fixed proportion of the purchase price of all commodities, and if the taxes collected by proprietors of businesses are not immediately turned over to the government's revenue agent, in an inflationary environment there will be some erosion of the real value of the taxes levied (Tanzi 1977). If the government is better able to maintain real government expenditure levels in the face of inflation, an initial inflationary impulse can lead to a widening of the government budget deficit in real terms.

Aghevli and Khan (1978) develop the dynamics of this phenomenon. They suggest that if governments are constrained to use money creation to finance their fiscal deficits, a rise in inflation which leads to a widening of the deficit can have a further inflationary impact through money creation, and possibly, a further widening of the deficit. One can see here a possible explanation for hyperinflation. Aghevli and Khan find support for their model in an empirical investigation of four countries (Brazil, the Dominican Republic, Colombia, and Thailand) using quarterly data over the period from 1961 to 1974. Lags in government expenditures behind price level increases were found to be minimal for these countries, while lags in government revenue collections were somewhat greater in magnitude. Those countries that had greater lags in tax collections experienced higher rates of inflation. Brazil was found to have had the greatest lags in tax collections of the four countries and also had the highest average inflation rate, while Thailand had the shortest lags in tax collections and the lowest average inflation rate.

Heller (1980) provides an empirical investigation of the response of fiscal policy to inflation in 24 developing countries. He finds that the Aghevli-Khan hypothesis (that expenditures tend to adjust more quickly than revenues in response to inflationary impulses) held in about 60 percent of the countries in the sample. He also found evidence that the higher the mean rate of inflation over the sample period, the greater the tendency for expenditures to adjust more rapidly than revenues in response to inflation.

These studies provide background for the research presented here. They are relevant to the present study in that it will be argued that the response of the fiscal deficit to an inflationary impulse will have a crucial impact on the economic performance of developing countries in response to perturbations in the economy.

We can illustrate the susceptibility of the fiscal deficit to widen in response to inflation as follows. We represent real tax revenues as:

$$R_t = \frac{1}{(1 + \pi_t)^{\nu}}$$

where R_t is the real value of a dollar of tax revenue collected today but levied based on the price level when the taxable event occurred, π_t

is the rate of inflation measured in the units of ν from time t-1 to t, and ν is the length of the lag in tax collections. (For example, the lag length can be measured in months or weeks; if it is measured in months then π is the monthly rate of inflation and ν would then be the average number of months between the taxable event and the receipt of the revenues by the government.) As long as both π_t and ν are greater than zero, there will be some erosion of real tax revenues to the government from the time a tax is levied until the time when the revenue is collected.

Given a set of taxes and a tax collection system already in place, real tax revenues will be a function of the rate of inflation, i.e., $R_t = R(\pi_t)$ with $\frac{dR_t}{d\pi_t} < 0$ Suppose as a first order of approximation that the government is committed to a fixed level of real government expenditures, $\bar{G}$, in each period. The fiscal deficit will then be a positive function of the rate of inflation. Thus:

$$FD_t = \phi(p_t - p_{t-1}) + u_t \tag{17}$$

where FD_t is the log of the real size of the fiscal deficit at time t, p_t and p_{t-1} are as before, and u_t is a random disturbance term. (u_t now represents the shock term to aggregate demand formerly represented by a_t.)

One further assumption of the model is now introduced. We assume that the fiscal authorities finance the government budget deficit through high-powered money creation. This assumption is reasonable for countries with limited ability to borrow through government debt issue on open markets, as is the case in most LDCs. An increase in the fiscal deficit will result in a rise in high-powered money to the degree that government deficits are financed by:

(1) Central bank borrowings or the use of cash balances held at the central bank,

(2) foreign borrowings, or

(3) borrowing from domestic commercial banks who in turn finance the borrowing by recourse to the discount window of the central bank.

An increase in the budget deficit would not result in money creation if it is financed by borrowing from commercial banks or the private sector without rediscounting by the central bank. We assume that deposit money is proportionally related to high-powered money (i.e., there is a constant money multiiplier). The relationship between the fiscal deficit and the nominal money supply can be expressed as follows:

$$m_t - m_{t-1} = \Omega\ FD_t + v_t = \Omega\ \phi\ (p_t - p_{t-1}) + \Omega\ u_t + v_t$$

or

(18) $$m_t = \Omega\ \phi\ (p_t - p_{t-1}) + \Omega\ u_t + v_t + m_{t-1}$$

We now incorporate the endogeneity of the fiscal deficit into the difference equation (12) describing the response of the price level to perturbations. In order to simplify the analysis, we assume that the fiscal deficit is the only component of autonomous expenditures subject to fluctuations.

Again we guess a solution of the form:

$$p_t = \zeta\, p_{t-1} + \Phi\, u_t + \eta\, m_{t-1} + \sigma\, v_t$$

In this part of the analysis, we ignore the possibility of persistence in shocks ($\rho_1 = 0$, $\rho_2 = 0$) and examine the stability of the system in response to only temporary shocks.[13] After working through the algebra, (see appendix), we find:

$$\zeta = \frac{1 - \delta_1 \phi - \mu_1 \eta \Omega \phi \mp \sqrt{(1 - \delta_1\phi - \mu_1\eta \Omega \phi)^2 - 4 (\mu_1) (\mu_2 - \delta_1\phi - \mu_1\eta \Omega \phi)}}{2 \mu_1}$$

For the purposes of a thought experiment, we temporarily ignore the correlation between increases in the fiscal deficit and increases in the nominal money supply and assume $\Omega = 0$. We now find that:

$$\zeta = \frac{1 - \delta_1\phi \mp \sqrt{(1 - \delta_1\phi)^2 - 4 \mu_1 \mu_2 + 4 \mu_1 \delta_1 \phi}}{2 \mu_1}$$

It is now easy to see that increasing the size of ϕ (or the tendency of the fiscal deficit to widen with increases in the rate of inflation) increases the likelihood that both roots of the characteristic polynomial will be greater than one in absolute value. Thus, an essential instability in the economy, which manifests itself as

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[13]It follows logically that if temporary shocks can destabilize the system, so too can persistent ones.

a tendency toward hyperinflation, becomes apparent when ϕ is large. Moreover, the instability is in the direction of hyperinflation rather than "hyperdeflation" so long as $1 - \delta_1\phi > 0$ and thus the positive root will be the root of greatest magnitude in the difference equation, and thus will tend to dominate movements of the price level over time.

Returning to the case where $\Omega > 0$, it is difficult to decipher whether or not nominal money shocks add to the instability or increase the likelihood of a stable system from the complicated expression on the preceding page. If nominal money shocks lead to decreases in the real money supply this would tend to destabilize the economic system and vice versa. If we assume monetary neutrality, the response of the fiscal deficit to inflation (ϕ) becomes the critical parameter determining whether or not stability prevails.

This part of the analysis illustrates the possibility of macroeconomic instability in the LDC economy when credit is rationed. Greater susceptibility of the fiscal deficit to widen in the face of inflation increases the likelihood of an initial disturbance leading to hyperinflation. An initial inflationary shock leads to an expansion of the fiscal deficit and aggravates demand relative to supply. This causes inflation to rise. Individuals adjust their asset portfolios away from money balances and toward inflation hedges. This further aggravates inflationary pressure and the whole cycle repeats itself. As inflation accelerates, the real money supply and bank credit availability contract leading to deepening recession.

5. Applications and Conclusions

At this point, it is pertinent to ask the question - does the model help to give insight into the recent experience of the less developed countries? In particular, does it help to explain the diverging economic performance of the East Asian and Latin American countries over the period of the early 1980s?

The three East Asian countries under consideration (Indonesia, Korea and Thailand) maintained relatively strong GDP growth with only minor drops in output over the period of the early 1980s. These countries were able to maintain relatively small fiscal deficits which were not very susceptible to widening in the face of inflationary pressure. Moreover, during this period inflation rates were generally declining while real money supplies were growing along with commercial bank credit availability. It is difficult to see a significant short-term relationship between commercial bank credit and GDP. This may indicate that the credit constraint was not a binding constraint on the production of output in these East Asian countries.

However, the observed pattern in the Latin American countries was different. These countries experienced increasing fiscal deficits, increasing inflation rates tending toward hyperinflation, and poor and even negative output growth rates. Commercial bank credit availability declined significantly in all three of the Latin American countries under consideration.

In Argentina, a drop in credit availability from 1980 to 1981 is accompanied by a dramatic drop in output in 1981. A further drop in credit availability in 1982 is again accompanied by a drop in output in 1982. After 1982, bank credit availability begins to grow again, as does output. In Brazil, the big drop in output in 1983 coincides with a drop in bank credit availability from 1982 to 1983. The pattern in Mexico also lends support to a credit-constrained interpretation of output fluctuations.

Of cours , there are many factors influencing these economies other than the influences focused on here. But overall the model does help to explain the pattern of response of less developed country economies to disturbances. Moreover, it provides an explanation for the paradox of accelerating inflation coupled with output contraction observed in many LDCs in recent years.

The research presented here suggests some policy implications for LDCs with limited non-bank capital markets. First, increasing the relative return to bank deposits can increase the size of the banking system and improve the availability of credit in such economies. If the financial system expands enough to eliminate the credit constraint on output, this can aid in moving the economy toward full employment and higher capacity utilization rates.

Second, less developed countries need to develop tax systems which are not vulnerable to inflationary erosion of revenues and thus lessen the susceptibility of the fiscal deficit to widen under inflationary pressure. This requires the reduction of time lags in the collection of taxes. If it is impossible or politically difficult to improve tax collections, measures must be taken to reduce the level of real government expenditures when revenues decline to maintain balance in the fiscal accounts. The model shows clearly how countries which are unable to maintain fiscal balance can be extremely vulnerable to adverse shocks creating problems of macroeconomic instability.

APPENDIX

Log linearization of equation (10)
(page 19 of text)

Using (1) and the definition of π , we can rewrite (10) as:

$$\frac{P_t - P_{t-1}}{P_{t-1}} = \beta A_t + \beta \left(b + s + \frac{1}{\alpha(1-r)} - 1\right) \alpha (1-r) \left(\frac{M}{P}\right)_{t-1}$$

$$- \beta M \left(n - \frac{E_t P_{t+1} - P_t}{P_t} , \alpha (1 - r) \left(\frac{M}{P}\right)_{t-1}\right)$$

It is convenient to denote the partial derivatives of the money demand function, M (.), by M_1 and M_2 , where both partial derivatives are positive.

Log linearizing around the mean values of the variables we get:

(i) $p_t - p_{t-1} = Z_0 + Z_1 a_t + Z_2 (m_{t-1} - p_{t-1}) + Z_3 (E_t p_{t+1} - p_t)$

where the lowercase letters represent the natural logarithms of the variables and:

$$Z_0 = \log (1 + \beta e^{\overline{\log A}} + K e^{\overline{\log (M/P)}} + \beta M_1 e^{\overline{\log (P_{t+1}/P_t)}} = \log [X] > 0$$

$$Z_1 = \frac{\beta e^{\overline{\log A}}}{X} > 0$$

$$Z_2 = \frac{K\, e^{\overline{\log (M/P)}}}{X} \gtreqless 0 \quad \text{(depending on the sign of K)}$$

$$Z_3 = \frac{\beta\, M_1}{X} > 0$$

$$\text{and } K = \beta \left(b + s + \frac{1}{\alpha\,(1 - r)} - 1 - M_2 \right) \alpha\,(1 - r) \gtreqless 0$$

The notation $\overline{\log (\,.\,)}$ denotes the average of log (·) in the expressions above and $\log (P_{t+1}/P_t) \doteq 0$.

Equation (i) can be rearranged in the following form:

(12) $$p_t = \mu_1\, E_t p_{t+1} + \mu_2\, p_{t-1} + \delta_1\, a_t + \delta_2\, m_{t-1}$$

where $$0 < \mu_1 = \frac{Z_3}{1 + Z_3} = \frac{\beta\, M_1}{X + \beta\, M_1} < 1$$

$$\mu_2 = \frac{1 - Z_2}{1 + Z_3} = \frac{X - K\, e^{\overline{\log (M/P)}}}{X + \beta\, M_1} \gtreqless 0$$ {If we presume that K > 0, then: $0 < \mu_2 < 1$}

$$\delta_1 = \frac{Z_1}{1 + Z_3} = \frac{\beta\, e^{\overline{\log A}}}{X + \beta\, M_1} > 0$$ { Assuming K > 0 , $0 < \delta_1 < 1$ }

$$\delta_2 = \frac{Z_2}{1 + Z_3} = \frac{K\, e^{\overline{\log (M/P)}}}{X + \beta\, M_1} \gtreqless 0$$

Solution to the difference equation (12)
(page 20 of text)

After having guessed a solution of the form of equation (13), we advance (13) one period and take expectations. We get:

$$E_t p_{t+1} = \zeta^2 p_{t-1} + \zeta \eta m_{t-1} + \eta \Phi a_t + \zeta \sigma v_t + \eta m_{t-1} + \eta v_t + \Phi \rho_1 a_t + \sigma \rho_2 v_t$$

Combining terms gives us:

$$(\mu_1 \zeta^2 - \zeta + \mu_2) p_{t-1} + (\mu_1 \eta + \mu_1 \zeta \eta + \delta_2 - \eta) m_{t-1} + (\delta_1 + \mu_1 \Phi \rho_1 + \mu_1 \zeta \Phi - \Phi) a_t$$

$$+ (\mu_1 \eta + \mu_1 \sigma \rho_2 + \mu_1 \zeta \sigma - \sigma) v_t = 0$$

We solve for the coefficients to get the values presented on page 21.

Solving the difference equation (12) with the fiscal deficit endogenous
(page 32 of text)

Equation (12) now becomes:

$$p_t = \mu_1 E_t p_{t+1} + \mu_2 p_{t-1} + \delta_1 [\phi (p_t - p_{t-1}) + u_t] + \delta_2 m_{t-1}$$

We again guess a solution of the form of (13) and advance the equation one period and take expectations. Assuming that all shocks are only temporary ($\rho_1 = 0$, $\rho_2 = 0$) , we get:

$$E_t p_{t+1} = \zeta\, p_t + \eta\, m_t$$

Using this expression for $E_t\, p_{t+1}$ and equation (18), we solve as above, yielding the following values for the coefficients:

$$\zeta = \frac{1 - \delta_1 \phi - \mu_1 \eta\, \Omega\, \phi \mp \sqrt{(1 - \delta_1 \phi - \mu_1 \eta\, \Omega\, \phi)^2 - 4\, \mu_1\, (\mu_2 - \delta_1 \phi - \mu_1 \eta\, \Omega\, \phi)}}{2\, \mu_1}$$

$$\eta = \frac{1 - \mu_1 - \delta_1 \phi - \mu_1 \zeta \mp \sqrt{(1 - \mu_1 - \delta_1 \phi - \mu_1 \zeta)^2 - 4\, \mu_1 \Omega\, \phi\, \delta_2}}{2\, \mu_1\, \Omega\, \phi}$$

$$\Phi = \frac{\delta_1 + \mu_1 \eta\, \Omega}{1 - \delta_1 \phi\, \zeta - \mu_1 \zeta - \mu_1 \eta\, \Omega\, \phi} \qquad \sigma = \frac{\mu_1\, \eta}{1 - \delta_1 \phi - \mu_1 \zeta - \mu_1 \Omega\, \eta\, \phi}$$

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