Aggregate Output and Price Adjustment with Credit Rationing and Informal Loan Markets*

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A macroeconomic model of output and price adjustment for a semi-industrialized developing country with informal loan markets is presented and tested. The model is based on the micro-foundations of firm behaviour under monopolistic competition and bank credit rationing. Empirical results for three Latin American countries (Brazil, Colombia, and Peru) provide no support to the "cost push" effect of restrictive monetary policy, as recently emphasized in the literature.

I. Introduction

Recent research in macroeconomics in less developed countries (LDCs) has pointed out to potentially perverse effects of monetary restraint on inflation and growth. The structure of the financial system has been regarded as the key to the explanation of the stagflationary effects of restrictive monetary policy measures.[1]

This "New Structuralist" view is based on the empirical observation that in most LDCs, the financial intermediation system is underdeveloped (or poorly articulated) and commercial banks play a predominant role as a source of funds for firms, both for short-term working capital purposes and for long-term fixed capital formation. Bank credit is however often rationed, with bank lending rates unresponsive to excess demand for credit. As a consequence, unorganized money markets play a key role in several countries.[2]

* This views expressed in this article are my own and should not be attributed to the International Monetary Fund.

[1] See Bruno (1979b), Van Wijnbergen (1982, 1983), and Taylor (1980, 1983, pp. 86-103) for a presentation and Buffie (1984) for a critical evaluation. The supply side effect of restrictive credit policies has also been emphasized by Leff and Sato (1980, pp. 175-6) in their discussion of alternative adjustment mechanisms to macroeconomic equilibrium in LDCs.

[2] It is important to note that until recently, relationships between formal and informal credit markets were completely overlooked by many economists concerned with short-run

The transmission channel between monetary instruments and the supply side of the economy via credit financing of working capital needs has been shown to be a crucial link to evaluate the effects of short-run stabilization policy. Working capital is needed to finance stocks of raw materials, semi-finished goods, intermediate imports, advance payments to workers, etc. In several countries, a large part of working capital needs is financed by bank or parallel market credit.[3] This implies, in turn, that the cost of credit (the interest rate) is a component of input costs. Mark-up pricing rules will therefore lead to an immediate cost push effect of high interest rates (in the parallel market) on prices. Furthermore, under monopolistic market structures, a high cost of credit will not only lead to a short-run cost push effect on prices, but will also lead to a reduction in real output as real input costs have gone up. This transmission channel, from tight ceilings on bank credit via the parallel market and high costs of financing working capital into the supply side of the economy, gives a stagflationary bias to restrictive monetary policies. Basically, this transmission channel adds an adverse-supply-shock aspect to policies of monetary restraint on top of the more traditional demand reducing effects. Restrictive monetary policies lead to expensive credit, which leads to an increase in a component of input costs; this in turn leads to more inflation and less output than would obtain without the transmission mechanism present. Restrictions on official credit push firms into the parallel market, drive up interet rates there, and so initiate the stagflationary effects mentioned above.[4]

macroeoconomic adjustment problems in LDCs. Behrman (1975) for example, in a classic paper, considers that changes in the organized money market have "…but a limited impact on the unorganized sector" (p. 480).

[3] The parallel or "curb" market is an informal (sometimes illegal) credit market in which loan suppliers and demanders can transact freely at uncontrolled interest rates. In some LDCs, the volume of loans transacted on the curb market is believed to be at least as great, and perhaps several fold greater, than that transacted in official credit markets. Some empirical evidence on the role of informal loan markets is provided by Chandavarkar (1986).

[4] If bank and parallel market credit has a short term maturity, the stagflationary impact of a tight credit policy via the credit-working capital link will work itself through the system quickly. On the contrary, the demand restraining impact typically works only gradually: first aggregate demand (or rather investment, since consumer credit is often limited, both in official and parallel credit markets) will fall, which, over time, will increase unempolyment. This in turn will after further lags ease real wages pressure and thus inflation. A typical response to a one shot tightening up of monetary policy would, therefore, be an initial acceleration of the inflation rate, after which demand effects take

In this paper, a model of aggregate output and price adjustment for a small open developing economy with informal credit markets is developed and tested econometrically. The model is basically similar to the analytical framework developed by Bruno (1979b), but is amended, following a recent contribution by Doukas (1987), for empirical tractability.

The theoretical model is developed in Section II. Econometric issues are discussed in Section III, and empirical results for three Latin American countries (Brazil, Colombia, and Peru) are presented in Section IV. Finally, conclusions and perspectives for future research are discussed in Section V.

II. The Theoretical Model

The model presented here follows Bruno's (1979b) approach and incorporates several stylized facts typical of financial markets in LDCs. We consider a small open developing economy for which import (and usually export) prices are given. Imported inputs (raw materials) play an important role in the production process. Markets for equities, commerical paper and non-monetary government debt are non-existent. Intermediation between households and the business sector takes place either via the banking system or the unorganized money market. So firms have to finance the working capital they need (as well as investment) by short-term bank credit, retained earnings or loans from the parallel money market.

Short-term credit is rationed by commercial banks.[5] Interest rates on the official credit market are set by the monetary authorities far below the market clearing rates and consequently an informal "curb" market charging high interest rates (incorporating a considerable risk factor) has arisen to supply the residual demands of firms rationed in official credit markets. Borrowing from world capital markets is not allowed by the government.

The representative domestic firm is assumed to maximize a separable production function which takes the generalized Cobb-

over, effecting a slowdown of the rate of price increases. Both effects have a negative impact on output. Simulation results presented by Van Wijnbergen (1982) for South Korea provide some support for this view.

[5] An explicit analysis of the rationing process of bank credit in LDCs is outside the scope of this paper. For an extensive discussion of this issue as well as a critical appraisal of the standard Stiglitz-Weiss approach, see Virmani (1982).

Douglas form

$$q = \Phi(K)\, L^{\alpha} N^{\delta}, \qquad \alpha > 0,\ \delta > 0,\ \alpha + \delta < 1, \tag{1}$$

q denoting output, K the capital stock, L the quantity of labour employed and N imported inputs. The capital stock is taken as fixed in the short-run, and for simplicity we set $\Phi(K) = 1$ in what follows. Assuming that the firm minimizes variable costs with respect to a given level of output q, the cost function takes the form (for a proof, see e.g. Varian 1984, p. 28)

$$C(\omega,\ P_N,\ q) = A\omega^{\lambda} P_N^{1-\lambda} q^{(\lambda/\alpha)}, \tag{2}$$

where $A = [(\alpha/\delta)^{1-\lambda} + (\alpha/\delta)^{-\lambda}]$,
$\lambda = \alpha/(\alpha + \delta), \quad 0 \leq \lambda \leq 1$

ω denoting the wage rate, and P_N the domestic price of the imported inputs. The (restricted) cost function is linearly homogeneous in ω and P_N, and it can be written as ("ΔZ" denoting the proportionate rate of change of varible Z)

$$\Delta C = \lambda \Delta\omega + (1 - \lambda)\, \Delta P_N + (\lambda/\alpha)\Delta q. \tag{3}$$

Differentiating equation (2) with respect to q gives the marginal cost function:

$$MC \equiv \partial C/\partial q = A(\lambda/\alpha)\ \omega^{\lambda}\ P_N^{1-\lambda} q^{(\lambda-\alpha)/\alpha}. \tag{4}$$

Since the average variable cost function is given by $C/q = A\omega^{\lambda} P_N^{1-\lambda} q^{(\lambda-\alpha)/\alpha}$, the marginal cost function (4) can be re-written as

$$MC = (\lambda/\alpha)\ (C/q). \tag{5}$$

Writing equation (5) in proportionate rates of change yields $\Delta MC = \Delta C - \Delta q$; substituting equation (3) for ΔC yields

$$\Delta MC = [(\lambda - \alpha)/\alpha]\ \Delta q + \lambda\Delta\omega + (1-\lambda)\Delta P_N. \tag{6}$$

The purchase of variable inputs (labor and imported raw materials) is assumed to precede the production and sale of output. The firm therefore borrows from the capital market to finance its working capital needs.[6] At the official nominal interest rate $\bar{i}$, the firm faces a credit ceiling $\overline{C}$. For financing needs exceeding this ceiling, the firm must go to the informal loan market and its marginal bor-

[6] All payments are by assumption financed by short-term credit. This is because retained earnings can be treated as a "loan" by the owner of the firm to the firm; therefore, the firm owner can be put in the same category as money lenders at the parallel market.

rowing cost increases with the amount borrowed.

Let $\xi[C(q)]$ denote total borrowing costs. The first-order condition for maximizing profits subject to borrowing costs is given as (p denoting the price of output)

$$d\{pq - C(q) - \xi[C(q)]\}/dq = 0,$$

which yields (MR denoting marginal revenue)

$$MR = MC = C'(q) + \xi' C'(q),$$

or, letting $i = \xi'$ (the marginal cost of borrowing), i denoting the nominal interest rate on the informal loan market,[7]

$$MR = MC(1 + i). \tag{7}$$

Now, the marginal cost of borrowing is an increasing function of the funds raised over the ceiling $\bar{C}$ faced by the firm on the official loan market. As long as the firm's financing needs (C) are less than or equal to $\bar{C}$, the interest rate paid by the firm is equal to the official rate $\bar{i}$. However, when financing needs exceed $\bar{C}$, the interest rate paid is equal to i, the parallel market rate, which increases by the amount $C - \bar{C}$ (or, equivalently, the ratio $C/\bar{C}$) to be financed.[8] Formally, this mechanism can be expressed as

$$1 + i = (1 + \bar{i})(C/\bar{C})^{\eta}, \begin{cases} \eta > 0 \text{ for } C > \bar{C} \\ \eta = 0 \text{ for } C \leq \bar{C} \end{cases}.$$

Letting $\rho = (1 + \bar{i})\bar{C}^{-\eta}$, the above expression can be re-written as

$$1 + i = \rho C^{\eta}. \tag{8}$$

Now, let $\psi = MC(1 + i)$; substituting equations (4) and (8) for MC and $(1 + i)$ respectively yields

$$\psi = (\lambda/\alpha)(C/q)\ \rho C^{\eta} = (\lambda/\alpha)(C^{\eta+1}/q)\rho,$$

[7] There has been substantial debate in the literature as to whether costs should be measured by the nominal interest rate instead of the *real* rate, defined as the nominal rate minus the expected rate of inflation. As shown by Taylor (1983, p. 88), the choice depends on how the "short-run" is defined. If it is assumed, as is done here, that there is a continuous flow input of labour during a period during which money wages do not change, then working-capital costs are appropriately measured by the nominal interest rate.

[8] The implicit assumption made here is that firms try to obtain bank credit before going into the curb market. This makes some sense, because bank credit is typically offered at below market clearing rates in most LDCs.

or, in terms of rates of change,

$$\Delta\psi = (\eta + 1)\ \Delta C - \Delta q + \Delta\rho.$$

Substituting equation (3) into the above expression yields

$$\Delta\psi = [(\lambda/\alpha)(\eta+1)-1]\ \Delta q + (\eta+1)[\lambda\Delta\omega + (1-\lambda)\ \Delta P_N] + \Delta\rho. \tag{9}$$

To complete the specification of firm behaviour, we consider the following demand function

$$q^d = \gamma\ (p/p^e)^{-\sigma}, \qquad \sigma > 1, \tag{10}$$

where p^e denotes the expected general price level for the current period (based on information available up to the preceding period), σ the price elasticity, and γ a parameter (discussed in more detail below) reflecting the firm's own perceived demand expectations. Differentiating equation (10) to obtain marginal revenue (MR) and writing the expression in terms of rates of change yields

$$\Delta MR \equiv \Delta p = \pi^e + (1/\sigma)\ (\Delta\gamma - \Delta q), \tag{11}$$

where $\pi^e = \Delta p^e$ denotes the expected inflation rate.

Using the equilibrium condition (7) together with equations (9) and (11) yields, after simple manipulations, the output equation

$$\Delta q = \Omega\sigma\ [\pi^e + (\Delta\gamma/\sigma) - \lambda(\eta+1)\Delta\omega - (1-\lambda)\ \Delta P_N - \Delta\rho], \tag{12}$$

where $\Omega = 1/\{1 + \sigma[(\lambda/\alpha)(\eta+1) - 1]\}$. Substituting equation (12) into equation (9) yields the price equation

$$\Delta p = (1-\Omega)[\pi^e + (\Delta\gamma/\sigma)] + \Omega(\eta+1)[\lambda\Delta\omega + (1-\lambda)\ \Delta P_N] + \Omega\Delta\rho. \tag{13}$$

Equations (12) and (13) indicate that an increase in borrowing costs ($\Delta\rho$) as well as an increase in the cost of labour ($\Delta\omega$) or imported inputs (ΔP_N) raises prices and depresses real output. In addition, expectations of inflation (π^e) and aggregate demand ($\Delta\gamma$) move both prices and output upward.

To get from the microeconomic framework described above to aggregate output and price equations requires detailed specification of the relationship between firm demand, industry demand, and aggregate demand, as well as the choice of an appropriate index for

aggregation purposes. We here adopt the Divisia index approach discussed by Bruno (1979a), which yields a pair of aggregate adjustment equations similar in form to equations (12) and (13):

$$\Delta Q = a_1 \pi^e + a_2 \Delta \Gamma - a_3 \Delta \omega - a_4 \Delta P_N - a_5 \Delta \theta , \qquad (14)$$

$$\Delta P = b_1 \pi^e + b_2 \Delta \Gamma - b_3 \Delta \omega - b_4 \Delta P_N - b_5 \Delta \theta , \qquad (15)$$

where Q and P denote aggregate price and output Divisia indexes, Γ an index of expected aggregate demand, and θ an aggregate index of financial factors $\bar{C}$ and ρ for all firms. The coefficients a_k and $b_k (k \neq 5)$ are weighted averages of the cost and demand elasticities appearing in equations (12) and (13).

Now let us examine the determination of wages, aggregate borrowing costs and expected aggregate demand. We assume that wages are determined by a labour union or a contract that extends through the production period, so that firm pricing and employment demand decisions are based at any moment on a predetermined wage rate. The (dynamic) wage adjustment equation must however be specified; it takes here a simple form, with the rate of growth of nominal wages depending on the expected rate of inflation:

$$\Delta \omega = c_0 + c_1 \pi^e, \qquad c_0 > 0, \; 0 \leq c_1 \leq 1. \qquad (16)$$

Consider now the marginal borrowing rate faced by each firm. As shown above, $1 + i = (1 + \bar{i})\,(C/\bar{C})^{\eta} = \rho\, C^{\eta}$, where $\rho = (1 + \bar{i})\bar{C}^{-\eta}$ (equation (8)). In rate-of-change terms, we have

$$(1 + i)^{-1}\, i\, \Delta i = (1 + \bar{i})^{-1}\, \bar{i}\, \Delta \bar{i} - \eta \Delta \bar{C} + \eta \Delta C = \Delta \rho + \eta \Delta C. \qquad (17)$$

Let us assume that individual credit quotas $\bar{C}$ move together with total bank credit available, which is given as $M - (1/m)M = [(m - 1)/m]M$, under the assumption that the money supply M is subject to a simple reserve requirement ratio $(1/m)$, $(0 \leq m \leq 1)$. In that case, individual ceilings will change at the rate $(m - 1)^{-1}\, \Delta m + \Delta M$. Using equation (17), the adjustment equation for the marginal borrowing rate can be written as

$$\Delta i = d_1 \Delta \bar{i} - d_2 [(m - 1)^{-1} \Delta m + \Delta M] + d_3 \Delta C.$$

Changes in the marginal borrowing rate are therefore influenced by changes in official interest rates, changes in the money supply and the reserve requirement ratio, and changes in (production) costs. Assuming the multiplier is fixed in the short-run, and using equation (4), the above expression can be re-written in the form

$$\Delta i = d_1 \Delta \bar{i} - d_2 \Delta M + d(\Delta q, \Delta \omega, \Delta P_N). \tag{18}$$

Now, since the coefficients of the output and price equations already implicitly incorporate the (positive) effect of increasing production costs on the borrowing rate, the aggregate financial cost index θ appearing in these equations can be expressed only in terms of the monetary variables $\bar{i}$ and M:

$$\Delta \theta = e_1 \Delta \bar{i} - e_2 \Delta M. \tag{19}$$

Finally, we assume that the index of expected aggregate demand is linearly related to the level of money balances, together with a set of exogenous variables left unspecified for the moment and discussed more fully below:

$$\Delta \theta = \Gamma_1 \Delta M + \cdots. \tag{20}$$

Substituting equations (16), (19) and (20) in equations (14) and (15) yields

$$\Delta Q = \delta_{11} \pi^e + \delta_{12} \Delta \Gamma - \delta_{13} \Delta P_N - \delta_{14} \Delta \bar{i} + \delta_{15} \Delta M, \tag{21}$$

$$\Delta P = \delta_{21} \pi^e + \delta_{22} \Delta \Gamma + \delta_{23} \Delta P_N + \delta_{24} \Delta \bar{i} + \delta_{25} \Delta M, \tag{22}$$

where all coefficients are positive, except $\delta_{11} = a_1 - a_3 c_1$ and $\delta_{25} = b_2 \Gamma_1 - b_5 e_2$ whose sign is now ambiguous.

These equations incorporate both cost factors, price expectations and demand variables. They show that a reduction in the money supply affects the system both from the "supply side" and the "demand side". By raising borrowing costs, a restrictive monetary policy will imply a contraction of output and an *increase* in prices, while by lowering expected aggregate demand, it will both reduce output and lower prices. The model therefore suggests a positive relationship between changes in the money supply and changes in real output, while the net effect on prices will be either positive or negative. This last result is in sharp contrast to what would be delivered by an "orthodox" model. Here, a restrictive monetary policy leads to expensive credit, pushes firms into the parallel market, and drives up interest rates there. This leads in turn to an increase in production costs and a fall in aggregate demand, which translates itself into less output and more inflation if the demand-reduction effect is weak.

The discussion above suggests that the net effect of a money supply contraction on prices can only be determined empirically, and to this we now turn.

III. Specification of the Econometric Model

Econometric estimation of equatons (21) and (22) requires that the formation of price expectations and the expected demand variable be fully specified.

Consider first the treatment of price expectations. In line with the current theoretical literature dealing with LDCs, inflationary expectations are assumed to be "rational", in the sense of Muth. Empirical implementation of this hypothesis follows here the "two-step" instrumental variable method described by McCallum (1976)(see also Cumby et al. 1983). The price equation is first estimated using the predetermined variables set as instruments. The model equations are then estimated (by the modified SURE procedure discussed below) using the predictions from the price regression as the expectational variable. Provided the set of instruments is independent of the disturbance term in the price equation, this method gives consistent estimators of the parameters. However, the procedure is not fully efficient because cross equations restrictions implied by the rationality assumption on the reduced form of the model are not imposed (for a further discussion, see Pagan 1984).

Consider now the full specification of the expected change demand parameter $\Delta\Gamma$. As shown by equation (20), the first variable considered is the change in money supply ΔM. Following suggestions by Bruno (1979a, p. 209) and Doukas (1987), the rate of change in the share of government deficit in total output (Δd) and the rate of growth of exports (ΔE) were also included as indicators of expected demand in the econometric model.

Adding a constant term to capture secular movements, the equations to be estimated take finally the form

$$\Delta Q = \tau_{10} + \tau_{11}\pi^e + \tau_{12}\Delta d + \tau_{13}\Delta E + \tau_{14}\Delta P_N + \tau_{15}\Delta M + \varepsilon_1, \quad (27)$$

$$\Delta P = \tau_{20} + \tau_{21}\pi^e + \tau_{22}\Delta d + \tau_{23}\Delta E + \tau_{24}\Delta P_N + \tau_{25}\Delta M + \varepsilon_2, \quad (26)$$

ε_1 and ε_2 denoting disturbance terms.

IV. Empirical Results

The model is estimated for three Latin American countries, Brazil, Colombia, and Peru. Although the choice has been dictated partly by data availability, these countries do provide a good testing

case for the model described above. The informal credit market is believed to be relatively large in all of them, although little is known about its actual size.

The estimation method is Zellner's Seemingly Unrelated Regression (SURE) procedure applied to output and price equations for each country separately. As is well known, the SURE estimator is more efficient than ordinary least squares (OLS) if disturbances across equations are contemporaneously correlated or when regressor matrices are *numerically* different across equations (see e.g. Harvey 1981, pp. 67-70; Fomby, Hill, and Johnson 1984, pp. 160-2). However, once serial correlation is introduced into the model, asymptotically efficient estimators of the parameters can no longer be obtained by the "standard" SURE procedure, unless the autoregressive process is strictly the same across equations (for further discussion of this point, see again Harvey 1981, pp. 218-9).

To correct for (first-order) autocorrelation with the SURE estimator, the procedure suggested by Parks (1967) and Kmenta and Gilbert (1970) is used here. First, consistent estimates of first-order autocorrelation coefficients are obtained separately for each equation. Second, a Prais-Winsten type transformation is applied to the original observations and the whole system is estimated by the SURE procedure. The resulting estimates of the regression coefficients have the same asymptotic properties as Aitken's generalized least squares estimates.[9]

Estimation results for both the output and price equations, based on annual data, are shown in Tables 1 and 2.[10] $\bar{R}^2$ denotes the

[9] It should be noted that the disturbance in each equation may depend not only on its *own* lagged value, but also on the lagged values of the disturbances appearing in *other* equations of the system (and this will not be picked up by a Durbin Watson test), in which case it is necessary to allow for *vector autoregressive disturbances* (Guilkey and Schmidt 1973). However preliminary testing showed that the simpler assumption used here provides more robust results.

[10] The main source of the data is the 1987 Yearbook of *International Financial Statistics* published by the International Monetary Fund. Gross Domestic Product (GDP) at constant 1980 prices is used for Q. The price variable P is measured by the GDP implicit deflator, a better proxy under the assumptions of the model than the consumer price index used by Doukas (1987). Preliminary experiments suggested the use of narrow money to measure the nominal money supply in the case of Brazil, and broad money in the case of Colombia and Peru. E is measured by exports of goods and non-factor services. The domestic index of import unit value is used for Brazil and Colombia. For Peru, no such index was available; the export price index for the United States (Peru's major trade partner) was used instead. Finally, the "fiscal impulse" variable is measured by the rate of change in the ratio of government deficit relative to nominal income.

adjusted coefficient of determination, $\hat{\sigma}$ the standard error of the equation, F the Fisher–Snedecor statistic, DW the Durbin–Watson statistic, and $\hat{\rho}$ the estimate of the first-order autocorrelation coefficient of the residuals. Coefficients below the estimated parameters are Student t.

The change in the interest rate on institutional markets has been omitted from the regression equations due to lack of adequate data. This constitutes a standard mis-specification problem due to the omission of a relevant explanatory variable. However, since the interest rate on loans is institutionally set in all the countries considered here, the variable $\Delta\bar{i}$ is unlikely to be correlated with the other explanatory variables in the regression equations. Therefore, except for the constant terms τ_{10} and τ_{20} in equations (25) and (26) which will be biased and inconsistent, the estimator of the other coefficients will still be unbiased and consistent, but their variance will be biased upwards. Hence, as argued by Kmenta (1986, pp. 443–5), the usual tests of significance and confidence intervals for τ_{ij} $(j > 0)$ will be unduly conservative.

Overall, considering that the equations are estimated in rate-of-change form, the results look quite satisfactory.[11] First consider the results for the output equation given in Table 1.[12] The expected inflation rate has a negative impact on output in Brazil and Colombia, reflecting its indirect effect on the rate of growth of nominal wages. Changes in the rate of growth of exports stimulate real output, although this effect appears to be weak for Colombia. Imported inflation (through changes in prices of raw materials) has a significant impact on the rate of growth of output in Colombia, but a much weaker effect in Brazil and Peru. Monetary growth has a positive impact on real output growth in all countries, but this variable is highly significant only for Brazil. Finally, fiscal deficits appear to play a direct role in determining activity only in Peru.

In terms of goodness-of-fit, much better results are obtained for

[11] The "fiscal impulse" variable was found to be insignificant and wrongly signed in the output and price equations for Brazil and Colombia, and was dropped from the equations. The same result was obtained with the rate of change in exports for Brazil, and the variable was also left out.

[12] In interpreting the results, it should be kept in mind that the aggregation rule in the theoretical model was based on a Divisia index. However, national accounts aggregates in LDCs are typically calculated using a simple sum/average procedure, which is likely to provide biased estimates (see e.g. Van Daal and Merkies 1984). There is therefore an aggregation bias (whose importance is not known) in the results, due to the type of data used.

TABLE 1
ESTIMATION RESULTS FOR OUTPUT EQUATION[1]

Coefficients	Country		
	Brazil (1966—1985)	Colombia (1962—1983)	Peru (1963—1985)
τ_{10}	0.1298	0.0758	0.0367
	(9.386)	(5.483)	(2.311)
τ_{11}	−0.4829	−0.2359	0.0947
	(−7.941)	(−2.667)	(0.926)
τ_{12}	−	−	−0.0251
			(−2.893)
τ_{13}	−	0.0552	0.1321
		(1.549)	(2.734)
τ_{14}	−0.2141	−0.0547	−0.2291
	(−2.432)	(−1.098)	(−1.723)
τ_{15}	0.2827	0.0277	0.0151
	(6.751)	(1.419)	(1.163)
ϑ	0.7	0.5	0.9
$\bar{R}^2$	0.6601	0.2917	0.4243
$\hat{\sigma}$	0.0275	0.0178	0.0386
F	8.765	2.956	1.917
$\hat{\rho}$	−0.3758	−	−
	(−2.784)		
DW	2.701	1.785	1.932

Note: 1. $\Delta Q = \tau_{10} + \tau_{11}\pi^e + \tau_{12}\Delta d + \tau_{13}\Delta E + \tau_{14}\Delta P_N + \tau_{15}\Delta M + \varepsilon_1$
(Modified SURE Procedure)

the price equation (Table 2). The expected inflation rate exerts a rather powerful impact on the rate of growth of prices in all countries. In the case of Brazil, parameter estimates show that inflationary expectations even have a *destabilizing* effect.[13] The rate of growth of import unit values (a proxy for changes in prices of imported inputs) is statistically significant only for Colombia, although the coefficient of this variable is positively signed in all equations. This may be the consequence of the poor quality of the data (Brazil) or the inadequacy of the proxy used (Peru). The rate of change of exports performs well for both Colombia and Peru.

The rate of growth of the nominal money stock is positive and significant only for Peru. The coefficient of this variable is however

[13] This result is interesting. It provides some support to those who attribute the failure of the recent attempt to bring down inflation through a comprehensive stabilization program, based on price controls and pre-announced restrictive monetary and fiscal policies (the so-called "Cruzado Plan"), to the persistence of high inflationary expectations. For an alternative view, see Cardoso and Dornbusch (1987).

TABLE 2
ESTIMATION RESULTS FOR PRICE EQUATION[1]

Coefficients	Country		
	Brazil (1966–1985)	Colombia (1962–1983)	Peru (1963–1985)
τ_{20}	−0.1142	−0.0601	0.0038
	(−2.065)	(−3.798)	(0.175)
τ_{21}	1.1813	0.6192	0.4995
	(4.798)	(6.029)	(2.581)
τ_{22}	–	–	−0.0008
			(−0.053)
τ_{23}	–	0.1115	0.2284
		(2.186)	(2.897)
τ_{24}	0.4154	0.1589	0.2531
	(1.171)	(2.361)	(1.236)
τ_{25}	0.2084	0.3701	0.3156
	(1.207)	(4.098)	(1.973)
ϑ	0.7	0.5	0.9
$\bar{R}^2$	0.8654	0.7617	0.9408
$\hat{\sigma}$	0.1213	0.0305	0.0667
F	26.732	12.501	51.34
$\hat{\rho}$	−0.5813	−0.5497	–
	(−4.465)	(−3.361)	
DW	1.946	1.998	2.031

Note: 1. $\Delta P = \tau_{20} + \tau_{21}\pi^e + \tau_{22}\Delta d + \tau_{23}\Delta E + \tau_{24}\Delta P_N + \tau_{25}\Delta M + \varepsilon_2$
(Modified SURE Procedure)

positive also for Brazil and Colombia, so that no support whatsoever can be found in favor of the dominance of the "cost push" effect on inflation, relative to the demand-reducing effect, of a money supply contraction discussed above.

The results are globally similar to those obtained by Doukas (1987), who estimated aggregate output and price equations using pooled cross-section time-series data for 10 countries (Brazil, Colombia, Greece, India, Israel, Korea, Pakistan, Philippines, Sri Lanka and Turkey) over the period 1974–1983. The most notable difference is the negative relationship found here between inflationary expectations and real output in Brazil and Colombia. Beyond the similarities however, the estimation procedure used in this paper, based on individual country data, seems to provide a more adequate statistical framework for testing Bruno's model. Because of the diversity of institutional features in the countries considered by Doukas, the pooling procedure used in his paper is unlikely to yield reliable results.

V. Conclusions

In this paper, following Bruno's (1979b) approach, we have presented a short-run model of price and output adjustment in a (semi-industrialized) developing economy, emphasizing the relationships between the financial and the real sectors. The model takes explicitly into acount the existence of a segmented credit market. It incorporates the link between monetary variables and the supply side via the financing of working capital with borrowed funds.

The model was estimated a modified SURE procedure for three Latin American countries, using annual data. The econometric results show that inflationary expectations have a negative impact on output and a strong, positive effect on the rate of growth of domestic prices. Imported inflation has also been shown to have a significant effect on activity and domestic inflation. No support was found however for the predominance of the "cost push" effect (relative to the demand-reducing effect) of a restrictive monetary policy, as recently emphasized by structuralist macroeconomists. However, the extent to which this result may be due to the exclusion of the interest rate variable in the empirical model is, at this stage, unclear.

The results point therefore to the necessity of further research. At the theoretical level the role of adjustment costs related to price changes (Barro 1972) and the role of inventories must, in particular, be discussed. The treatment of the labour market (most notably the wage adjustment equation, where no excess demand parameter appears) must also be improved. At the empirical level, more extensive econometric tests, using a larger sample of developing countries, would provide a better appraisal of the predictive power of the model.

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