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An Empirical "Dependent Economy" Model for Pakistan*

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Abstract

While the "dependent economy" approach has been used extensively in theoretical work on developing countries, there is very little empirical analysis of it available in the literature. This paper specifies a dependent economy model which incorporates several developing-country features, including an explicit role for public investment and legal interest rate ceilings. The model is estimated for Pakistan and is used to analyze the country's recent high growth-low inflation experience. In particular, the contribution that external inflows, in the form of workers' remittances and concessional lending, may have made in generating this outcome is assessed.

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Contents

I. Introduction

The "dependent economy" approach to modelling developing countries has been very popular and useful for analyzing the macroeconomic role of the real exchange rate. This approach lends itself readily to studying sectoral shifts of resources and changes in the composition of demand arising from a change in the real exchange rate in response to an exogenous or a policy shock. Although the model has been used extensively in analytical work, surprisingly there are few, if any, empirical economy-wide applications available in the literature. 1/ This paper seeks to fill this void by presenting econometric estimates for a dependent economy representation of the economy of Pakistan.

The dependent economy model is also the standard approach taken for the study of issues relating to the "Dutch disease" phenomenon--a term used to describe the coexistence of an externally-driven booming sector with lagging sectors in a small open economy. 2/ This phenomenon was thought to have been experienced by many countries during the seventies and eighties, when various commodity booms resulted in favorable terms of trade shocks--i.e., sharp increases in the prices of their principal export commodities. 3/ The increase in external inflows in the form of export receipts, or in some cases, in the form of borrowing in anticipation of such receipts, led to an increase in the demand for nontraded goods. The resulting appreciation in the real exchange rate--the relative price of tradables in terms of nontradables--led to a resource shift towards the nontradable sector. Consequently, the tradable goods sector declined, leading to a collapse of the boom and often to severe international indebtedness.

Pakistan's economy is an interesting case for the estimation and use of the dependent economy model, because during the last two decades it has experienced large inflows of remittances from Pakistani workers employed in the oil-exporting countries of the Middle East, as well as a substantial inflow of concessional bilateral external assistance from Middle Eastern as well as western countries. During the period 1973-87, remittances averaged almost 4 percent of GNP while external concessional assistance average over 6 percent of GNP. Yet unlike other countries, Pakistan appears not to have caught the "Dutch disease". Through the 1970s and 1980s, the economy of Pakistan has continued to grow at a comparatively high rate (an average of over 5 percent per year). Moreover, during the same period, inflation remained under control, while the external trade deficit appeared sustainable. Even adverse external shocks such as the two oil shocks of 1973 and 1979 had a limited impact on the economy. The apparent puzzle of the continued high-growth performance of the economy is thought to be in

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1/ For examples of developing country models see Khan, Montiel and Haque (1991).

2/ See, for example, Bevan, Collier, and Gunning (1989).

3/ Commodity booms were experienced in oil, cocoa, coffee, copper, sugar, etc.

part explained by the inflow of remittances and external concessional assistance. To assess the role of such inflows, the estimated model is used to study the macroeconomic effects of external inflows on Pakistan's economy by conducting a variety of counterfactual simulations.

The paper is divided into four sections as follows: Section II sets out the model. This is followed in Section III by a description of the econometric estimates. The simulation results are presented in Section IV. A concluding section discusses the main findings of the paper. Data issues, which are critical in this context, are discussed in Appendix I, while Appendix II contains definitions of the variables.

II. Specification of the Model

As indicated above, the dependent economy approach has long proved useful in analyzing the effects of foreign inflows on an economy where such inflows play an important role. 1/ The approach requires that productive sectors be subdivided into a nontradable sector, which produces goods consumed exclusively at home, and a traded sector, producing goods consumed both at home and abroad. 2/ We assume that physical capital is irreversible--i.e., once in place it becomes sector-specific, and that in each period the price in the nontraded goods market adjusts to clear the market. The traded good is, however, bought and sold in internationally competitive markets. A small country like Pakistan, therefore, faces a perfectly elastic demand for such goods, and any disequilibrium in the traded goods market is therefore reflected in the external trade balance. The real exchange rate affects private decisions concerning the composition of production and consumption between the two goods.

With this brief overview, we now turn to the details of the model.

1. Prices

Denoting the domestic-currency price of tradables and nontradables as P^T and P^N respectively, the overall domestic price level P is given by the weighted average of the prices of the two goods:

$$P_t = {P_t^T}^{\upsilon} {P_t^N}^{1-\upsilon}, \quad (1)$$

1/ See Corden and Neary (1982).

2/ Throughout the paper, the superscript "T" will be used to denote traded goods, while the superscript "N" will be used to describe nontraded goods.

where the weight υ defines the share of tradables in total domestic consumption. The real exchange rate, denoted e, is defined as the price of tradable goods in terms of nontradables:

$$e_t = P_t^T / P_t^N \tag{2}$$

2. <u>Aggregate demand</u>

Total real output in the economy is expressed as the sum of the output of the traded (Y^T) and nontraded (Y^N) sectors, measured in units of the consumption basket:

$$Y_t = \left[P_t^T Y_t^T + P_t^N Y_t^N \right] / P_t \tag{3}$$

where Y_t is real GDP in period t.

Turning to the components of demand in the model, total private consumption (denoted C_t^P) is specified in real per capita terms as:

$$\tilde{C}_t^P = ¢_o + ¢_1 \tilde{C}_{t-1}^P + ¢_2 \tilde{Y}_t^D + ¢_3 \tilde{Y}_{t-1}^D + ¢_4 \pi_t \tag{4}$$

where π_t is the expected rate of increase in the price level P_t, and $\tilde{Y}_t^D$ (private per capita disposable income) is given by:

$$\tilde{Y}_t^D = (Y_t - NT_t - DT_t + \frac{RM_t}{P_t} - i_t DC_{t-1}^P / P_t) / N_t . \tag{5}$$

Tildes (˜) over variables denote per capita magnitudes (i.e., $\tilde{X} = X/N$). NT denotes real indirect taxes, DT is real direct taxes, RM is real remittances receipts from abroad, i is the domestic (controlled) nominal interest rate, DC^P is domestic banking-system credit to the private sector, and N is the population. This formulation of the consumption function embeds several alternative hypotheses. If $¢_o = ¢_2 = ¢_3 = 0$ and $¢_1 = 1$, we get the simplest version of the Hall permanent income hypothesis. Alternatively, if $¢_3 < 1$, current disposable income is important and liquidity constraints are binding for a fraction of households. 1/

Total private consumption is the sum of private consumption of traded (C_t^{PT}) and nontraded (C_t^{PN}) goods:

$$C_t^P = \left(P_t^T C_t^{PT} + P_t^N C_t^{PN}\right)/P_t \tag{6}$$

We assume that households possess CES utility functions. Consequently, solving the consumer's maximization problem, we can determine that the shares of the two goods in total consumption are a function of the relative price of tradables to non-tradables or the real exchange rate. Thus,

$$C_t^{PN} = k_c \; e_t^{\sigma_c} \; C_t^P \tag{7}$$

where k_c and σ_c are positive parameters. The private consumption demand for traded goods is implied by (6) and (7).

Private investment, I_t^P, is the sum of private investment demand originating from firms in the traded (IT_t^P) and nontraded (IN_t^P) sectors. Hence,

$$I_t^P = IT_t^P + IN_t^P \tag{8}$$

A neoclassical formulation of investment demand is adopted here, with some modifications. Since interest rates were controlled by the government for much of our sample period, the change in real domestic credit to the private sector is used as the relevant financial variable, instead of the interest rate. Since we envisage an economy with two goods, changes in the relative price of the two goods will affect the incentives to produce the two goods, and hence affect investment in the two sectors. Consequently, both investment equations contain the real exchange rate--the relative price of traded to nontraded goods--as an explanatory variable. Finally, the government invests in infrastructural development which is regarded as a public good in the production of both goods. Hence the government capital

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1/ See Haque and Montiel (1989), Hall (1978), Flavin (1981) and Blinder and Deaton (1985).

stock is included in both investment equations and is expected to affect both sectors positively. Thus the investment equations are:

$$IT^P_t = \beta_o + \beta_1 Y^T_t + \beta_2 \left(\frac{DC^P_t}{P_t} - \frac{DC^P_{t-1}}{P_{t-1}} \right) + \beta_3 K^T_{t-1} + \beta_4 K^G_{t-1} + \beta_5 e_t . \tag{9a}$$

$$IN^P_t = \gamma_o + \gamma_1 Y^N_t + \gamma_2 \left(\frac{DC^P_t}{P_t} - \frac{DC^P_{t-1}}{P_{t-1}} \right) + \gamma_3 K^N_{t-1} + \gamma_4 K^G_{t-1} + \gamma_5 e_t . \tag{9b}$$

The expectation is that β_1 and γ_1 would be positive. Since the flow of credit is a source of financing for investment, β_2 and γ_2 are also expected to be positive. The signs of β_3 and γ_3 are indeterminate, since an increase in last period's capital stock on the one hand lowers the marginal product of capital, thereby reducing net investment, on the other hand increases total depreciation, thus increasing replacement investment. Since the dependent variable is gross investment, it is clear that the signs of β_3 and γ_3 may be positive or negative. Finally, β_4, γ_4 and β_5 are expected to be positive, while γ_5 is negative for the reasons discussed above.

Investment in each sector is assumed to consist of purchases of both traded and nontraded goods:

$$IT^P_t = \left(P^T_t IT^{PT}_t + P^N_t IT^{PN}_t \right) / P_t \tag{10a}$$

$$IN^P_t = \left(P^T_t IN^{PT}_t + P^N_t IN^{PN}_t \right) / P_t \tag{10b}$$

As in the case of consumption, we assume that the commodity composition of investment spending in each sector is derived from a CES function:

$$IT^{PT}_t = k_{IT} \; e_t^{\sigma_{IT}} \; IT^P_t \tag{11a}$$

$$IN^{PT}_t = k_{IN} \; e_t^{\sigma_{IN}} \; IN^P_t . \tag{11b}$$

In this case, the relevant CES function is a production function that generates sector-specific capital from inputs of both kinds of goods. The sectoral capital stocks accumulate over time according to:

$$K_t^{P,T} = (1 - \delta^T)\, K_{t-1}^{P,T} + IT_t^P \tag{12a}$$

$$K_t^{P,N} = (1 - \delta^N)\, K_{t-1}^{P,N} + IN_t^P \tag{12b}$$

where δ^i is the rate of depreciation in sector i.

The next component of aggregate demand is government expenditure, which is divided into public consumption and public investment: 1/

$$G_t = C_t^G + I_t^G \tag{13}$$

Though typically neglected in econometric models, the separate treatment of public investment is critical in the developing-country context, since the evidence suggests that public investment is a substantial part of total investment in many countries. 2/ Government consumption and investment consist of both traded and nontraded goods. Hence,

$$C_t^G = \left[P_t^T\, C_t^{GT} + P_t^N\, C_t^{GN}\right]/P_t \tag{14a}$$

$$I_t^G = \left[P_t^T\, I_t^{GT} + P_t^N\, I_t^{GN}\right]/P_t. \tag{14b}$$

1/ The superscript "G" denotes government.

2/ See Blejer and Khan (1984), Severn and Solimano (1991), Cardoso (1991), and Larrain and Vergara (1991).

The components of government spending are policy-determined. Public capital is assumed to be in the form of a public good, and thus it is not taken to be sector-specific. It accumulates according to:

$$K_t^G = (1 - \delta^G)\, K_{t-1}^G + I_t^G \tag{15}$$

3. <u>Aggregate supply</u>

Each sector i is endowed with a Cobb-Douglas production function of the form:

$$Y_t^i = \alpha_o^i\, {K_t^{P,i}}^{\alpha_1^i}\, {K_t^G}^{\alpha_2^i}\, {L_t^i}^{\alpha_3^i} \exp\left[\alpha_4^i t\right] \qquad i = T,\, N. \tag{16}$$

where K^G is the public capital stock and L^i is employment in sector i.

Differentiating (16) with respect to L^i, setting the resulting marginal product equal to the product wage and solving for L^i, a demand curve for labor in sector i may be derived. Labor market clearing implies that the sum of the labor demand of the two sectors equals labor supply. Assuming supply to be price-inelastic, labor-market equilibrium permits us to solve for the real wage in terms of tradables, W/P^T, as a function of the three capital stocks, the labor supply, and the real exchange rate. Substituting back into the labor demand functions, and then into the production functions, the aggregate supply of sector i may be written as:

$$\log (Y_t^i) = \lambda_o^i + \lambda_1^i \log (K_{t-1}^{P,i}) + \lambda_2^i \log (K_{t-1}^G) + \lambda_3^i \log (K_{t-1}^{P,j})$$

$$+ \lambda_5^i \log e_t + \lambda_6^i t, \qquad i = T,\, N;\ j = T,\, N;\ i \neq j. \tag{17}$$

with λ_1^i, $\lambda_2^i > 0$, $\lambda_3^i < 0$, and $\lambda_5^i > 0$ for $i = T$, $\lambda_5^i < 0$ for $i = N$. The parameter λ_6^i, which is a function of productivity and labor force growth, is expected to be positive.

4. Money market and remittances

Since interest rates are controlled, the standard money demand equation with an interest rate as the opportunity cost variable is not applicable. Following Khan (1980), the specification

$$\log (M/P)_t = \mu_o + \mu_1 \log (Y_t) + \mu_2 \pi_t + \mu_3 \log(M/P)_{t-1} \qquad (18)$$

is adopted, where M_t is the nominal money supply. 1/ The only modification to Khan's specification is that current inflation, rather than last period's inflation, is included in the money demand function. As in Khan, μ_1 is expected to be positive, and since inflation captures the opportunity cost of holding money, μ_2 is expected to be negative.

As mentioned above, the rapid growth in the receipt of workers' remittances from abroad has played an important part in the recent economic history of Pakistan. An equation for recorded remittances is accordingly included in the model. 2/ Since remittance behavior is expected to be influenced by the level of economic activity in the host region as well as by exchange rate considerations, it can be modelled as follows:

$$\frac{RM_t}{P_t} = \omega_o + \omega_1 \left[e_t - e_{t-1} \right] + \omega_2 \, OIL_t + \omega_3 \frac{RM_{t-1}}{P_{t-1}} \qquad (19)$$

The variable OIL, an index of international oil prices, is intended to capture the demand for Pakistani workers in the Middle East. Since Pakistanis working abroad face a choice between investing abroad or remitting earnings to Pakistan, a change in the real exchange rate, taken as a proxy for expected changes in the nominal exchange rate, will influence the composition of this portfolio. Thus, ω_1 and ω_2 are both expected to be positive, as is the partial-adjustment coefficient ω_3.

1/ With rationed credit, the supply of credit to the private sector could in principle appear as an independent variable in (18). However, this variable was not found to enter our estimated equations with a statistically significant coefficient.

2/ Recall that remittances are included in the definition of household disposable income.

5. Identities and market-clearing conditions

The market for nontraded goods must clear each period. Hence the output of the nontraded sector must equal consumption and investment demand for the nontraded good:

$$Y_t^N = C_t^N + I_t^N \tag{20}$$

Consumption and investment demand for nontraded goods will involve purchases of consumption and investment by both the private and public sectors. Thus, total consumption and investment spending on nontraded goods are:

$$C_t^N = C_t^{PN} + C_t^{GN} \tag{21a}$$

$$I_t^N = IT_t^{PN} + IN_t^{PN} + I_t^{GN} \tag{21b}$$

The difference between domestic output and domestic demand for the traded good for consumption and investment uses is the trade balance (TB_t). Thus,

$$TB_t = P_t\left(Y_t^T - C_t^T - I_t^T \right) \tag{22}$$

where:

$$C_t^T = C_t^{PT} + C_t^{GT} \tag{23a}$$

$$I_t^T = IT_t^{PT} + IN_t^{PT} + I_t^{GT} \tag{23b}$$

The current account is the trade balance plus remittances and net interest receipts on assets held abroad. This may be expressed as

$$CA_t = TB_t + RM_t + i_t^* s_t FA_{t-1} \tag{24}$$

where i* is the foreign interest rate, s is the fixed nominal exchange rate and FA is the economy's stock of net foreign assets expressed in foreign currency units. Foreign assets are held by the central bank (FA_t^c), and the government (FA_t^G):

$$FA_t = FA_t^c + FA_t^G \tag{25}$$

The central bank's foreign assets (net international reserves) evolve according to the balance of payments identity:

$$\Delta FA_t^c = CA_t - \Delta FA_t^G \tag{26}$$

The money supply is the sum of net international reserves of the central bank and total domestic credit:

$$M_t = s_t FA_t^c + DC_t^P + DC_t^G , \tag{27}$$

where DC^G is domestic credit to the public sector. Finally, the public sector's consolidated budget constraint is

$$s_t \, \Delta FA_t^G - \Delta DC_t^G = P_t \left[NT_t + DT_t \right] - P^N (C_t^{NG} + I_t^{NG}) - P^T (C_t^{TG} + I_t^{TG})$$

$$+ i_t^* \, s_{t-1} \, FA_{t-1}^G - i_t \, DC_{t-1}^G \tag{28}$$

where i is the (controlled) interest rate charged on domestic credit. Government revenues derive from taxes (direct and indirect), interest receipts on domestic credit to the private sector, interest receipts on foreign assets, and money creation. The government's expenditures are divided into public consumption and public investment. The difference between revenues and expenditures equals the accumulation of foreign assets plus the accumulation of claims on the private sector via an increase in domestic credit to that sector.

III. Estimation Results

The behavioral equations of this model were estimated for Pakistan using annual data over the years 1968 to 1987. Details of the data sources and definitions, as well as the construction of the empirical counterparts of the variables in the model, are presented in Appendix I. The behavioral equations of the model were estimated using two stage least squares. The results of this estimation are presented in Table 1.

Despite the attempt to keep the structure of the model relatively simple, it nevertheless contains nine behavioral equations with 39 estimated parameters. In view of this and the relatively limited amount of data available, the results of the estimations can be considered to be fairly good. The goodness of fit statistics indicate that the specifications chosen tend to explain about 95 percent of the variation in the data on average, while estimated Durbin-Watson and Durbin's h statistics show that in most of the equations the null hypothesis of no autocorrelation of the error structure cannot be rejected. Finally, in almost all cases the signs of the estimates conform to our expectations.

With these general observations, we can turn to a discussion of the estimates of individual equations:

1. Supply

While in both supply functions the estimated coefficients are of the correct sign, and the coefficients of the capital stock variables are in most cases statistically significant, the most surprising result is the statistical insignificance of the real exchange rate in both of the equations. As expected, however, the real exchange rate is negatively related to the supply of nontraded goods and positively related to the supply of traded goods. As implied by the derivation of the supply equations, the capital stock installed in a particular sector is positively related to the supply of output of that sector, while the installed capacity in the competing sector is negatively related to the output of the sector. The government capital stock is positively related to outputs in both sectors. However, judging from the magnitude of the coefficient of this variable in the estimated supply functions, the effect of the public sector capital stock is much weaker in the traded goods sector than in the nontraded goods sector.

2. Investment

In both sectors, private investment responds positively to increased sectoral output, to increases in the supply of real domestic credit to the private sector, and to an increase in the relative price of the sector's output. Surprisingly, neither the government capital stock nor the current level of the real exchange rate proved to be significant in explaining investment behavior. However, the coefficient of the lagged real exchange

Table 1. Model Estimates

A. Supply

Nontraded Goods Supply Function.

$$Log(y^N_t) = \underset{(3.98)}{4.169} + \underset{(8.26)}{0.057}\ TREND_t - \underset{(-0.83)}{0.056}\ Log(e_t) - \underset{(-2.45)}{0.772}\ Log(K^T_{t-1})$$

$$+ \underset{(2.89)}{1.043}\ Log(K^N_{t-1}) + \underset{(1.93)}{0.233}\ Log(K^G_{t-1})$$

$$R^2 = 0.99 \qquad D.-W. = 2.09$$

Traded Goods Supply Function.

$$Log(y^T_t) = \underset{(4.73)}{6.391} + \underset{(4.02)}{0.035}\ TREND_t + \underset{(0.66)}{0.057}\ Log(e_t) + \underset{(2.51)}{1.018}\ Log(K^T_{t-1})$$

$$- \underset{(-1.67)}{0.779}\ Log(K^N_{t-1}) + \underset{(0.40)}{0.062}\ Log(K^G_{t-1})$$

$$R^2 = 0.99 \qquad D.-W. = 2.02$$

B. Investment

Investment in the Nontraded Goods Sector.

$$IN^P_t = \underset{(-0.90)}{-417.346} + \underset{(5.42)}{0.038}\ y^N_t + \underset{(1.47)}{0.052}\ \Delta(DC^P_t/P_t) + \underset{(3.74)}{0.049}\ K^N_{t-1} - \underset{(-2.52)}{595.710}\ e_{t-1}$$

$$R^2 = 0.94 \qquad D.-W. = 0.98$$

Investment in the Traded Goods Sector.

$$IT^P_t = \underset{(-4.09)}{-1743.530} + \underset{(4.88)}{0.061}\ y^T_t + \underset{(3.55)}{0.169}\ \Delta(DC^P_t/P_t) + \underset{(4.37)}{0.481}\ K^T_{t-1} + \underset{(0.10)}{30.830}\ e_{t-1}$$

$$R^2 = 0.94 \qquad D.-W. = 1.60$$

Investment Demand for the Nontraded Good.

$$\text{Log}\left(\frac{I_t^{PN}}{I_t^P}\right) = -\underset{(42.51)}{0.808} + \underset{(5.70)}{0.306}\,\text{Log}(e_t)$$

$R^2 = 0.99$ D.-W. = 1.70

C. <u>Consumption</u>

Aggregate Consumption.

$$\tilde{C}_t^P = -\underset{(-0.32)}{3.990} + \underset{(0.58)}{0.122}\,\tilde{C}_{t-1}^P + \underset{(4.63)}{0.774}\,\tilde{y}_t^d - \underset{(-0.04)}{0.010}\,\tilde{y}_{t-1}^d + \underset{(1.75)}{72.851}\,\pi_t$$

$R^2 = 0.99$ D.-W. = 1.86

Consumption of the Nontraded Good.

$$\text{Log}\left(\frac{C_t^{PN}}{C_t^P}\right) = -\underset{(48.02)}{0.961} + \underset{(5.26)}{0.297}\,\text{Log}(e_t)$$

$R^2 = 0.99$ D.-W. = 1.70

D. <u>Remittances</u>

Remittance Behavior.

$$RM_t = \underset{(0.38)}{198.643} + \underset{(2.41)}{6748.930}\,\Delta(e_t) + \underset{(1.95)}{137.31}\,OIL_t + \underset{(8.68)}{0.712}\,RM_{t-1}$$

$R^2 = 0.98$ D.-W. = 1.90

E. <u>Demand for Money</u>

$$\text{Log}\left(\frac{M_t}{P_t}\right) = \underset{(-0.60)}{-0.212} + \underset{(2.49)}{0.295}\,\log(y_t) - \underset{(-5.10)}{1.310}\,\pi_t + \underset{(5.83)}{0.717}\,\text{Log}\left(\frac{M_{t-1}}{P_{t-1}}\right)$$

$R^2 = 0.98$ D.-W. = 1.83

rate bears the right sign and is statistically significant in both equations, indicating perhaps some lags in adjustment.

Gross investment is positively related to the capital stock, though the coefficient of the capital stock in the traded goods sector investment equation is implausibly high. Not surprisingly, the effects of an expansion in domestic credit are stronger on the supply of traded goods than on that of nontraded goods.

3. Consumption

Although the estimated consumption function has a high R^2 and a Durbin's h statistic that suggests that the residuals of the equation are non-autocorrelated, the coefficient of lagged consumption, though of the right sign, is not significant and close to unity as implied by the permanent income hypothesis. 1/ However, the coefficient of disposable income is positive and significant, in line with expectations. This coefficient, which measures the incidence of liquidity constraints in the population, suggests that roughly three quarters of the population is liquidity constrained. This fraction is larger than similar estimates derived for the proportion of population that is liquidity constrained in other countries by Haque and Montiel (1989).

The coefficient of the rate of inflation is positive and significant at the 10 percent level. This suggests that the private sector's reaction to inflation is to move out of money and into goods, therefore increasing current private consumption.

4. Remittances

The remittance equation appears to fit the data rather well, as judged by the coefficient of determination and the coefficients of the explanatory variables. The coefficient of lagged remittances is large and significant, reflecting considerable inertia in remittance behavior. This is to be expected given the nature of the migrant worker phenomenon in Pakistan. 2/

The proxy for the level of economic activity in the host country, the price of oil relative to the international price level, is of the right (positive) sign and statistically significant. As expected, then, increased

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1/ For a detailed discussion of the modelling and estimation of a consumption function using the approach employed here, see Haque and Montiel (1989).

2/ The typical migrant worker moves to the Middle East, leaving his family at home. Despite exogenous shocks of various kinds, remittances have displayed a fair amount of inertia, reflecting the consumption needs of the family that has been left at home. This behavior is captured well by the coefficient of the lagged remittance variable.

economic activity in the oil-producing Middle Eastern countries leads to increased remittances.

Finally, the coefficient of the change in the real exchange rate is positive and significant, suggesting that a depreciation of the real exchange rate reduces expectations of devaluation and thus encourages an increase in remittances.

5. Demand for money

The estimating form for the money demand function is fairly standard. All the variables are statistically significant, and the signs of their coefficients conform to theoretical expectations. Moreover, the estimates are similar to those for other developing economies, indicating that both the income and inflation elasticities of money demand are relatively small. In the short run, an increase in the growth rate of the economy by one percentage point increases money demand by only about 0.3 percent, while a percentage-point increase in the rate of inflation reduces money demand by about one-tenth of one percent.

The coefficient of the lagged dependent variable is, as elsewhere, significant, positive, and less than one. This coefficient measures the stock-adjustment behavior in the money demand equation. The magnitude of the coefficient implies that full adjustment to any change in the exogenous variables is a drawn out process--i.e., the mean lag is two to three years.

IV. Solution of the Model

To describe how the model is solved, we begin by specifying the policy variables. The government is assumed to directly control the components of its primary deficit--i.e., its own spending for consumption (C^G) and investment (I^G), as well as both direct (DT) and indirect taxes (NT). In addition to these, the government also determines the amount of its external borrowing (ΔFA^G). The monetary authorities, on the other hand, set the official exchange rate s, determine the amount of lending to the private sector (ΔDC^P) and set the administered interest rate (i).

For the model's short-run solution, a number of variables are taken as predetermined. 1/ These include last period's values of all real (K^T_{t-1}, K^N_{t-1}, K^G_{t-1}) and financial (FA^P_{t-1}, FA^C_{t-1}, FA^G_{t-1}, DC^P_{t-1}, DC^G_{t-1}) stocks, as well as lagged disposable income ($\tilde{Y}^D_{t-1}$), consumption (C^P_{t-1}), and

1/ For a fuller explanation of the solution of such models see Haque and Montiel (1991).

relative prices (ρ_{t-1}). In addition to these predetermined variables, purely exogenous variables include the size of the labor force (L_t) and the population (N_t), as well as the external variables (OIL_t and i_t^*).

It is useful to organize the solution of the model around two equations. Equation (20), the market-clearing condition for non-traded goods, is the first of these. Substituting equation (17) in (20), after using (2), expresses the supply of nontraded goods as a function of the price of nontraded goods P^N, plus other variables that are predetermined or exogenous. On the demand side of this equation, first C^N and I^N are divided into their private and public components using equations ((21a) and 21b). Next, to express the consumption demand for nontraded goods as a function of P^N, substitute (17) into (3), and the result into (5). After also using the remittance equation (19) in (5), the resulting expression for disposable income can be substituted in the consumption function (4). Using this in (7) expresses the private consumption demand for nontraded goods as a function of the real exchange rate plus predetermined, exogenous, and policy variables. Next we turn to the investment component of private demand. Using equations (17) in (9a) and (9b), followed by (9a) and (9b) in (11a) and (11b), and using (10a) and 10b), we can derive expressions for IT^{PN} and IN^{PN} which depend only on two endogenous variables (P^N and ΔDC^P). Using these expressions in (20) yields the market-clearing condition for nontraded goods as a function of P^N and ΔDC^P plus exogenous and predetermined variables.

A second relationship between P^N and ΔDC^P can be derived from the financial side of the model. First, we use equations (17) to express real output Y in equation (3) as a function of P^N. We then substitute this expression for Y in the money market equilibrium equation (18). The resulting expression for M can be used directly in the central bank balance sheet (27), yielding an expression which contains, in addition to DC_t^P and P_t^N, the endogenous variables FA_t^c and DC_t^G. The latter can be eliminated as follows: since ($DC_t^G = DC_{t-1}^G + \Delta DC_t^G$), ΔDC_t^G can be eliminated by substituting from the government budget constraint (28). Similarly, writing (FA_t^c as $FA_{t-1}^c + \Delta FA_t^c$) permits us to eliminate ΔFA_t^c by substituting from the balance of payments identity (26). It is then a straightforward matter to express the current account portion of the balance of payments as a function of DC_t^P, P_t^N and exogenous and predetermined variables by using equations (22) - (24) and a procedure similar to that described in the preceding paragraph.

The two relationships described above, derived from the real and financial side of the model, together determine the equilibrium values of

DC^P and P^N. The solution for P^N determines the real exchange rate e (from (2)), and (17) can then be used to determine the sectoral outputs Y^T and Y^N. Y^T and Y^N in turn determine total GDP (Y) from (3). Given Y and RM, equation (5) determines disposable income Y^D, which from the consumption function (4) yields C^P. Similarly, equations (9a) and (9b) determine IT^P and IN^P respectively. Given these, the sectoral components of private consumption and investment can now be derived from equations (6) and (7), as well as (10) and (11). With all the components of the trade balance thus determined, equation (19) yields TB and (24) produces CA. From (26), it is then possible to solve for the balance of payments. Notice that the effects of remittance receipts are transmitted through changes in private consumption, while foreign capital inflows directly affect the extent to which government credit demands crowd out the private sector.

The complete model (i.e., the estimated equations plus the accounting identities) proved to be dynamically stable, as all the eigenvalues of the matrix of coefficients of the endogenous variables were estimated to be less than one. 1/ As a check, the model was solved for the seventies and eighties and appeared to track the data fairly well. This indicates that the model provides a reasonable representation of the behavior of the Pakistan economy during this period, suggesting that it can serve as a useful tool for counterfactual simulations.

V. External Inflows, the Public Sector Deficit and Economic Performance

As discussed in the introduction, in the last two decades external inflows increased significantly in Pakistan both because of the availability of external concessional assistance from a consortium of donors and because of a growing number of workers employed in the Middle Eastern oil producing countries. At the same time, the ratio of the public sector deficit to GDP has been high compared to other developing countries over this period. 2/ This raises the possibility that the noninflationary growth of the last decade in the face of a large fiscal deficit was made possible because of the receipt of such inflows. 3/ We used our model to study this proposition by conducting counterfactual simulations in which the amount of external inflows for the years 1974 to 1987 was reduced and the effects on the economy were analyzed when: (a) the government attempted to continue to run the level of deficit that it did during the period; and (b) when the public sector deficit was forced to adjust. In both cases the external borrowing of the government as well as the flow of remittances were reduced by 50 percent respectively in each year. The results of the simulation exercises are discussed below.

1/ The model simulations and calculations for stability were all performed in TROLL.

2/ For an analysis of the macroeconomic effects of fiscal deficits in Pakistan see Haque and Montiel (1990).

3/ See Khan (1990).

1. A policy of no adjustment

In this case it is assumed that the government attempts to make no adjustment in its spending or revenues. The reduction in external borrowing that is imposed exogenously by our counterfactual simulation is offset by borrowing from the central bank to finance the same level of the fiscal deficit that actually prevailed over the period 1974 to 1987. Consequently, credit to the public sector from the central bank expands rapidly over this period. Given the fixed exchange rate regime, the amount of money that is willingly held by the private sector, however, remains unchanged. In order to defend the exchange rate the central bank must exercise one of two options: either to lose reserves or to reduce credit to the private sector.

Since external reserves and external borrowing by the government are perfect substitutes in the model, when these reserves are used to finance the lending to the government, there are no real effects on the economy. Both government expenditures and the domestic money supply remain unchanged and the increased supply of credit to the government merely translates into a reserve loss of the central bank. Relative to the baseline, a rapid reserve loss takes place for each of the years under review. The reserve loss reaches about 55 percent of GDP which, given the already low level of reserves that were available during the period, would clearly have been untenable. A large and rapid reserve loss as implied by this experiment would have resulted instead in some change in policy and at the very least made the exchange rate indefensible. It would be fair to conclude, therefore, that adjustments would be forced upon the economy at some point if such a reduction in foreign borrowing took place.

2. A policy of fiscal deficit reduction

As a response to the reduced availability of external resources, it is now assumed that the government attempts to reduce the fiscal deficit. Three alternative strategies for the reduction of the fiscal deficit were considered: (a) a reduction in government consumption of nontraded goods; (b) a reduction in government investment consisting of reduced purchases from the traded goods sector; and (c) increased indirect taxation. 1/

Counterfactual simulations for the three alternative deficit reduction strategies were run for the period 1974 to 1987. The results of the simulations are presented in Tables 2 and 3. Table 2 presents the results for the three target variables: inflation, growth, and the current account, while Table 3 presents the effects of the alternative policies on key economic variables that help explain the behavior of the targets. In both tables the results presented are period averages of deviations from the baseline. The fourteen year period has been divided into two sub-periods to

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1/ In order to isolate the effects of the experiments that we were conducting, all equations were made to hold identically by means of adding in a calculated residual term to each equation.

Table 2. Counterfactual Effects of a Reduction in External Financing: Adjustment of the Fiscal Deficit

(Average deviation from baseline/actual data during the period: in percent)

	Inflation	Growth	Ratio of Current A/c to GDP
The Short Run--1974-77 Adjustment in:			
Government Consumption of Nontraded Goods	-1.0	0.7	2.5
Government Investment of Traded Goods	-0.3	-0.3	2.3
Indirect Taxation	-1.0	0.5	2.3
The Long-Term--1978-87 Adjustment in:			
Government Consumption of Nontraded Goods	-0.4	0.6	2.4
Government Investment of Traded Goods	0.8	-0.7	2.3
Indirect Taxation	0.8	-0.3	2.2

Table 3. Counterfactual Effects of a Reduction in External Financing: Adjustment of the Fiscal Deficit
(Average deviation from baseline/actual data during the period; in percent)

	Ratio of Fiscal Deficit to GDP	Real Exchange Rate	Ratio of Private Consumption to GDP	Ratio of Private Consumption of Traded to Nontraded Goods	Ratio of Traded to Nontraded Goods Production	Growth of Traded Goods Production	Growth of Nontraded Goods Production
The Short Run--1974-77 Adjustment in:							
Government Consumption of Nontraded Goods	2.9	7.9	-1.8	-12.6	4.5	1.3	-1.0
Government Investment of Traded Goods	3.0	0.8	-1.7	-0.7	1.2	-0.1	-0.8
Indirect Taxation	3.0	4.7	-4.0	-6.2	2.0	0.6	-0.5
The Long Term--1978-87 Adjustment in:							
Government Consumption of Nontraded Goods	4.0	-2.7	-3.3	7.3	15.3	1.0	-1.2
Government Investment of Nontraded Goods	3.8	-1.9	-3.4	6.5	5.0	-0.1	-0.8
Indirect Taxation	4.0	-1.7	-5.3	5.9	8.5	0.7	0.8

capture short-run and long-run effects. The short run has arbitrarily been defined to be from 1974 to 1977, and the long run from 1978 to 1987.

a. Reduced government consumption of nontraded goods

When the fiscal deficit is reduced via decreased government consumption of nontraded goods, aggregate demand for such goods in the economy declines upon impact. As a result, the price of nontradables falls to clear the nontraded goods market, since by definition this good is purely consumed and produced at home. Given that the price of tradables is internationally determined and that the nominal exchange rate is fixed, the real exchange rate depreciates by about 8 percent (see Table 3) in the short run. The depreciation of the real exchange rate makes nontradables cheaper relative to tradables, so private consumption of tradables falls while that of the now cheaper nontradables rises (see Table 3).

On the production side, due to the depreciation in the real exchange rate, resources are now directed to the more profitable tradable sector. During the short run, therefore, the ratio of tradable goods production to that of nontradables increases relative to the baseline by an average of about 4.5 percent. Growth of traded goods production increases by an average of 1.3 percent annually while that of the nontraded goods sector declines by an annual average of 1 percent.

Several macroeconomic indicators of economic performance are improved by this policy, as shown by the deviations from the baseline for the target variables in Table 2. Inflation falls, growth rises, and the current account balance improves relative to GDP. Total domestic inflation falls by an average of about 1 percent each year during the first four years following the shock. On balance, growth increases by about 0.7 percent per annum over the actual levels that had prevailed in the period. Reflecting the decline in the consumption as well as the increase in the production of tradable goods, the current account improves by about 2.5 percent of GDP over the baseline average for the period. The ratio of the fiscal deficit to GDP also improves by about 3 percent over its average baseline value for the period.

In the long run, reflecting the earlier decline in the nontraded goods sector, the supply constraint begins to bite in that sector due to a reduced capital stock, and the price of nontraded goods starts to rise. Given the fixed exchange rate policy, the real exchange rate appreciates, causing consumption to switch towards tradable goods and production to nontradable goods. Both the acceleration in the growth of the traded goods sector and the decline in the nontraded goods sector are therefore dampened. As a result of the slowdown in the growth of the traded goods sector and the continued--albeit slower--decline in the nontraded goods sector, growth, though remaining higher than its baseline level, exceeds that level by only half a percentage point during the period. Reflecting the policy of fiscal deficit reduction, the current account continues to show an improvement of about 2.4 percentage points of GDP relative to the baseline over the longer time period.

b. Reduced government investment

Turning to fiscal adjustment by means of reducing government investment in traded goods, Table 2 suggests that economic performance, again as measured by conventional indicators, is more adversely affected in this case than under the first policy alternative discussed above. While the current account correction is roughly comparable in the two counterfactuals, growth is reduced, with lower government investment in both periods, and the rate of inflation is higher over the long term.

Since the government capital stock acts like a public good, affecting the supply functions of both goods, output in both sectors is reduced in this case. However, given that the estimated coefficient of the public capital stock is higher in the nontraded goods sector, growth is reduced by more in that sector. Because of the deceleration in growth in that sector the ratio of output of traded goods to that of nontraded goods shows an increase over time.

Since there is a decline in output in both sectors relative to the baseline, growth in the aggregate is also lower (see Table 2). As output is less, private disposable income falls, leading to a reduction in consumption. This reduction in domestic aggregate demand leads to a small decrease in the domestic price level, and hence a small depreciation in the real exchange rate, especially in the short run. Once again, we observe that in the absence of an active exchange rate policy, the real exchange rate appreciates in the second period as the continued reduction in the government capital stock reduces the growth of nontraded goods by more than that of traded goods.

c. Increased taxation

An increase in indirect taxation directly reduces consumers' disposable income and hence depresses aggregate demand. Since only the nontraded goods price can adjust, this leads to a depreciation in the real exchange rate. Effects similar to the ones described in the previous simulations are once again observed. The fiscal adjustment again leads to a correction in the current account. Growth increases for the first period as the depreciation in the real exchange rate leads to an expansion in traded goods output. However, reduced domestic demand dampens growth in the second period. Overall, based on conventional indicators, macroeconomic performance under this mode of adjustment is less favorable than when adjustment takes the form of reduced government consumption of nontraded goods, but more favorable than in the case of reduced public investment.

VI. Conclusions

The objective of this paper has been to assess empirically issues related to the "Dutch disease" phenomenon. The behavior of the Pakistan economy over the period 1974-87 provides an interesting case study in this regard. The continued respectable growth performance of the economy is often attributed to the large inflows of remittances and external concessional assistance. In an effort to measure the effects of these inflows, we specified and estimated an empirical "dependent economy" macroeconomic model for Pakistan, and then undertook counterfactual simulations with that model to examine how reduced inflows might have affected the country's performance as measured by standard aggregate indicators.

To our knowledge, this represents among the first attempts to implement the dependent economy framework empirically, so our first conclusion is that, while data problems are indeed daunting, and rather strong assumptions may need to be made, meaningful empirical results can be obtained. This suggests that the dependent economy model can be a very useful empirical tool in addressing developing-country macroeconomic issues.

Our findings suggest that the view one takes about the role of external inflows in Pakistan's recent economic history depends on the uses to which one assumes that they were put. In other words, it depends on how policy would have been different in the absence of such inflows. If Pakistan's fiscal authorities had attempted to implement the policies actually carried out in the absence of one half of the observed external inflows, the country's foreign exchange reserves would quickly have disappeared and the exchange rate could not have been sustained.

It is more likely, however, that the fiscal policy actually observed was in part the result of the availability of external resources. If so, to the extent that these resource flows led to increased government consumption of nontradables, Pakistan's macroeconomic indicators might actually have deteriorated as a result of external inflows, i.e., the country could have done better, at least as measured by such indicators, by foregoing its access to such resources and instead maintaining lower fiscal deficits, implemented through reduced government consumption of nontradables.

If instead the access to external resources permitted Pakistan to sustain greater levels of government investment, or to maintain lower levels of indirect taxation, than would otherwise have been the case, then these resources may indeed have made substantial contributions to Pakistan's macroeconomic performance. While access to external resources obviously permitted Pakistan to run a larger current account deficit than it may otherwise have, our results suggest that growth in particular may have averaged 1/2-3/4 of a percent lower per year had only half of the observed inflows materialized.

Data Issues and Methodology

Three sets of data are unavailable, and have to be constructed for the purposes of estimation. These are discussed below.

1. Sectoral composition of spending

Only data on aggregate consumption and investment are available. The model, however, requires a sectoral breakdown. If it is assumed that $\sigma_C = \sigma_{IT} = \sigma_{IN}$ and $k_C = k_{IT} = k_{IN}$, then $IT^{PT} = \theta IT^P$ and $IN^{PT} = \theta IN^P$, where $\theta = C^{PT}/C^P$. Applying the same ratio to the composition of public investment spending implies $I^T = \theta I$. From equation (22):

$$C_t^T = \frac{Y_t^T - TB_t}{1 + \frac{I_t}{C_t}} \tag{29a}$$

$$I_t^T = \frac{Y_t^T - TB_t}{1 + \frac{C_t}{I_t}} . \tag{29b}$$

Since all the data on the right-hand side of (29a) and (29b) are observable, this permits us to construct C^T and I^T. Assuming the government only consumes non-traded goods, $C^{PT} = C^T$. From this relationship and (29a), the components of private consumption can be constructed. Similar procedures were followed for public and private investment, using (29b).

2. Capital stock

Capital stock series are also not available for either the public sector or the private sector. Based on the identities (12a), (12b), and (15), capital stocks may be calculated for each sector if the initial capital stock is given and depreciation rates are known. To construct these series, an initial total capital/output ratio of three was assumed. (Total capital, of course, is just the sum $K^G + K^N + K^T$.) Depreciation in each sector was assumed to be ten percent. Finally, the initial composition of the capital stock was assumed to be:

$$\frac{K^G}{K} = \frac{1}{2} \quad \frac{K^N}{K} = \frac{2}{9} \quad \text{and} \quad \frac{K^T}{K} = \frac{5}{18} \tag{30}$$

3. Real exchange rate

Data on the sectoral composition of GDP was used to allocate total output across the traded and nontraded goods sectors. The traded goods sector is assumed to consist of agriculture, manufacturing, and mining, while the rest of GDP is allocated to the nontraded sector.

The weighted average of the GDP price deflators for each nontraded sector, with each sector's weight calculated in proportion to its share in total nontraded output, was used to compute P^N. The U.S. producer price index is converted to domestic currency units using the nominal exchange rate and is used as a proxy for P^T.

Variable definitions

a. Prices

P^T = domestic currency price of tradables.

P^N = domestic currency price of nontradables.

P = overall domestic price level

e = real exchange rate

s = nominal exchange rate

b. Output

Y^N = real output of nontradables

Y^T = real output of tradables

Y = real output

c. Consumption

C^P = real private consumption

C^{PT} = real private consumption of tradables

C^{PN} = real private consumption of nontradables

C^{GT} = real government consumption of tradables

C^{GN} = real government consumption of nontradables

d. Investment

IT^P = real investment in traded sector

IN^P = real investment in nontraded sector

IT^{PT} = real purchases of traded goods for investment in traded sector

IT^{PN} = real purchases of nontraded goods for investment in traded sector

IN^{PT} = real purchases of traded goods for investment in nontraded sector

IN^{PN} = real purchases of nontraded goods for investment in nontraded sector

I^{PT} = real purchases of traded investment goods

I^{PN} = real purchases of nontraded investment goods

I^{P} = total real private investment

I^{G} = total real public investment

I^{GT} = real purchases of traded goods for investment in public sector

I^{GN} = real purchases of nontraded goods for investment in public sector

δ^{T} = depreciation rate of traded sector capital stock

δ^{N} = depreciation rate of nontraded sector capital stock

K^{T} = real capital stock in traded sector

K^{N} = real capital stock in nontraded sector

K^{G} = real public sector capital stock

L^{i} = Labor in sector i

e. Money

M = nominal money supply

π = inflation rate

i = domestic nominal interest rate

i^{*} = foreign nominal interest rate

DC^{G} = stock of domestic credit to the public sector

DC^{P} = stock of domestic credit to the private sector

f. Other

OIL = index of world oil prices

RM = remittances

TB = trade balance

CA = current account

FA = foreign assets in foreign currency units

FA^C = foreign assets of the central bank, in foreign currency units

FA^G = foreign assets of the government, in foreign currency units

NT = real indirect taxes

DT = real direct taxes

Y^D = real disposable income

N = population

G = real government expenditure

References

Bevan, D., P. Collier, and J. W. Gunning, "Fiscal Response to a Temporary Trade Shock: The Aftermath of the Kenyan Coffee Boom," unpublished, Oxford Institute of Economics and Statistics, 1989.

Blejer, M. I. and M. S. Khan, "Government Policy and Private Investment in Developing Countries," IMF Staff Papers (June 1984), Vol. 31, pp. 379-403.

Blinder, A. S., and A. C. Deaton, "The Time Series Consumption Function Revisited," Brookings Papers on Economic Activity: No.2 (Washington: The Brookings Institution, 1985), pp. 465-511.

Cardoso, E., "Macroeconomic Environment and Capital Formation in Latin America," unpublished, World Bank, 1991.

Corden, M. and J. P. Neary, "Booming Sector and De-Industrialization in a Small Open Economy," Economic Journal (December 1982), pp. 825-48.

Flavin, M., "The Adjustment of Consumption to Changing Expectations About Future Income," Journal of Political Economy (October 1981), Vol. 89, pp. 974-1009.

Giovannini, A., "Saving and the Real Interest Rate in LDC's," Journal of Development Economics (August 1985), Vol. 18, pp. 197-217.

Hall, R. E., "Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence," Journal of Political Economy (December 1978), Vol. 86, pp. 971-87.

Haque, N. U., and P. Montiel, "Consumption in Developing Countries: Tests for Liquidity Constraints and Finite Horizons," Review of Economics and Statistics (August 1989), Vol. 71, pp. 408-415.

_____, "The Macroeconomics of Public Sector Deficits: The Case Pakistan" World Bank Country Economics Department Working Paper (WPS 673), May 1991.

_____, "Dynamic Responses to Policy and Exogenous Shocks in an Empirical Developing Country Model with Rational Expectations," Economic Modelling (April 1991), pp. 201-218.

Khan, M. S., "Monetary Shocks and the Dynamics of Inflation," IMF Staff Papers (June 1980), Vol. 27, pp. 250-84.

_____, "Macroeconomic Policies and the Balance of Payments in Pakistan, 1972-1986," IMF Working Paper WP/90/78, September 1990.

_____, P. Montiel and N. U. Haque, "Mactoeconomic Models for Adjustment in Developing Countries," IMF 1991.

Larrain, F., and R. Vergara, "Investment and Macroeconomic Adjustment: The Case of East Asia," unpublished, World Bank, 1991.

Severn, L., and A. Solimano, "Economic Adjustment and Investment Performance in Developing Countries: The Experience of the 1980's," unpublished, World Bank, 1991.