The Impact of Public Investment on Private Capital Formation: A Study Relating to Mexico

Miguel D. Ramirez

INTRODUCTION.

In many developing nations the government plays an important role in the provision of social overhead capital and market information services. Mexico is no exception. The Mexican state, through industrial development banks such as Nacional Financiera, S.A., has channelled domestic and foreign funds to infrastructure and basic industry. They have invested in the nation's railways, highways, bridges, modern power plants, irrigation projects, dams, and port facilities (see Barr, 1983; Hansen, 1971; Newell, 1984; Ramirez, 1989a; and Reynolds, 1970). Moreover, as their counterparts in other Latin American nations, have regarded intervention by the state as justifiable when projects of crucial importance to the nation are at stake (see Vernon, 1964; Meier, 1989). As far back as the early thirties, they came to the realisation that private investors would be reluctant to channel resources to projects whose social cost (benefit) is less (greater) than its private cost (benefit). Put differently, the unmodified interaction of private agents in markets characterized by the existence of monopolies and the lack of fully developed markets for capital, insurance, and information has led to savings and investment rates which are less than optimal. By making public and private markets work more efficiently, government investments in social capital goods have generated substantial positive spillover effects for the private sector.

Despite evidence which suggests that substantial complementarities may be present between private and public investment in developing nations—not to mention developed ones—most macroeconomic models and textbooks continue to assume that government and private spending are independent of one another. Only in recent years have economists begun to develop theoretical models and empirical formulations which relinquish this restrictive assumption. Barth and Corden (1980), for example, investigated the theoretical implications of a macroeconomic model in which government spending could either complement or substitute for private spending. More recently, Feder (1983), Ratti Raim (1986), and Aschauer (1988; 1989) have developed and empirically tested similar theoretical constructs in which government is explicitly included as an argument in the production function for the private sector. Lastly, Ramirez (1986a) has shown that within such a framework the composition of government spending may be treated as an additional policy instrument in setting a stable assignment in a simple closed economy.

This study seeks to assess both conceptually and empirically the role and impact of the state as investor in the Mexican economy. The need for such a study becomes all the more important in view of the IMF-sponsored stabilization measures implemented by Mexico and other Latin American nations during the eighteen and early nineties as a result of the debt crisis—measures which have stashed public spending across the board and thus generated a precipitous decline in the level of public investment on infrastructure and basic industry. To the extent that public investment has a direct impact on private investment, this further decreases the overall rate of capital formation.

* Associate Professor of Economics Trinity College, Summit Street Hartford, CT 06106
The paper is organized as follows. First, it briefly describes the role of the Mexican state in the process of capital accumulation during the 1950-1966 period. Next, the paper develops a theoretical model which disposed of the independence assumption by explicitly incorporating public capital spending in the investment function for the private sector. In addition, it includes government spending on collective consumption goods as an argument in the private consumption function in view of the state’s extensive provision of subsidized food, transportation, and housing in developing countries. The paper will then proceed to estimate a simple Keynesian macroeconomic model for Mexico which incorporates both of these economic relationships. It also disaggregates government investment spending in order to assess which types of public spending are complementary with private investment spending. The paper thus considers an important issue which has not yet received adequate treatment in the existing development literature. The discussion will be brought to a close by considering the policy implications that emerge when the composition of government spending is incorporated as an additional policy instrument.

DESCRIPTIVE BACKGROUND

The Mexican government’s role in the accumulation process during the 1950-1966 period has been relatively significant as evidenced by its average coefficient of participation. During the 1950-66 period the state’s share of total gross fixed capital formation averaged 46% and 40%, whereas in the 1975-80 period it fluctuated between 39% and 45% percent. It was even higher during the sixties when the Mexican government intervened heavily in the economy to ensure an adequate supply of labor, raw materials, and minerals for the armed war effort (see Hansen, 1971).

To gain a more complete description of the behavior of public investment for the period in question it is useful to focus on its distribution by sector, as well as its ratio to government consumption expenditures. During the 1947-62 period, for example, the Mexican government allocated a significant fraction of its overall investment expenditures more or less evenly between infrastructure (35%) and basic industry (32%). However, beginning with the administration of Gustavo Diaz Ordaz (1964-1970), and especially those of Lopez Portillo (1976-82) and Miguel de la Madrid (1982-88), the emphasis shifted towards promoting the country’s basic industry (e.g., petroleum, gas, electrical energy, steel, etc.). During the 1964-86 period the share of overall investment expenditures channeled to industry averaged close to 45 percent, while that allocated to infrastructure averaged only 16 percent of the total.

The ratio of public investment to consumption reflected this overall trend by averaging about 1.3 for the 1947-64 period, and only 0.8 for the 1965-86 period—failing an on all-time low of 0.75 for the 1983-86 interval. This is explained by the Mexican government’s intense pursuit of an import-substitution industrialization (ISI) strategy during the earlier period. On the other hand, the decrease in the ratio during the seventies and eighties, can be attributed to the country’s economic and financial difficulties, and the adoption of an IMF stabilization program beginning in 1982. In retrospect, the rapid economic growth of the “miracle years” of the sixties and the oil-petroleum-led boom of the 1977-81 period was achieved at the expense of sectoral imbalances in the allocation of resources, excessive protection of the emerging industrial sector, and inflationary pressures, which ultimately exhibited themselves in rising current-account deficits and an excessive reliance on foreign funds.

Having said this, the harsh austerity measures implemented during the eighties to deal with Mexico’s development crisis have stunted private spending in an indiscriminate fashion despite evidence which suggests that substantial complementarities may be present between certain types of public and private investment. Consider, for example, Figure 1 below which displays annual percentage changes for both public and private gross fixed investment during the 1974-86 period. It clearly shows that during the 1982-86 period both public and private investment experienced negative growth rates except for 1984—an election year. More importantly, Figure 1 reveals that changes in public investment are closely mirrored by changes in private investment. Thus, it seems to be evidence to indicate that the draconian cuts in public investment undertaken by the Mexican state during the eighties have been partly responsible for the precipitous drop in gross domestic investment—the country’s future source of employment and growth.

CONCEPTUAL MODEL

The conceptual model employed in this study is a modified version of one originally developed by Barth and Cordes (1980). It can be represented by the following system of equations:

\[ y = c(y, l) + g(l, x) + x + \phi y^{**}, \alpha - m(y, c) \]

\[ 0 < c_1 < 1, c_2 \frac{d}{dy} y, \lambda_1, \lambda_2 > 0 \]

\[ x_1 > 0, x_2 > 0, 0 < m_1 < 1, m_2 < 0 \]

\[ M = L(y, x) \]

\[ L_1 > 0, L_2 < 0 \]

where \( y \) = level of real income; \( c \) = real private consumption expenditures; \( x \) = real export demand; \( m \) = real import demand; \( L \) = real private investment expenditures; \( \phi \) = exchange rate, defined to be the price of foreign currency in terms of domestic currency; \( x \) = level of real foreign income; \( t \) = rate of interest; \( g \) = real government expenditures; \( m_1 \) = government expenditures for consumption; \( m_2 \) = government expenditures for investment; and \( c_1 \) = \( c \) of the above, and \( c_2 \) of the above, \( x_1 \) and \( x_2 \) are set equal to 0. Equation (1), however, discards this assumption by hypothesizing that government and private spending may be complements (\( c_1 \) and \( c_2 \) > 0) or substitutes (\( c_1 \) and \( c_2 \) < 0) for each other. This is especially relevant in developing countries such as Mexico where the public sector has heavily subsidized and promoted investments in infrastructure and basic industry, thereby crowding out private investment. Similarly, the Mexican state’s expenditures on collective consumption goods such as housing, food, and transportation may "crowd out" private investment on these items. Lastly, the income variable has been added as an argument in the investment equation to separate the direct effects of public investment from those induced by changes in the level of economic activity.

Equations (1) and (2) can be solved via Cramer’s rule to determine the effects of \( g, M, P, c, x, y \) and on the two endogenous variables \( y \) and \( t \). The Jacobian of the system is given by,

\[ J = \begin{vmatrix} \frac{\partial y}{\partial c_1} & \frac{\partial y}{\partial c_2} & \frac{\partial y}{\partial m_1} & \frac{\partial y}{\partial m_2} \\ \frac{\partial x}{\partial c_1} & \frac{\partial x}{\partial c_2} & \frac{\partial x}{\partial m_1} & \frac{\partial x}{\partial m_2} \\ \end{vmatrix} > 0 \]

Provided that \( 0 < c_1, c_2, m_1, m_2 < 1 \), we can generate the following multipliers of interest,

\[ \alpha \gamma = \frac{\partial y}{\partial c_1} \frac{1}{1 - \frac{\partial y}{\partial x}} + \frac{\partial x}{\partial c_1} \frac{1}{1 - \frac{\partial x}{\partial x}} > 0 \]

\[ \gamma = \frac{\partial y}{\partial c_1} \frac{1}{1 - \frac{\partial y}{\partial x}} > 0 \]

It is readily seen that the multiplier in equation (5) is reduced to its conventional form whenever both \( c_1 \) and \( c_2 \) are equal to 0. If government and private spending are complements, then the multiplier is greater than the conventional multiplier. The reverse would be the case if government spending "crowd out" private
expenditures. Lastly, it is clear from equation (6) that when $c_2$ and $s$ are in opposite sign, the effect of a change in the composition ($s$)—rather than the level of government expenditures—is unambiguously in its impact.

**EMPIRICAL MODEL**

To test the hypothesis of complementarity and/or substitutability between government and private spending, we estimated the following simple macroeconomic system presented below via both Two-Stage Reduced Form (TSR) and Three-Stage Least Squares (3SLS) for the 1970-86 period.

**Equation:**

\[ RPC = \beta_0 + \beta_1 GDP + \beta_2 GPC + \beta_3 RINT + \beta_4 DUM1 + \epsilon_t \]

\( 1 = 2. \quad \text{(8)} \)

\[ RPL = \theta_0 + \theta_1 GDP + \theta_2 GPC + \theta_3 RINT + \theta_4 DUM2 + \epsilon_t \]

\( 9 \)

\[ RINT = \alpha_0 + \alpha_1 GDP + \alpha_2 GPC + \alpha_3 RPL + \alpha_4 DUM3 + \epsilon_t \]

\( 10 \)

\[ RMP = \eta_0 + \eta_1 PC + \eta_2 GDP + \eta_3 DUM4 + \epsilon_t = 1.2. \]

\( 11 \)

\[ RX = \tau_0 + \tau_1 PC + \tau_2 GDP + \tau_3 RMP + \epsilon_t \]

\( 12 \)

\[ RGDP = RPC + RPL + RMP + RX, \]

\( 13 \)

Here GDP is real gross domestic product in millions of 1970 pesos; RGDP refers to the change in real gross domestic product; RPL denotes real private consumption in millions of 1970 pesos; RIPC is real private fixed capital formation in millions of 1970 pesos; RGC and RGI are respectively, real government consumption and real government investment in millions of 1970 pesos; RMP is the real money supply (currency plus demand deposits) in billions of 1970 pesos; RINT refers to the real interest rate on long-term financial bonds (percent); RDP is the real government deficit in millions of 1970 pesos; RX denotes real exports of goods and services (millions of 1970 pesos); RMP is real imports of goods and services (millions of 1970 pesos); RX represents the real exchange rate (1970 pesos per dollar of 1970); USGDP is the real gross national product of the US (millions of 1972 dollars); DUM1 is a dummy variable that takes on a 1 for 1970-1979, and 0 otherwise; DUM2 = 1 for 1979-81, 0 otherwise; DUM3 = 1 for 1976 and 1981, 0 otherwise; DUM4 = 1 for 1982-83, 0 otherwise; the dummy variables are explained below.

The five endogenous variables are $RDP$, $RPC$, $RPL$, $RINT$, and $RMP$, while the twelve exogenous variables are $DUM1$, $DUM2$, $DUM3$, $DUM4$, $RMP$, $RX$, $PC$, $GDP$, $USGDP$, $RO$, $KC$, and $GCGP$. The $\epsilon_t$s are the error terms, and they are assumed to be normally distributed. The behavioral equations are identified by the order condition because the number of included exogenous variables is equal to the number of endogenous variables. The estimated model may be termed Keynesian in the sense that the determination of national income is generated by the aggregate spending of households, businesses, and the government sector—all of which are, in turn, partly a function of income.

Lags for government consumption and fixed capital formation have been included in the investment and consumption equations because it takes time for government spending on new roads, bridges, housing, and苦恼to have its full impact on private expenditures. The nature and length of the lag structure has been determined by examining the relevant data and estimating it with appropriate lag structures such as the Almon Distributed-lag model with no endpoint constraints. The $RDP$ term has been added to the investment equation in order to separate the direct effects of government investment spending from those generated by an accelerator effect. On a priori grounds $\theta_3$ is expected to be positive whereas $\theta_4$ could be positive or negative. A negative coefficient might arise because in Mexico government consumption expenditures are undertaken primarily by government monopolies such as CONASUPO (Compañía Nacional de Subsidiarias Populares) which are notorious for their inefficiency and deteriorating impact on the rural poor's income and private consumption. The real interest rate has also been included in the consumption equation because access to credit may play a role in consumer durable expenditures; it is expected to have a negative sign.

A dummy variable has been included in the investment equation because during the López Portillo administration (1976-82) the government was engaged in an unprecedented promotion of basic industry (primarily petroleum and gas) via a number of projects which included, among other things, tax concessions, subsidized credit, overvalued exchange rates, and favorable licensing agreements when importing capital inputs. A dummy variable has been added also to the consumption function since during the Fierro-Moreira administration (1978-80) the state embarked upon a populist program designed to raise the consumption possibilities of the Mexican people. The sign of the first dummy is expected to be positive, while that of the second could be either positive or negative. The interest rate has been endogenized by adding a simple money market equation. RM is the endogenous real money supply (currency plus demand deposits) and it is expected to have a negative impact on the real interest rate. The AR(1) model captures the transactions demand for money component and it is expected to have a positive effect on the real interest rate. RDP is the real government deficit and it is expected to have a positive impact on the real interest rate. Lastly, a dummy variable has been added to capture the impact of inflationary expectations—measured by actual inflation—generated by the financial and economic crisis of 1976 and 1982. If the Mexican hypothesis is right then the nominal interest rate should adjust fully to the actual rate of inflation, in which case the real interest rate should remain roughly the same. However, if the nominal interest rate does not fully adjust, then the coefficient of the dummy variable should be negative. The export and import functions are fairly straightforward in their specifications. Besides including the real exchange rate, the export function includes the gross domestic product of the U.S. as an argument, in view of the fact that Mexico's exports to the U.S. comprise approximately 65 percent of its total exports. A dummy variable has been added to this structural equation to capture the impact of the massive devaluations of 1976 and 1982. The sign is expected to be positive. Implied as the import function is concerned, its arguments are the real exchange rate and the level of real gross domestic product. The signs are expected to be negative and positive, respectively. A dummy variable has been included in this function in order to capture the steep decrease in imports resulting from the IMF prescribed adjustment program implemented in 1982-83. The sign is expected to be negative. Lastly, both the export and import functions include lags for the exchange rate given the delayed effect of this price variable on the level of exports and imports. The results of the OLS and 2SLS estimation procedures are presented in Tables 1 and 2. The structure and significance of the results were not altered when these equations were estimated without the dummy variables. This is the RFI-RGI relation remained positively significant along with a negatively significant RPC-RGC relation. Lastly, serial correlation in the structural equation has been corrected by using the Cochrane-Orcutt method.

It can be seen from Tables 1 and 2 that all the coefficients have the expected sign for both the OLS and 2SLS estimates (this is also the case without the dummies). In addition, the magnitude of all the variables in the estimated investment equation with a one-year lag for the government variable increases as we pass from the OLS to the 2SLS estimation procedure and, more importantly, they remain significant at least at the 1 percent level. An Almon distributed lag model was fitted to the investment equations to determine the nature and length of the lags. The results of the second degree, three-lag polynomial are presented below:

\[ RPL = 2587.61 + 16.41GDP_{-1} + 0.49GDP_{-2} + 0.007RDP_{-1} + 2.66GCGP_{-1} + 3.34GCGP_{-2} + 0.17RMP_{-1} + 0.007RMP_{-2} \]

\[ (1.35)^* (2.30)** (-6.6) (1.1) (1.71)* (2.22) \]

\[ + 3.48GCGP_{-1} + 3.15GCGP_{-2} + 1.78RMP_{-1} (2.83)** (1.90)** (9.9) \]

\[ R^2 = 98.9, D.W. = 1.96, p \leq 87 (7.56)** \]
### TABLE 1
Regression Results

**OLS Results:**

\[
RPI = 27105.3 + 23.9 GDP + 58.9 RGDP + 440.2KINTT + 31877.2DUIM1
\]

(3.65)***

\[
(4.74)***
\]

\[
(4.35)***
\]

\[
(6.08)***
\]

\[ R^2 = .96, D.W. = 1.90, \delta = .86 (5.68)*** \]

\[
RPC = 64708.3 + 58.9 GDP + 33.4 RGDP + 100.4KINTT + 6396.6DUUM2
\]

(3.43)***

\[
(17.6)***
\]

\[
(-1.39)***
\]

\[
(1.21)
\]

\[ R^2 = .99, D.W. = 1.85, \rho = .84 (8.32)*** \]

\[
RINT = 6.78 + .0004 ARGDP + 12.4 RM1 + .0002 RDP - 17.2 DUUM3
\]

(2.52)***

\[
(1.95)***
\]

\[
(1.81)***
\]

\[
(3.06)***
\]

\[
(3.45)***
\]

\[ R^2 = .77, D.W. = 1.59 \]

\[
RIMP = 15374.7 + 11.9 GDP - 867.4 EXM + 7896.4 DUUM4
\]

(3.11)***

\[
(15.3)***
\]

\[
(-3.75)***
\]

\[
(-2.20)***
\]

\[ R^2 = .97, D.W. = 1.75, \rho = .62 (4.03)*** \]

\[
RX = -78328.8 + 125.9 USGDP + 1407.7 EXM + 19668.1 DUUM3
\]

(-.86)

\[
(2.36)***
\]

\[
(3.83)***
\]

\[
(3.73)***
\]

\[ R^2 = .56, D.W. = 1.61, \rho = .89 (12.2)*** \]

**Notes:** Figures in parentheses are the calculated t-values. Number of asterisks denotes significance at the 10%, 5%, and 1% levels respectively.

The government investment variable has the expected sign and is becoming significant when lagged one to two years. Lagged values for real gross domestic product were also included to capture any cyclical effects that might affect the significance of government investment expenditures. However, the results indicate that these lagged income variables are insignificant in their effect. Returning to Tables 1 and 2, the estimates for RGLD in the OLS and 2SLS specifications are highly significant and they suggest that a one-percentage increase in current fixed capital formation by the government of 10 million pesos gives rise to an increase of between 5.8 and 7.2 million pesos of fixed capital formation by the private sector within one year. The implied elasticity (evaluated at the mean) for RGLD is 80.

The absolute value and significance of the investment rate variable increases in magnitude in as we move from OLS to 2SLS. These results suggest that the real interest rate plays some role in rationing funds among investors and savers in Mexico. The coefficient for the dummy variable in both specifications suggests that the economic incentives implemented by the Forbiddlo administration raised the cumulative level of private capital formation. Lastly, the adjusted coefficients of determination remain basically the same as we pass from the OLS to the 2SLS estimation procedures, and the Durbin-Watson (D-W) statistics indicate that, although serial correlation is a problem in the sample, it has been corrected via the C-O procedure.

### TABLE 2
Regression Results

**2SLS System (TSF) Results:**

\[
RPI = 24372.6 + 20.3 GDP + 61.3 RGDP + 498.5 RINT + 3312.1 DUUM1
\]

(3.02)***

\[
(5.28)***
\]

\[
(5.09)***
\]

\[
(-4.55)***
\]

\[
(7.26)***
\]

\[ R^2 = .96, D.W. = 1.83, \delta = .84 (7.78)*** \]

\[
RPC = 62509.3 + 64.8 GDP + 48.8 RGDP + 159.8 RINT + 4454.5 DUUM2
\]

(6.54)***

\[
(17.7)***
\]

\[
(-1.60)***
\]

\[
(-1.12)
\]

\[ R^2 = .99, D.W. = 1.99, \rho = .86 (8.67)*** \]

\[
RINT = 7.11 + 0.0001 ARGDP + 168.4 RM1 + 0.0002 RDP - 16.6 DUUM3
\]

(2.57)***

\[
(1.90)***
\]

\[
(-1.85)***
\]

\[
(2.65)***
\]

\[
(3.18)***
\]

\[ R^2 = .77, D.W. = 1.62 \]

\[
RIMP = 12528.1 + 12.8 GDP + 745.8 EXM + 6438.0 DUUM4
\]

(2.52)***

\[
(6.5)***
\]

\[
(-3.43)***
\]

\[
(-2.62)***
\]

\[ R^2 = .97, D.W. = 1.63, \rho = .64 (4.19)*** \]

\[
RX = 12846.7 + 158.9 USGDP + 1610.2 EXM + 2362.7 DUUM3
\]

(-8.80)***

\[
(12.1)***
\]

\[
(3.08)***
\]

\[
(3.90)***
\]

\[ R^2 = .96, D.W. = 1.75, \rho = .91 (11.7)*** \]

**Notes:** Figures in parenthesis are the calculated t-values. Number of asterisks denotes significance at the 10%, 5%, and 1% levels respectively.
TABLE 3
Regression Results

3SLS System (TSP) Results:

\[ RPI_t = 18149.1 + 0.60\Delta GDP_t + 0.65\Delta RL_t + 79.7\Delta RNT_t + 2853.1\Delta DUM1 \\
(5.46)** (5.20)** (7.56)** (4.15)** (4.07)**
\]

\[ R^2 = .96, D.W. = 1.76, \sigma = .54 (3.06)**
\]

\[ RPC_t = 40345.9 + 0.63\Delta GDP_t - 0.59\Delta RGC_t - 79.0\Delta RNT_t + 2662.5\Delta DUM2 \\
(7.96)** (17.9)** (19.0)** (-32) (65)
\]

\[ R^2 = .99, D.W. = 1.31, \rho = .58 (4.05)**
\]

\[ RINT_t = 6.93 + 0.0001\Delta GDP_t - 0.15\Delta RL_t + 0.0002\Delta RF_t - 16.0\Delta DUM3 \\
(2.78)** (1.05)** (-1.95)** (3.21)** (3.45)**
\]

\[ R^2 = .77, D.W. = 1.62
\]

\[ RIMP_t = 21020.1 + 11.9\Delta GDP_t - 1292.5\Delta X_t + 81148.8\Delta DUM4 \\
(6.46)** (27.5)** (-3.68)** (-2.65)**
\]

\[ R^2 = .97, D.W. = 1.92, \rho = .42 (2.56)**
\]

\[ RX_t = -10205.1 + 134.1USGNFr_x + 1978.5\Delta X_t + 208118.8\Delta DUM3 \\
(-8.58)** (12.3)** (3.36)** (2.04)**
\]

\[ R^2 = .95, D.W. = 1.12, \rho = .60 (3.87)**
\]

Notes as in previous pages

The results for the interest rate, import, and export equations are also reported in Tables 1 and 2. It can be seen that the signs for the estimated coefficients are as expected, and significant at least at the 10 percent level. In particular, the dummy variable in the interest rate equation suggests that the Tobinian hypothesis can be rejected in the Mexican case. Also, the results indicate that a 1 billion peso increase in the money supply generates a criterion paribus reduction of the real interest rate of 14 basis points. Lastly, the government deficit variable is highly significant and suggests that the large deficits of the late seventies and eighties may have led to reductions in private planned consumption and investment expenditures.

The exchange rate has a lagged impact on both exports and imports, while the dummy variable in the import function suggests that the stabilization program resulted in a criterion paribus decrease in imports of 7.9 billion pesos in

1982-83. This result is consistent with the argument of critics of these adjustment programs who indicate that the observed surplus in the trade balance is largely the result of a reduction in imports and investment, not an increase in exports.

At this juncture the reader may question the assumption of exogeneity of government expenditures. After all, Figure 1 above reveals that government spending fluctuations significantly from year to year, and may well be a function of the same sorts of variables that affect private investment, including real GDP, consumption and lagged, and interest rates. That is, government policy may be aimed at stabilizing the domestic deficit and interest rates in order to reassure foreign and domestic investors. Thus, a fall in RGDP (reducing real tax revenues), or a rise in real interest rates, would lead to a fall in real government investment in future periods. A similar argument can also be made for the case of real government consumption expenditures. The model was therefore reestimated by endogenizing both RPI and RCP via the following general function:

\[ RG_t = (\beta GDP_t, RGDGT_x, RGDGT_x, RINT_t, RINT_t, \alpha) \\
(14)
\]

\[ RINT_t, DUM_t \]

DUM2 was included in the estimation of the RGI function because it was found to be highly significant in explaining variations in this variable—more even so than in the case of the RFI function with the same arguments. This suggests that the exogenous component of RGI is not inconsequential. The 3SLS estimation results for the revised model—which are available upon request—show that the RFI-RGI and RCP-RGC relationships remain, respectively, positively and negatively significant.

Lastly, the original model was also estimated via the 3SLS estimation procedure. The latter procedure was utilized because the error term of each structural equation may be correlated with each other. For example, an unanticipated bout with inflation and/or recession (as in the crises of 1976 and 1982) may cause both consumption to fall and producers to curtail their investment expenditures. If this is the case, the 3SLS procedure will not generate asymptotically efficient estimates of the structural parameters. A comparison of the 3SLS results with those displayed in Tables 1 and 2 suggests that the 3SLS procedure strengthens both the direction and significance of some of the hypothesized relationships. For example, both RGI and RGC, RGI increase in magnitude and significance. Similar increases in the magnitude and significance of some of the other quantitative variables is also observed. The interested reader may also obtain these results upon request.

POLICY IMPLICATIONS

On the basis of the empirical results presented above it is not possible to sign conclusively the multiplier in equation (6), although if one accepts the estimates of the magnitudes of the coefficients at their face value, they indicate that the above multiplier is greater than zero. More importantly, the results presented in the previous Tables suggest that Mexican policymakers may have at their disposal an additional instrument for achieving their policy targets: namely, the role of government spending between consumption and investment goods.

The evidence presented above suggests that \( \rho_1 \), and \( \rho_2 \) are opposite in sign so that the multiplier in equation (6) is likely to be less than 1. Thus, in order to increase the level of real income, government officials can either raise the share of government spending \( (\alpha \leq \alpha_0) \) allocated to capital goods or/and increase the level of government spending. The recognition on the part of government officials in countries such as Mexico and liberal of an additional instrument in the form of the composition of government spending may lead to a more prudent use of fiscal and monetary policy. Thus, if there are substantial complementarities between public and private investment spending, it would be ill-advised for government officials to undertake across-the-board reductions in government spending to meet some prescribed reduction in the public sector deficit.

The effects of this all too frequent policy recommendation by IMF officials to Latin American policymakers can be conceptualized in terms of a simple aggregate demand-aggregate supply model. First, the indiscriminate reduction in government spending and the resulting negative multiplier effect would shift the short-run AD curve to the left (for a given short-run AS curve), thereby reducing output and the rate of
inflation. But before long, the reduction in total investment would reduce the economy's capital stock per worker and shift the economy's production function downward, thereby lowering the marginal product of labor at every level of employment. This supply shock would, in turn, shift the short-run AS curve to the left (and possibly the long-run level of real GDP), thus reducing output once again and pushing the rate of inflation up. This unexpected turn of events could reignite inflationary expectations and, through the price-wage spiral mechanism, lead to further bouts of stagflation. These supply-side shocks would be further aggravated in the presence of revenue net transfers and raw capital flight.

In addition to determining the impact of the composition of government spending between aggregate consumption and investment goods, policymakers in developing nations may be far more interested in the degree of complementarity and/or substitutability between the various components of public and private spending. That is, for a given level of government investment (consumption) expenditures, private investment (consumption) spending may be affected by varying the distribution of public investment (consumption) spending between the various investment (consumption) goods. The extent and impact of these changes in the distribution of government investment spending to infrastructure, basic industry, agriculture, education, and research have yet to be determined empirically for many developing nations. If they are found to be significant, then policymakers may avail themselves of this information so as to distribute scarce resources to those items of public investment and/or consumption spending that maximize the potential for economic growth. The importance of this cannot be emphasized enough in light of the dim economic prospects faced by many Latin American nations.

In a preliminary effort to determine which types of government investment spending are complementary with private investment, the following investment equations were estimated for Mexico during the 1950-85 period. Both private investment equations were fitted with a second degree, three-lag polynomial (no-endpoint constraints).

\[
\begin{align*}
RPL &= 194.37 + 13.8RGDP - 1.105NINT + 0.86GIFN + 1.45GIFN^2 + 1.54GIFN^3 \\
&+ 5.3GINF\frac{1}{3} \\
&+ 7.7,
\end{align*}
\]

\[
R^2 = 0.97, D.W. = 1.31, p = 0.02 (8.65)***
\]

\[
RPL = 4448.4 + 14.4RGDP - 187.1NINT + 10.9GIND + 14.0GIND^2 + 11.0GIND^3 \\
(2.65)*** + (3.32)*** + (-1.52)*** + (2.17)*** + (3.32)*** + (2.59)*** \\
+ 0.064GINF, \frac{1}{3} \\
(32)
\]

\[
R^2 = 0.97, D.W. = 1.82, p = 0.91 (13.1)***
\]

where GINF is real government infrastructure expenditures in millions of 1978 pesos; and GIND denotes real government investment expenditures in basic industry in millions of 1978 pesos. The results suggest that both types of government investment expenditures crowd in private investments, with infrastructure expenditures having a greater and more significant positive effect. Thus, the present trend of reducing the share of government investment spending channeled to infrastructure is not conducive to minimizing the country's long-term growth and employment prospects.

**CONCLUSION**

This paper has developed a modified macroeconomic model for testing the hypothesis of complementarity and/or substitutability between government and private spending in a developing country. It presented tabular and statistical evidence for Mexico which suggests that government spending has a direct impact on private investment expenditures, but an inverse one on private consumption spending. The paper also outlined some important policy implications for government officials when faced with complementarities (substitutabilities) between public and private expenditures. Specifically, it was argued that Mexican and other Latin American policymakers could benefit from including the composition of government spending as an additional policy instrument in the implementation of fiscal and monetary measures. The recognition of this becomes all the more pressing in view of the unprecedented reductions in public investment and consumption expenditures by the Mexican and other Latin American governments since 1982. Lastly, the paper disaggregated government investment expenditures in the private investment equations and generated estimates which suggest that the degree of complementarity (substitutability) between the various components of public and private spending may constitute an important determinant of the level of income.

**References**


NOTES

1. It is sufficient to phrase through any of the well-recognized macroeconomic models to come to this conclusion. For example, Robert J. Gordon (1987) does not mention even in the early 1980s paper one of his book the possibility of direct complementarities (substitutionalities) between government spending and investment function. 

2. Bins and Cordes (1989) and Auchter (1988) argue that the theoretical justification for including government spending in the investment function of the private sector lies in the following neoclassical production function

\[ y = f(L, K', L') \]

where \( y \) is real output, \( L \) is labor, \( K \) is the private capital stock, and \( K' \) is the public capital stock. Thus, if the public capital stock is productive and complements the private capital stock, a "spillover" effect increase in the former raises the marginal productivity of the latter relative to the real interest rate. The higher real net rates for the private sector, in turn, gives the government an incentive to increase output and eventually output (Le, L). A similar line of reasoning can be undertaken for the case in which public and private goods are substitutable.


4. Ibid.

5. Ibid.

6. For further detail see James H. Street, Mexico's Development Crisis, "Current History" 86, no. 318 (March 1987).

7. Some indication of the direct costs in the government spending can be gauged by the fact that the public sector deficit as a proportion of gross domestic product fell from 17.6 percent in 1962 to 2.5 percent in 1984. For further detail see CEPEAL (1990).

8. Mexico's investment coefficient (gross domestic investment as a proportion of GDP) fell from 23 percent during the seventies to 19 percent during the 1980-88 period. The investment crisis, however, was by no means relegated to Mexico alone. It was reflected in the experiences of other countries of Latin America. Argentina's investment coefficient fell from 21.7 percent in the seventies to 15.2 percent during the 1980-88 period; in Brazil it dropped from 24.5 percent to 17.9 percent; and in Chile it decreased from 17.9 percent to 17 percent. The investment coefficient for Latin America fell from 23 percent during the seventies to a 30-year low of 18.5 percent during the 1980-88 period. For further detail see IDB (1989), Table 3.4, p. 20.

9. It is assumed that the Marshall-Lerner condition is satisfied.

10. The specification of the money market equation in this simple model is not complete. In a more sophisticated model it would have to show explicitly the relationship between the domestic credit and foreign reserve components of the money supply. It would also have to specify the adjustment mechanism pursued by the monetary authorities in the face of an outflow (inflow) of foreign reserves. See Varsky (1985) for further detail.

11. The real interest rate \( r \) is defined as \( r = i - p \), where \( i \) is nominal interest rate and \( p \) is the implicit price deflators of the U.S. and Mexico, respectively. In order to render the Mexican and U.S. price series comparable, the base 1979-1980 was selected. Data for the U.S. were obtained from the Statistical Abstract for the U.S. Data for Mexico were obtained from National Financial, S.A., "La Economía Mexicana en cifras" (1985).


13. For example, between 1963 and 1972 the government monopoly kept "guaranteed corn prices constant in spite of inflation; bean prices were not increased between 1961 and 1973, CONARRO was 17 years (1955-72) without increasing the guaranteed price for wheat." For further detail see Race J. Spalding (1984, p. 10).

14. An Allen distributed lag model (second degree, three-lag polynomial) was fitted to the export and import specifications to determine the structure of the lags. The results suggested that the impact of the exchange rate was greater after one lag. The presence of lags arises because it takes time for new businesses to be formed and new orders to be placed. In addition, it requires that businesses order new equipment and train capacity. This is especially the case in international trade because of language differences and distance obstacles.

15. The results without the dynamic are available upon request from the author.