DEFENSE EXPENDITURES, INVESTMENT AND CROWDING OUT: PROBLEMS OF CAPITAL FORMATION IN PAKISTANI MANUFACTURING

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INTRODUCTION

Toward the end of 1988, Pakistan's deteriorating resource situation caused a financial crisis many remnants of which still exist today. In 1988 the Government's budget deficit reached 8.5% of Gross Domestic Product (GDP), inflation accelerated, the current account deficit doubled to 4.3% of Gross National Product (GNP), the external debt service ratio reached 28% of export earnings, and foreign exchange reserves fell in half to $438 million, equal to less than three weeks of imports.[1]

These developments have eroded the ability of the government to affect the country's development process. In fact, the encouragement of private sector activity, particularly investment, is the only viable option open to the authorities. It follows that for policy purposes the most important issue involves restructuring government expenditures and their financing in a manner that would provide the maximum induce-

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ment to private sector capital formation, especially in manufacturing. Operationally, this means finding an optimal balance between the Government's three most important budgetary items: defense, public consumption and infrastructural development. More importantly because there is abundant evidence[2] that the government's deficits have crowded out a certain amount of private investment, the authorities must achieve this balance within the context of a reduced level of expenditures and/or tax increases.

Defense expenditures are a logical area for budgetary cuts: current expenditures account for the major part of government budgetary allocations, averaging 65-75 percent in recent years. In fact, in recent years defense expenditures together with debt servicing have accounted for around 80 percent of current expenditures.

While not necessarily arguing that reduced defense expenditures would free sufficient funds to restore the country's deteriorating capital stock,[3] the purpose of this paper is to examine whether defense expenditures have affected the private sector's willingness and ability to invest in manufacturing. Has the general impact of defense expenditures on private investment in manufacturing differed significantly from that associated with other categories of government expenditures? If so, in what regard? Are these differences associated with the manner in which defense and expenditures in other areas are funded?

The analysis below is largely quantitative since a key element in assessing these issues revolves around the issue of causality. That is have the Pakistani government_s expenditures resulted in a follow-on set of effects on private investment or, instead, has private investment created pressures for the government to expand its expenditures? In turn, answer to these questions will in large part determine the appropriate strategies for fiscal policy.

BACKGROUND

As noted, previous studies have suggested that government expenditures in Pakistan have been a mixed blessing. On the one hand, these expenditures have the potential to increase private sector profitability either through increases in aggregate demand (the Keynesian effect) and/or cost reductions (the infrastructural effect). On the other hand, public expenditures appear to compete for funds with the private sector, thus reducing **ceteris paribus** the total volume of private capital formation.

Apparently these affects vary by expenditure category. For example, infrastructure investment has played a passive role in stimulating follow-on private investment.[4] Surprisingly, there is little evidence that government investment in manufacturing crowds out private investment. Instead there is a much greater likelihood that other forms of government investment may be responsible for the private sector's funding difficulties. In particular government investment in public enterprises and general government investment seem to be more responsible for the country's increasing fiscal imbalances.

Little can be said on these issues until the issue of causation is adequately resolved:

1. Often in studies of this type the direction of causation has implicitly been assumed to go from government deficits to expanded domestic borrowing to interest rate increases and ultimately reduced private investment. One could just as easily argue that increased levels of private investment have placed pressure on the government to expand facilities, especially in energy. The government, wishing to aid private investment while simultaneously lacking adequate funding for major infrastructural programs, may first grant the private sector various forms of relief such as tax holidays followed by modest increases in public investment. The

outcome of this process would be expanded deficits, but not necessarily the crowding out of private investment in the classical sense. The causation issue must be addressed before any definitive conclusion can be made concerning crowding out.

2. As a related issue, the timing of these impacts needs to be identified. Many effects associated with government deficits are likely to have a delayed impact on private investment decisions. Again because the timing of these effects has not been identified, the patterns of causation are unclear.[5]

3. If we assume that interest rate effects are only one factor associated with the government deficit as it pertains to private investment, the theory of crowding out becomes unclear as to the relevant form of the budgetary deficit. If the interest rate mechanism is not perfect, are private investors more concerned or affected (through perhaps credit rationing) by the actual deficit, some sort of expected deficit, unanticipated changes in the deficit, or even deviations in the deficit from some longer run budgetary trend?

4. The environment in which deficits exist needs to be identified. Obviously, if deficits stem largely from increased government consumption or defense, their negative impact on private investment will be greater than if they had stemmed simply from increased infrastructural investment.

5. The financing of the public sector deficit and government capital formation needs to be examined in detail. Have the deficits been associated with government investment or consumption? How have the deficits been financed as between domestic and foreign borrowing? Do the impacts of domestic versus foreign borrowing

vary with regard to their effect on private industrial investors?.

THE ISSUE OF CAUSATION

Ultimately any statistical test for causation will be based on a number of arbitrary assumptions. Still, using a number of alternative specifications for the key variables it is possible to make some credible inferences concerning the timing of say government expenditures and public sector deficits: do some types of government expenditure tend to generate a stream of deficits (and associated public borrowing) over time (soft budgetary constraint[6] or are selected budgetary allocations constrained by past deficits (hard budgetary constraint). Similarly, which types of expenditures are more likely financed (or constrained) through the domestic capital markets and which are more reliant (or constrained) by foreign borrowing?

The original and most widely used causality test was developed by Granger.[7] According to this test (again using the example of public expenditures and deficits), deficits (DEF) affect growth of public sector expenditures (PE) if this series can be predicted more accurately by past values of deficits than by past (expenditure) growth patterns. To be certain that causality runs from deficits to PE, past values of the public deficit must also be more accurate than past values of public expenditures at predicting increases in the deficit.

Granger Test

More formally, Granger[8] defines causality such that X Granger causes (G-C) Y if Y can be predicted more accurately in the sense of mean square error, with the use of past values of X than without using past X. Based upon the definition of Granger causality, a simple bivariate autoregressive (AR) model for public deficits (DEF) and PE can be specified as follows:

$$(1)\ PE(t) = c + \sum_{i=1}^{p} a(i)DEF(t-i) + \sum_{j=1}^{q} b(j)DEF(t-j) + u(t)$$

$$(2)\ DEF(t) = c + \sum_{i=1}^{r} d(i)\ DEF(t-1) + \sum_{j=1}^{s} e(j)PE(t-j) + v(t)$$

where PE is the growth in public sector expenditures and DEF = the growth in public sector deficits; p, q, r and s are lag lengths for each variable in the equation; and u and v are serially uncorrelated white noise residuals. By assuming that error terms (u, v) are "nice" ordinary least squares (OLS) becomes the appropriate estimation method.[9]

Within the framework of unrestricted and restricted models, a joint F-test is appropriate for causal detection. Where:

$$(3)\ F = \frac{(RSS(x) - RSS(u)/(df(x) - df(u)}{RSS(u)/df(u)}$$

RSS(r) and RSS(u) are the residual sum of squares of restricted and unrestricted models, respectively; and df(r) and df(u) are, respectively, the degrees of freedom in restricted and unrestricted models.

The Granger test detects causal directions in the following manner: first, unidirectional causality from DEF to PE if the F-test rejects the null hypothesis that past values of DEF in equation (1) are insignificantly different from zero and if the F-test cannot reject the null hypothesis that past values of PE in equation (2) are insignificantly different from zero. That is,

DEF causes PE but PE does not cause DEF. Unidirectional causality runs from PE to DEF if the reverse is true. Second, bi-directional causality runs between DEF and PE if both F-test statistics reject the null hypotheses in equations (1) and (2). Finally, no causality exists between DEF and PE if we can not reject both null hypotheses at the conventional significance level.

The results of Granger causality tests depend critically on the choice of lag length. If the chosen lag length is less than the true lag length, the omission of relevant lags can cause bias. If the chosen lag is greater than the true lag length, the inclusion of irrelevant lags causes estimates to be inefficient. While it is possible to choose lag lengths based on preliminary partial autocorrelation methods, there is no *a priori* reason to assume lag lengths equal for all types of deficits.

The Hsaio Procedure

To overcome the difficulties noted above, Hsaio[10] developed a systematic method for assigning lags. This method combines Granger Causality and Akaike's final prediction error (FPE), the (asymptotic) mean square prediction error, to determine the optimum lag for each variable. In a paper examining the problems encountered in choosing lag lengths, Thornton and Batten[11] found Hsiao's method to be superior to both arbitrary lag length selection and several other systematic procedures for determining lag length.

The first step in Hsiao's procedure is to perform a series of autoregressive regressions on the dependent variable. In the first regression, the dependent variable has a lag of one. This increases by one in each succeeding regression. Here, we estimate M regressions of the form:

$$(4) \qquad G(t) = a + \sum_{i=1}^{m} b(t-1)G(t-1) + e(i)$$

where the values of m range from 1 to M. For each regression, we compute the FPE in the following manner

$$(5)\ FPE(m) = \frac{T + m + 1}{T - m - 1} ESS(m)/T$$

Where: T is the sample size, and FPE(m) and ESS(m) are the final prediction error and the sum of squared errors, respectively. The optimal lag length, m*, is the lag length which produces the lowest FPE. Having determined m* additional regressions expand the equation with the lags on the other variable added sequentially in the same manner used to determine m*. Thus we estimate four regressions of the form:

$$(6)\ G(t) = a + \sum_{i=1}^{m^*} b(t-1)G(t-1) + \sum_{i=1}^{n} c(t-1)D(t-1) + e(i)$$

with n ranging from one to four. Computing the final prediction error for each regression as:

$$PE(m^*,n) = \frac{T + m^* + n + 1}{T - m^* - n - 1} \cdot ESS(m^*,n)/T$$

we choose the optimal lag length for D, n* as the lag length which produces the lowest FPE. Using the final prediction

error to determine lag length is equivalent to using a series of F tests with variable levels of significance.[12]

The first term measures the estimation error and the second term measures the modeling error. The FPE criterion has a certain optimality property that "balances the risk due to bias when a lower order is selected and the risk due to increases in the variance when a higher order is selected."[13] As noted by Judge[14] et. al., an intuitive reason for using the FPE criterion is that longer lags increase the first term but decrease the RSS of the second term, and thus the two opposing forces are optimally balanced when their product reaches its minimum.

Depending on the value of the final prediction errors, four cases are possible: (a) **Government Deficits cause Public Expenditures** when the prediction error for public expenditures decreases when the government deficit is included in the expenditure equation. In addition, when public expenditures are added to the deficit equation, the final prediction error should increase; (b) **Public Expenditures causes Government Deficits** when the prediction error for public expenditures increases when government deficits are added to the regression equation for public expenditures, and is reduced when public expenditures are added to the regression equation for government deficits; (c) **Feedback** occurs when the final prediction error decreases when government deficits are added to the public expenditures equation, and the final prediction error decreases when public expenditures are added to the government deficit equation; and (d) **No Relationship** exists when the final prediction error increases both when government deficits are added to the public expenditures equation and when public expenditures are added to the deficit equation.

OPERATIONAL PROCEDURES

The government expenditure data used to carry out the causation tests[15] was derived from data provided by the World

Bank.[16] figures in: Gross Domestic Product and the GDP price deflator is from various issues of the International Monetary Fund, **International Financial Statistics Yearbook**. All variables were deflated by the GDP deflator and are in constant 1985 prices. For best statistical results,[17] the variables were transformed into their logarithmic values.[18]

To determine the robustness of our findings and whether the results were sensitive to the definition of key variables various measures of the deficit were examined. These included the actual or realized deficit, the expected deficit (the predicted value obtained by regressing each year's deficit on its value for the previous year, the unexpected deficit (the difference between each year's actual deficit and that anticipated based on past patterns) and finally deviations of the deficit from its longer run growth path (the actual deficit minus the exponential trend in the deficit). The same definitions were used in deriving series for public domestic borrowing.

Relationships were considered valid if they were statistically significant at the ninety-five percent level of confidence. That is, if ninety-five percent of the time we could conclude that they had not occurred by pure chance, we considered them statistically significant.

As noted above, there is no theoretical reason to believe that fiscal deficits and government expenditures by category have a set lag relationship—that is they impact on one another over a fixed time period. To find the optimal adjustment period of impact, lag structures of up to six years were estimated. The lag structure with the highest level of statistical significance was the one chosen best depict the relationship under consideration (the optimal lag reported in Tables 1 through 5).[19]

RESULTS

Two sets of causality tests were performed. The first set, (Tables 1 and 2) examines the interaction of the four broad categories of government expenditures: (a) defense, (b) con-

sumption, and (c) general government investment and (d) infrastructure on: (a) private sector investment in large scale manufacturing and (b) private investment in small scale manufacturing enterprises.

The second set of estimates examine the interrelationships between these four types of government expenditures and movements in the fiscal deficit. Since previous studies have suggested that it is not the deficits *per se*, but rather the method by which they are financed (domestic versus foreign) that determines whether crowding out occurs, the second set of tables also takes the analysis a step further by examining the corresponding link between public sector expenditures and the pattern of public sector domestic/foreign borrowing. Put differently even though public expenditures in certain areas may lead to increased budgetary deficits, crowding out might not occur if the authorities are able to fund this expenditure through foreign borrowing.

The analysis produced a number of interesting patterns that are summarized in Tables 1-5. Those for public expenditures and private investment in manufacturing (Tables 1 and 2) provide an interesting contrast in the manner in which public sector spending has provided a stimulus to private sector capital formation. Specifically (Tables 1 and 2):

1. The impact of defense expenditures (Table 1) on investment in large scale manufacturing appears consistently strong across all measures[20] of this category of expenditures. Also, in all cases the impact lag appears quite short, averaging only a year.

Table 1
Pakistan: Interaction of Public Expenditures, Deficits, Borrowing and Private Investment in Large Scale Manufacturing, 1972-1991

Causation Patterns

	Invest Invest	Invest Expend	Expend Expend	Expend Invest
Defense Expenditures				
Optimal Lag (years)	3.0	1.0	2.0	2.0
Final Prediction Error	(0.11E-1)	(0.65E-2)	(0.26E-2)	(0.26E-2)
Durbin-Watson Statistic	1.72	1.91	1.62	2.13
Adjusted r^2	0.982	0.990	0.985	0.984
Dominant Pattern: Defense—>Investment (+m)				
Public Consumption				
Optimal Lag (years)	3.0	1.0	3.0	3.0
Final Prediction Error	(0.11E-1)	(0.12E-1)	(0.69E-2)	(0.43E-2)
Durbin-Watson Statistic	1.72	1.65	1.69	1.98
Adjusted r^2	0.982	0.981	0.975	0.985
Dominant Pattern: Investment—>Consumption (+w)				
Public Investment (actual)				
Optimal Lag (years)	3.0	1.0	1.0	1.0
Final Prediction Error	(0.11E-1)	(0.12E-1)	(0.93E-2)	(0.45E-2)
Durbin-Watson Statistic	1.72	1.62	1.56	2.16
Adjusted r^2	0.982	0.983	0.935	0.959
Dominant Pattern: Private—>Public (+m)				
Public Investment (infrastructure)				
Optimal Lag (years)	3.0	1.0	1.0	3.0
Final Prediction Error	(0.11E-1)	(0.13E-1)	(0.69E-2)	(0.37E-2)
Durbin-Watson Statistic	1.72	1.72	1.69	2.25
Adjusted r^2	0.982	0.981	0.932	0.958
Dominant Pattern: Private—>Public (+w)				

Notes: Summary of results obtained from Granger Causality Tests. A Hsaio Procedure was incorporated to determine the optimal lag. All variables estimated in lograthmic form. The dominant pattern is that with the lowest final prediction error. The signs (+.-) represent the direction of impact. In the case of feedback the two signs represent the lowest final prediction error of relationships **B and D**. Each of the variables was regressed with 1, 2, 3, and 4 year lags. Strength assessment (s=strong; m=moderate; w=weak) based on the size of the standardized regression coefficient and t test of statistical significance.

2. In contrast to the case for large scale manufacturing, defense expenditures have no appreciable effect on private investment in small scale manufacturing (Table 2).

Table 2
Pakistan: Interaction of Public Expenditures, Deficits, Borrowing and Private Investment in Small Scale Manufacturing, 1972-1991

	Causation Patterns			
	Invest Invest	**Invest Expend**	**Expend Expend**	**Expend Invest**
Defense Expenditures				
Optimal Lag (years)	2.0	1.0	2.0	2.0
Final Prediction Error	(0.22E-2)	(0.23E-2)	(0.27E-2)	(0.28E-2)
Durbin-Watson Statistic	2.10	2.10	1.62	2.08
Adjusted r^2	0.986	0.985	0.985	0.985
Dominant Pattern: No Relationship				
Public Consumption				
Optimal Lag (years)	2.0	1.0	3.0	1.0
Final Prediction Error	(0.22E-2)	(0.24E-2)	(0.69E-2)	(0.74E-2)
Durbin-Watson Statistic	2.10	2.07	1.70	1.74
Adjusted r^2	0.986	0.988	0.975	0.975
Dominant Pattern: Consumption—>Investment(+w)				
Public Investment (actual)				
Optimal Lag (years)	2.0	1.0	1.0	1.0
Final Prediction Error	(0.22E-2)	(0.24E-2)	(0.93E-2)	(0.63E-2)
Durbin-Watson Statistic	2.10	2.18	1.57	2.04
Adjusted r^2	0.986	0.985	0.936	0.958
Dominant Pattern: Private—>Public (+m)				
Public Investment (infrastructure)				
Optimal Lag (years)	2.0	3.0	1.0	1.0
Final Prediction Error	(0.22E-2)	(0.23E-2)	(0.20E-2)	(0.21E-2)
Durbin-Watson Statistic	2.10	2.10	1.69	2.04
Adjusted r^2	0.986	0.985	0.932	0.958
Dominant Pattern: Private—>Public (+w)				

Notes: Summary of results obtained from Granger Causality Tests. A Hsaio Procedure was incorporated to determine the optimal lag. All variables estimat-

ed in lograthmic form. The dominant pattern is that with the lowest final prediction error. The signs (+.-) represent the direction of impact. In the case of feedback the two signs represent the lowest final prediction error of relationships **B and D**. Each of the variables was regressed with 1, 2, 3, and 4 year lags. Strength assessment (s=strong; m=moderate; w=weak) based on the size of the standardized regression coefficient and t test of statistical significance.

3. As a basis of comparison, public sector expenditures on consumption does not provide a stimulus to private investment in large scale manufacturing(Table 1). Here, the pattern is largely one whereby expanded private sector activity induces the government to provide additional services. For public services (consumption), this process occurs over a fairly long period with an average lag of three years.

4. While one might anticipate that general government investment, especially in the areas of infrastructural expansion, would provide a stimulus to private investment in manufacturing, this does not appear to be the case (Table 1). In fact, causation is generally from private investment to public. For actual public investment (including both infrastructural and non-infrastructural components) the lag is rather short—a year. For longer term infrastructural investment (here proxied as expected investment) the lag tends to be about three years. Interestingly deviations of public investment from its historical exponential trend tend to impact negatively on private investment in manufacturing.

5. Private investment in small scale manufacturing is again affected differently than that in larger scale firms. In this case (Table 2) public consumption expenditures provide a weak stimulus to the private sector. This lag is short, averaging about a year.

6. Private investment in smaller scale industrial ventures interacted with public investment in a manner some-

what similar to that found in larger scale enterprises. However several minor differences do appear to characterize investment by the private sector. First, the lag between private investment and the government provision of infrastructure (anticipated investment) was shorter (one year) in the case of small scale firms. Secondly, while unanticipated (the difference between actual and anticipated) public investment impacted negatively (not shown here) on private investment in smaller scale firms, there were no statistically significant patterns between private investment and deviations from the exponential trend in public investment.

As noted above, in looking for an explanation for these patterns, several previous papers have indicated that public sector crowding out of private investment may be occurring as a result of stepped-up government borrowing in the domestic financial markets. To examine this possibility, an analysis similar to that performed above was used to identify the linkages and causality patterns between the different broad types of public expenditures (defense, consumption, and general government investment) and potential sources of funding (deficits, domestic borrowing, and foreign borrowing).

Again several interesting patterns appeared (Tables 3-5):

1. Of the three types of government expenditures, those allocated to defense appear to have the most complex budgetary linkages. In one sense the military faces a hard budgetary constraint in the sense that increases in past deficits tend to suppress the expansion in allocations to the military (Table 3). On the other hand increased defense expenditures do force an expansion in future deficits.

Table 3
Pakistan: Interaction of Public Expenditures, and the Fiscal Deficit, 1972-1991

Causation Patterns

	Invest Invest	Invest Expend	Expend Expend	Expend Invest
Defense Expenditures				
Optimal Lag (years)	2.0	1.0	3.0	3.0
Final Prediction Error	(0.27E-1)	(0.27E-2)	(0.19)	(0.12)
Durbin-Watson Statistic	1.62	1.76	1.97	2.35
Adjusted r^2	0.985	0.986	0.584	0.756
Dominant Pattern: Feedback (-w,+w)				
Public Consumption				
Optimal Lag (years)	3.0	1.0	3.0	4.0
Final Prediction Error	(0.69E-2)	(0.63E-2)	(0.19)	(0.13)
Durbin-Watson Statistic	1.70	1.76	1.97	1.76
Adjusted r^2	0.975	0.978	0.584	0.764
Dominant Pattern: Feedback (-w, +w)				
General Public Investment				
Optimal Lag (years)	1.0	1.0	3.0	4.0
Final Prediction Error	(0.93E-2)	(0.91E-2)	(0.19)	(0.86E-1)
Durbin-Watson Statistic	1.57	1.75	1.97	2.70
Adjusted r^2	0.936	0.940	0.584	0.856
Dominant Pattern: Feedback (+w, +s)				
General Public Infrastructure				
Optimal Lag (years)	1.0	1.0	2.0	4.0
Final Prediction Error	(0.93E-2)	(0.10E-1)	(0.19)	(0.64E-1)
Durbin-Watson Statistic	1.57	1.84	1.97	2.23
Adjusted r^2	0.936	0.910	0.584	0.791
Dominant Pattern: Infrastructure—> (+m)				

Notes: Summary of results obtained from Granger Causality Tests. A Hsaio Procedure was incorporated to determine the optimal lag. All variables estimated in lograthmic form. The dominant pattern is that with the lowest final prediction error. The signs (+.-) represent the direction of impact. In the case

of feedback the two signs represent the lowest final prediction error of relationships **B and D**. Each of the variables was regressed with 1, 2, 3, and 4 year lags. Strength assessment (s=strong; m=moderate; w=weak) based on the size of the standardized regression coefficient and t test of statistical significance.

2. This same general framework carried over to the borrowing patterns (Tables 4 and 5) associated with military expenditures. For most measures of domestic borrowing, higher growth rates in funding from the domestic markets tends to suppress the expansion in future military expenditures. These suppressing effects are most important in cases where the rate of borrowing (domestic or foreign) expands over its anticipated (or longer term) growth rate. Still, feedback effects are present whereby military expenditures are in turn generally funded in part through both domestic and foreign borrowing.

Table 4
Pakistan: Interaction of Public Expenditures, and Public Sector Borrowing in Domestic Markets, 1972-1991

Causation Patterns

	Invest Invest	Invest Expend	Expend Expend	Expend Invest
Defense Expenditures				
Optimal Lag (years) 2.0	3.0	3.0	3.0	
Final Prediction Error	(0.27E-2)	(0.27E-2)	(0.26)	(0.12)
Durbin-Watson Statistic	1.62	2.43	2.16	2.28
Adjusted r^2	0.985	0.987	0.284	0.444

Dominant Pattern: Feedback (+w,+w)

Public Consumption

Optimal Lag (years) 3.0	1.0	3.0	4.0	
Final Prediction Error	(0.69E-2)	(0.77E-2)	(0.26)	(0.17)
Durbin-Watson Statistic	1.70	1.69	2.17	1.86
Adjusted r^2	0.975	0.973	0.284	0.618

Dominant Pattern: Consumption—>Borrowing (+w)

General Public Investment

Optimal Lag (years) 1.0	1.0	3.0	3.0	
Final Prediction Error	(0.93E-2)	(0.10E-1)	(0.26)	(0.18)
Durbin-Watson Statistic	1.57	1.58	2.17	1.86
Adjusted r^2	0.936	0.932	0.284	0.516

Dominant Pattern: Investment—>Borrowing (+m)

General Public Infrastructure

Optimal Lag (years) 1.0	1.0	3.0	1.0	
Final Prediction Error	(0.93E-2)	(0.10E-1)	(0.26)	(0.56E-1)
Durbin-Watson Statistic	1.57	1.81	2.17	2.05
Adjusted r^2	0.936	0.909	0.284	0.322

Dominant Pattern: Investment—>Borrowing (+w)

Notes: Summary of results obtained from Granger Causality Tests. A Hsaio Procedure was incorporated to determine the optimal lag. All variables estimated in lograthmic form. The dominant pattern is that with the lowest final prediction error. The signs (+.-) represent the direction of impact. In the case of feedback the two signs represent the lowest final prediction error of relationships **B and D**. Each of the variables was regressed with 1, 2, 3, and 4 year lags. Strength assessment (s=strong; m=moderate; w=weak) based on the size of the standardized regression coefficient and t test of statistical significance.

Table 5
Pakistan: Interaction of Public Expenditures, and Public Sector Borrowing in Foreign Markets, 1972-1991

Causation Patterns

	Invest Invest	Invest Expend	Expend Expend	Expend Invest
Foreign Borrowing (actual)				
Optimal Lag (years)	2.0	4.0	3.0	3.0
Final Prediction Error	(0.27E-2)	(0.22E-2)	(0.17)	(0.12)
Durbin-Watson Statistic	1.62	1.80	2.36	3.17
Adjusted r^2	0.985	0.989	0.571	0.742
Dominant Pattern: Feedback (+w,+w)				
Public Consumption				
Optimal Lag (years)	3.0	4.0	3.0	4.0
Final Prediction Error	(0.69E-2)	(0.31E-2)	(0.17)	(0.15)
Durbin-Watson Statistic	1.57	2.19	2.36	2.32
Adjusted r^2	0.975	0.989	0.571	0.688
Dominant Pattern: Feedback (-m, +m)				
General Public Investment				
Optimal Lag (years)	1.0	3.0	3.0	1.0
Final Prediction Error	(0.93E-2)	(0.95E-1)	(0.17)	(0.19)
Durbin-Watson Statistic	1.57	2.19	2.36	2.37
Adjusted r^2	0.936	0.922	0.571	0.540
Dominant Pattern: No Relationship				
General Public Investment				
Optimal Lag (years)	1.0	2.0	4.0	1.0
Final Prediction Error	(0.93E-2)	(0.85E-2)	(0.36E-1)	(0.42E-1)
Durbin-Watson Statistic	1.57	2.34	1.77	21.78
Adjusted r^2	0.936	0.914	0.574	0.527
Dominant Pattern: Borrowing—>Investment (-w)				

Notes: Summary of results obtained from Granger Causality Tests. A Hsaio Procedure was incorporated to determine the optimal lag. All variables estimated in lograthmic form. The dominant pattern is that with the lowest final prediction error. The signs (+.-) represent the direction of impact. In the case of feedback the two signs represent the lowest final prediction error of relationships **B and D**. Each of the variables was regressed with 1, 2, 3, and 4 year lags. Strength assessment (s=strong; m=moderate; w=weak) based on the size of the standardized regression coefficient and t test of statistical significance.

3. Since a large portion of public consumption consists of allocations to the military, the budgetary patterns of this expenditure category are a bit similar to that characterizing defense, particularly consumption's relationship to the fiscal deficit (Table 3).

4. Several important differences do occur however. The major difference between defense expenditures and public consumption is associated with the manner in which each is actually funded. Increased growth in public consumption definitely contributes to expanded domestic borrowing requirements over time (Table 4). Also the expansion in public consumption appears to be more constrained than defense during periods of expanded foreign borrowing (Table 5).

5. Of the three types of government expenditures examined here, general government investment tends to have the strongest impact on the public sector deficit (Table 3).

6. For all four measures of the deficit,[21] increases in general public investment tends to result in expanded fiscal imbalance (Table 3). While expanded deficits (actual and deviations from the exponential trend) facilitate a future expansion in public investment, this effect is weak relative to the impact of investment on the deficit.

7. A clear link also exists between expanded public sector investment and increased future domestic borrowing requirements (Table 4) Interestingly enough few links exist between the growth in public investment and the country's pattern of external pubic borrowing (Table 5).

CONCLUSIONS

While the results presented above do not provide a definitive proof of the existence of the crowding out mechanism in Pakistan, they are quite consistent with what one might find if the phenomena were present. Public investment and infrastructural development appear to have the least stimulating (and sometimes negative) affect on private sector investment. This is ironic given that a major purpose of these allocations is to provide a stimulus to follow on private investment. Clearly this effect stems from the large demands placed on the domestic capital market by this type of expenditure.

At the other extreme is defense. Again a somewhat ironic pattern exists by which expanded military expenditures provide a generally strong stimulus to private investment in large scale private manufacturing. While the analyses does not let us identify the cause of this stimulus (general Keynesian demand expansion and/or direct linkages to the country's military procurement program), the fact remains that the government has shown restraint in funding defense expenditures once domestic borrowing begin to accelerate.

General public consumption falls somewhere between defense and investment in affecting the private sector's willingness (or ability) to commit capital to manufacturing. While the government does fund increased consumption through expanded domestic borrowing, the magnitudes involved are not nearly as great as with investment. Thus, government consumption is still able to provide a net positive stimulus to small scale private investors (who presumably are not as reliant on the domestic capital markets as are their larger scale counterparts).

NOTES:

1. *Pakistan: Current Economic Situation and Prospects, Report No. 9283-PAK* (Washington: The World Bank,

March 22, 1991), p. ii.

2. See for example A.R. Kemal, "Fiscal Imbalances as an Obstacle to Privatization Effort" *The Pakistan Development Review*, vol. 28, no.4, Part II (Winter 1989), pp. 1009-1019; Nadeem Burney and Attiya Yasmeen, "Government Budget Deficits and Interest Rates: An Empirical Analysis for Pakistan," *The Pakistan Development Review* (Winter 1989), vol. 28, no. 4, Part II, pp. 971-980; and A.H. Khan and Z. Iqbal, "Fiscal Deficit and Private Sector Activities in Pakistan," *Economina Internazionale* (May-August 1991), vol. XLIV, no- 2-3, pp. 182-190.

3. As Richards and Waterbury note: "We may estimate, counterfactually, the returns on alternative uses of the moneys devoted to defense, but practically nowhere in the world is there any assurance that reduced defense budgets would result in increased outlay on say, social welfare or infrastructure. Defense outlays are laden with the symbols and sentiments of national pride and survival. People seem prepared to accept disproportionate public investment in defense. They and their leaders find less justification in using equivalent resources to reduce adult illiteracy or line irrigation ditches." Alan Richards and John Waterbury, *A Political Economy of the Middle East: State Class, and Economic Development* (Boulder, CO: Westview Press 1990), pp. 360-61.

4. See Robert E. Looney, "Infrastructure and Private Sector Investment: The Case of Pakistan's Transportation and Communications Sector, 1972-1990" *Rivista Internazionale di Scienze Economiche e Commerciali*, vol. XXXIX, no 9 (September 1992), pp. 771-792; Robert E. Looney "Infrastructural Constraints on Transport and Communications: The Case of Pakistan" *International Journal of Transport Economics*, vol. XIX, no. 3 (October 1992), pp.287-306; and Robert E. Looney "Infrastructural constraints on Energy Development: The Case

of Pakistan" *The Journal of Energy and Development* vol., XVI, no 2 (Spring 1991), pp. 267-286.

5. Gupta does make an attempt to identify the relevant lag structure, but these are arrived at in a somewhat arbitrary manner.
6. Janos Kornai, "The Soft Budgetary Constraint" *Kyklos*, vol., 39, no. 1, pp. 3-30.
7. C.W.J. Granger, "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods,' *Econometrica* (1969), pp. 424-438.
8. C.W.J Grander, "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods," *Econometrica* (1969), pp. 424-438.
9. If the disturbances of the model were serially correlated, the OLS estimates would be inefficient, although still unbiased, and would distort the causal relations. The existence of serial correlation was checked by using a maximum likelihood correlation for the first-order autocorrelation of the residuals [AR(1)]. The comparison of both OLS and AR(1) results indicated that no significant changes appeared in causal directions. Therefore, we can conclude "roughly" that serial correlation was not serious in this model.
10. C. Hsiao, "Autoregressive Modeling and Money-Income Causality Detection," *Journal of Monetary Economics* (1081), pp. 85-106.
11. D.L. Thornton and D.S. Batten, "Lag-length Selection and Tests of Grander Causality Between Money and Income," *Journal of Money, Credit and Banking* (1985), pp. 164-78.
12. Since the F statistic is redundant in this instance they are not reported here. They are, however, available form the authors upon request.
13. C. Hsiao, "Causality Tests in Econometrics," *Journal of Economic Dynamics and Control* (1979), p.326.
14. G.G. Judge, W. Hill, H. Griffiths, H. Lutkephol, and T.C. Lee, *Introduction to the Theory and Practice of Econo-*

metrics (New York: John Wiley and Sons, 1982).

15. Causation tests were performed using a program written in RATS386 Version 4.0. Cf. Thomas A. Doan, *RATS User's Manual Version 4* (Evanston, IL: Estima, 1992).
16. World Bank, *Pakistan: Current Economic Situation and Prospects—Report No. 10223-PAK* (March 16, 1992). *Pakistan: Current Economic Situation and Prospects—Report No. 10223-Pak* (Washington: The World Bank, 1982). World Bank, *Pakistan: Current Economic Situation and Prospects—Report No. 9283-PAK* (March 22, 1991) *Pakistan: Current Economic Situation and Prospects—Report No. 9283-PAK* (March 22, 1991).; World Bank, *Pakistan: Progress Under the Sixth Plan* (1984). *Pakistan: Progress Under the Sixth Plan* (1984).
17. The reasons underlying involve the assumption of stationary conditions. See: C. Hsiao, "Autoregressive Modeling and Money-Income Causality Detection" *Journal of Monetary Economics* (1981), pp. 85-106 and W. Joerding, "Economic Growth and Defense Spending: Granger Causality" *Journal of Development Economics* (1986), pp. 35-40.
18. Dickey-Fuller tests for unit roots indicated that none were present when the variables were transformed to lograthims. See Jurgen A. Doornik and David F. Hendry, *PC Give, Version 7: An Interactive Econometric Modelling System* (Oxford: Institute of Economics and Statistics, 1992) for a description of this test and its interpretation.
19. As a practical matter, the results were insensitive to the manner in which a variable was defined—actual, expected, and unexpected usually provided a consistent picture. Because of this only the actual impacts are summarized in the tables below. However because of its importance government investment in the form of infrastructure (here proxied as expected), or on-going

government expenditure are also included in the set of main findings. The findings for the other variable definitions are available from the author upon request.

20. Again those for anticipated (expected) and unanticipated (unexpected) are not presented in detail. They are however available from the author upon request.

21. Again only the results for the actual (realized) deficit are presented here.