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Constraints on Pakistan's industrial development

A test of the infrastructural bottleneck hypothesis

This paper examines the infrastructural investment bottleneck hypothesis for Pakistan: have shortages in infrastructure investment constrained manufacturing output in Pakistan, as recently suggested by the World Bank? Using Granger causality techniques, we find evidence that the hypothesis does hold true for Pakistan, although the general pattern between public sector investment and manufacturing output is one of little coordination between the two sectors.

Introduction

During the past three decades, Pakistan has enjoyed a credible economic performance. The Gross Domestic Product (GDP) grew at an average annual rate of 5.5 per cent between 1961 and 1988, compared to 4.7 per cent for all developing countries. Economic growth was particularly strong during the 1980s, with an average annual growth rate of 7.0 per cent. Growth rates in large-scale and small-scale manufacturing were 8.2 per cent and 9.2 per cent respectively.

Despite these impressive results, some scholars feel that the expansion in manufacturing may be self-terminating due to a critical shortage, or 'bottleneck', of infrastructure, now barely adequate in the major cities and even more acute in smaller cities and rural areas. In particular, the lack of necessary infrastructure in those rural areas and small towns with an abundant labour force and inexpensive raw materials has seriously impeded the establishment of growth-enhancing export industries (Lee and Iwasaki, 1989).

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The purpose of this paper is to examine the infrastructure bottleneck hypothesis for Pakistan. Specifically, we will examine (a) whether or not infrastructural facilities have indeed lagged behind the needs for the investment caused by Pakistan's rapid growth, (b) what specific types of infrastructure are in short supply, and (c) whether both large and small firms have been equally affected by the shortage in infrastructure investment.

Pakistan's experience

The hypothesis that shortages in infrastructure have constrained manufacturing output in Pakistan—and are also likely to do so in the near future—has been suggested in a series of reports by the World Bank (1983, 1986, 1987, 1988, 1989 and 1991). Briefly stated, the Bank's view is that beginning in the early 1970s several factors contributed to a slowdown in economic growth. Among these factors were the loss of a large part of the import-substitution potential in consumer industries, excessive protection, over-capitalisation and major infrastructural and energy bottlenecks (see also Sarmad, 1984 and United Nations, 1985, 7). Arguing along similar lines, Naqvi and Sarmad noted that a general lack of infrastructural facilities in the 1970s was a serious obstacle to investment growth in large-scale manufacturing (Naqvi and Sarmad, 1984).

Under the Fifth Plan (1979–83), the government assigned a leading role in industrial development to the private sector. Under this strategy, the government denationalised most agricultural processing units, made private sector investment easier, restricted the use of public sector investment to the completion of ongoing projects, liberated trade policies and introduced a wide range of industrial incentives (World Bank, 1983).

When the Sixth Plan (1983–88) was introduced, it was clear to the Bank that infrastructure deficiencies—in energy, water, transportation and telecommunications—were a major constraint to industrial development. As the Bank noted:

> Sustained industrial growth will not be possible without rapid expansion of essential infrastructure, especially energy. The Plan partly addresses this constraint by increasing outlays for energy and water. With respect to energy, although the increased allocations are welcome, energy shortages will continue during the Sixth Plan period. (World Bank, 1983, 59)

The report suggested that the Government should improve load-shedding (temporary 'brownouts') management and assign a high priority to the establishment of a modern load dispatch centre. Furthermore, the Plan assigned a high priority to completing and establishing new industrial estates and developing growth points (World Bank, 1983, 59).

By the time the Seventh Plan (1988–93) was enacted, the Government had responded to the above and had placed an increased emphasis on its industrial estate programme. Provisional governments were charged with providing road links, and the Water and Power Authority and the Telephone and Telegraph departments

were to set up grid stations and telephone exchanges. It was hoped to have all estates fully serviced by 1989–90.[1]

Increasing the efficiency and international competitiveness of the industrial sector was an important aspect of the recent structural adjustment plan (1989–91). In the World Bank's last evaluation of Pakistan's economy, it noted that market mechanisms were essential in guiding investment and that public sector participation in manufacturing and financial services should be curtailed (World Bank, 1991, 25).

Both the Asian Development Bank (ADB) and the United States Agency for International Development (USAID) have been monitoring the country's infrastructural problems. The ADB estimated that the direct cost of power output was approximately nine per cent for the industrial sector. The indirect cost was an additional Rs. 2 billion (Pasha and Gellerson, 1988). USAID has estimated that Pakistan is losing about $500 million of value added in manufacturing due to load-shedding. According to USAID, Pakistan will need to double its energy capacity by 1993 to meet the growing demand at an approximate cost of Rs. 100 billion (Arab Emirates Nations Industrial Development Organisation, 1990, 90).

Recently, industrial growth in Pakistan fell sharply from 8.7 per cent in 1988 to 3.9 per cent in 1989; most of the drop originated in the manufacturing sector. In large-scale and medium-scale industries the growth rate was 1.2 per cent, the lowest rate since 1977. While it is tempting to place the majority of the blame for this performance on the lack of infrastructure, undoubtedly other factors—ethnic disturbances and floods, for example—have also played a major part. While industrial growth improved in 1990 concomitant with a substantial recovery in large-scale manufacturing, infrastructure bottlenecks clearly remain a major problem. Although the government has announced that power supplies have been expanded to ensure no load-shedding in 1991–92, new threats to foreigners and foreign investment emerged in Sindh and doubts as to the availability of funds to finance new private investment make the government's assurance very doubtful (The Economist, 1991, 158).

In summary, it is clear that industry has experienced a host of problems in recent years and has pushed the sector's trend growth rate well below the 1978–88 average of nearly 10 per cent. Infrastructure shortages are but one of the factors involved; deteriorating law and order in Sindh, political uncertainty, natural disasters, and a low savings and investment rate have all combined to dampen industrial growth.

Causality between infrastructure and growth

The accounts noted above suggest that in recent years infrastructure shortages have slowed down industrial output, but indicate little about the relative effectiveness of different types of infrastructure. In addition, little is known about the causal relationship between infrastructure investment and industrial output. On the one hand, some economists such as Voigh (1974) maintain that causality runs from

1 Government of Pakistan (1988). The progress of this industrial estate programme was to be monitored by a joint committee from the government and the Federation of Pakistan Chambers of Commerce and Industry.

alterations in the stock of infrastructure to investment and economic growth. On the other hand, economists such as Glover and Simon (1975) believe that infrastructure investment merely relieves 'tensions' which have resulted from imbalances between supply and demand patterns as well as bottleneck pressures (see also Looney and Frederiksen, 1981, and Frederiksen, 1981). This view suggests that the government invests in infrastructure only after deficiencies have severely constrained output and the flow of private capital to the private sector. Thus, there is the need to examine whether infrastructure investment prompts manufacturing output in Pakistan or whether infrastructure investment itself is a response to the needs created by manufacturing activity. Has the government taken a proactive or reactive role in infrastructure investment since 1971, and what can we infer about the appropriate future strategy for the government of Pakistan?

A problem facing researchers is that infrastructure is not homogeneous. Another problem is that infrastructure's contribution may well depend on the existing stock of supporting factors of production which most likely will vary in composition over time. A final complication has been the reluctance of researchers to discuss causality from a statistical perspective. While exact 'cause and effect' cannot be proved, several statistical tests have been introduced in recent years to indicate causal relationships. The original and most widely used causality test was developed by Granger (1969). Using regression analysis techniques, the past values of some variable Y are used to predict Y values. Then another variable X is included with the past values of Y. If the predicted values of Y are 'improved' with the inclusion of past X values, then we conclude that X 'Granger causes' Y.

As shown by LaCivita and Frederiksen (1991), the results of any Granger-causality test depend on the choice of lag lengths between the dependent and independent variables. Hsiao (1981) has developed a systematic procedure for choosing optimal lag lengths for the variables in the regression equation. His method combines Granger causality with Akaike's final prediction error (FPE) to determine not only the optimum lag length, but also the causal relationships.[2]

In this paper, we apply Hsiao's procedure to test whether infrastructure investment (I) in Pakistan has Granger caused economic activity (G), or whether G has caused I. Initially, a series of autoregressive regression equations are estimated on the dependent variable. To start, the dependent variable is lagged one year and in each succeeding estimate an additional lag on the dependent variable is added. Thus M regression equations are estimated in the following form:

$$G_t = \alpha + \sum_{i=1}^{m} \beta_{t-i} G_{t-i} + \varepsilon_t,$$

where G is economic growth and where m ranges from 1 to M.[3] For each equation, the FPE is computed and the optimal lag length, m*, is the lag length which

2 Thornton and Batten (1985) found that Hsiao's method was superior to merely choosing arbitrary lag lengths or several other procedures for determining lag length.

3 As was pointed out in LaCivita and Frederiksen (1991), the choice of M—the maximum lag length—is abritary. M should be as large as possible, consistent with the sample size and the underlying economic process in Pakistan. In this paper we have set M equal to 4.

produces the lowest FPE—the most accurate forecast. Another set of equations is then estimated, with lagged variables of I added sequentially as above. The FPE for each equation is examined to choose n^*, the optimal lag length for I. This procedure is then duplicated, but with I as the dependent variable, and lagged variables of I are introduced to find m^*. Finally, lagged values of G are included to find n^* (for a more detailed description of the procedure, see Frederiksen, 1991).

The causality test is made up of three steps.

STEP 1: the FPE for the model $G = f(G_L)$ is compared to the FPE for the model $G = f(G_L, I_L)$. If the FPE decreases, i.e. the model's predictive power increases as lagged values of I are added, we conclude that I Granger causes G. If the FPE increases, we conclude that I does not cause G.

STEP 2: the same comparison is made when I is the dependent variable and lagged values of G are added. If the FPE declines, we conclude that G causes I; if the FPE increases, we conclude that G does not cause I.

STEP 3: the FPE under Steps 1 and 2 are compared. If the FPE increases in both cases, no relationship exists between G and I for Pakistan. If the FPE declines in both cases, a feedback relationship between I and G exists: I causes G which causes I, etc. Finally, if the FPE declined under Step 1 but increased during Step 2, we conclude that I causes G. If the FPE increased under Step 1 but declined under Step 2, the reverse is true—G causes I.

Empirical results

While the government of Pakistan publishes extensive data on various types of public investment, the infrastructure component of this investment is not reported. However, it is possible to approximate increments to the country's infrastructural base using the approach outlined by Blejer and Khan (1985). Assuming that investment in infrastructure is a process which changes very slowly over time, Blejer and Khan's approach makes the distinction between expected investment—assumed to be the long-term infrastructure component—and unexpected investment, which is assumed to be short-term and non-infrastructural investment. The expected infrastructure investment measure was calculated as a function of the investment in the preceding year. Thus the difference between the actual level and expected level of investment is 'unexpected', i.e. the short-term component.[4] The data on Pakistan investment were derived from World Bank data (World Bank, 1983 and 1991). The data were expressed in real terms and deflated using the International Monetary Fund's GDP deflator.[5]

4 An alternative approach calculates a trend value of (real) public sector investment which is assumed to represent long-term infrastructure investment. Deviations from the long-term trend (i.e. actual minus trend value) are assumed to represent the short-term or non-infrastructural component. Since we do not know the correct trend (linear or exponential), we have used the expected method to estimate infrastructure investment in this paper.

5 International Monetary Fund, *International Financial Statistics Yearbook*, Washington DC, International Monetary Fund, various annual issues. All data are in constant 1985 prices.

Our initial focus was to estimate the infrastructure component of Total Public Investment (government enterprises investments, e.g. railways and post offices, semi-public investment in large-scale manufacturing and energy, and general government investment in roads, schools, etc.). However, since public infrastructure investment is not usually directed towards a particular sector, five additional measures of investment were examined and their respective infrastructure component estimated. The five additional investment categories were: General Government, Semi-Public,[6] Federal Government, Provincial, and Local. For purposes of comparison, two measures of private investment—Total Private Investment and Long-Term Private Investment—were included in the analysis.

The causal relations between the various investment measures (and their infrastructure component) and three measures of economic activity (total, large-scale, and small-scale manufacturing output) are shown in Table 1 (cols. 1, 2, and 3, respectively).[7] The dominant pattern to emerge was a feedback relationship, especially between investment on the one hand and total and large-scale manufacturing output on the other hand. In other words, government investment stimulated increased output, and this in turn led to more investment. With regard to the relationship between investment and total manufacturing output (Table 1, col. 1), total public investment provided a strong[8] stimulus to output. The feedback from private sector activity to public investment was much weaker. General government investment produced a strong impact on manufacturing output. Total private investment had a moderate effect on economic output, but in contrast to public investment the feedback effect further stimulated private investment. Interestingly, our results indicated several instances of a negative feedback: from increased private sector manufacturing activity to (a) public infrastructure investment, (b) semi-public investment and infrastructure and (c) general government infrastructure investment. These results could reflect either a crowding out of physical resources (manpower), which may have gone into private construction, or a financial crowding out where government funding has taken place through borrowing. In turn this has resulted in credit rationing in the private sector.[9] Recently Khan and Iqbal (1991) have examined crowding out in Pakistan; their results are consistent with our interpretation of the negative feedback.

When government investment is broken down into its sub-components, several differences are noted. Expanded federal government investment produced a strong increase in output; the federal government in turn responded weakly to the increased needs of the manufacturing sector. In contrast, expanded provincial investment and infrastructure investment had a negative effect on output. On the other hand, provincial governments invested heavily following expansions in output. Local government infrastructure investment appeared to have produced a very strong follow-on increase in total manufacturing output.

6 General Government and Semi-Public Investment are sub-categories of Total Public Investment.

7 While only the causal relationships are shown in Table 1, the entire results (estimated regression equations, t-statistics, and optimal lag lengths) are available from the authors on request.

8 Based on the size of the standardised regression coefficient.

9 Crowding out in the case of Mexico was discussed in Looney and Frederiksen (1987).

Table 1 *Causal relationships between various investment measures (and respective infrastructure components) and manufacturing output, Pakistan, 1972–1990*

Investment measure / *Infrastructure component*	*Manufacturing output* *Total* (1)	*Large-scale* (2)	*Small-scale* (3)
Total public investment	⟷	⟷	G→INV
Infrastructure	⟷	⟷	⟷
General government investment	⟷	⟷	G→INV
Infrastructure	G→INF	⟷	⟷
Semi-public investment	⟷	⟷	G→INV
Infrastructure	⟷	⟷	G→INF
Federal government investment	⟷	⟷	G→INV
Infrastructure	⟷	⟷	G→INF
Provincial government investment	⟷	G→INV	G→INV
Infrastructure	⟷	⟷	⟷
Local government investment	⟷	⟷	⟷
Infrastructure	⟷	⟷	G→INF
Total private investment	INV→G	INV→G	G→INV
Long-term private investment	⟷	INF→G	⟷

Notes: ⟷ indicates feedback between investment and economic output, G represents economic output, INV represents the investment measure, and INF represents the infrastructure component of INV. See text for discussion of the strength and sign of the relationship.

A similar analysis was conducted to determine whether these patterns were consistent for different-sized manufacturing units. With regard to large-scale manufacturing firms (Table 1, col. 2), both total public investment and infrastructure investment produced a strong stimulus to output. In contrast to the total manufacturing sector, public sector infrastructure reacted weakly to higher levels of large-scale output. Total private investment stimulated output, but less so than public investment. The private sector did not appear to respond to increases in output with follow-on capital formation. Investment by semi-public organisations generated a strong expansion in output, but, as above, the response of these agencies to increase investment was rather weak. General government investment provided a small stimulus to output and was moderately responsive to the investment needs of the manufacturing sector. This was in contrast to total manufacturing output, where the feedback effect was negative. The federal government provided a strong stimulus to large-scale manufacturing, although weaker than in the case for total output. While provincial government investment did not prompt large-scale output, manufacturing output had a positive impact on provincial investment levels. Finally, investment by local governments had a fairly strong impact on manufacturing but the feedback effect was weak.

With regard to the relationship between investment and small-scale manufacturing output (Table 1, col. 3), a general pattern emerged where most government investment and infrastructure investment failed to stimulate the output of small-scale firms. In fact, an opposite pattern emerged, where government investment reacted to changes in the output of small-scale firms. In addition, the response of the public sector to small-scale manufacturing was much weaker than for large-scale manufacturing.

Conclusions

This paper has examined whether or not the recent slowdown in manufacturing output in Pakistan has been due to a critical shortage, or 'bottleneck', of infrastructure. The results suggest that infrastructure bottlenecks have indeed occurred in Pakistan. However, the general picture that emerges between patterns of public sector investment and manufacturing output is one of a lack of coordination between the two sectors. Although a feedback causal relationship most often existed between public and private sectors, our analysis suggests that public sector investment has had a much stronger impact on private sector activity than the response by government to the needs of the private sector. Furthermore, in those cases where the public sector did respond to the private sector requirements, more often than not the response seems not to have matched the requirements of the private sector. While some of the investment needs of the large-scale manufacturing sector were met by the government, this was definitely not true for the small-scale manufacturing sector.

A decade ago, Naqvi and Sarmad noted that:

> Though infrastructural facilities improved substantially, many crucial problems still remain to be solved. An important problem was the imbalance between major production units, due mainly to unsatisfactory trunk connections, which impeded the distribution of additional supplies, especially outside the main urban centers. The solution to the problem requires a substantial extension of the existing transport facilities into rural areas to enable the manufacturing sector to respond more readily to the growth of the agricultural sector, and promote a more balanced regional development of the country. (Naqvi and Sarmad, 1984, 39)

Our results suggest that many of the problems noted by Naqvi and Sarmad still remain in Pakistan today.

REFERENCES

ARAB EMIRATES NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION (1990), *Pakistan: Towards Industrial Liberalization and Revitalization*, Vienna.

BLEJER, M. I. and KHAN, M. S. (1985), 'Public investment and crowding out in the Caribbean basin countries', in M. Connolly and J. McDermott (eds.), *The Economics of the Caribbean Basin*, New York, Praeger, 219–36.

THE ECONOMIST (1991), *Country Report—Pakistan/Afghanistan* (Report No. 2), London, Economist Intelligence Unit.

FREDERIKSEN, P. C. (1981), 'Further evidence on the relationship between population density and infrastructure: the Philippines and electrification', *Economic Development and Cultural Change*, **29**, 749–58.

FREDERIKSEN, P. C. (1991), 'Economic growth and defense spending: evidence on causality for selected Asian countries', *Journal of Philippine Economic Development*, **XVIII**, 131–47.

GLOVER, D. R. and SIMON, J. (1975), 'The effect of population density on infrastructure: the case of road building', *Economic Development and Cultural Change*, **57**, 71–79.

GRANGER, C. W. J. (1969), 'Investigating causal relations by econometric models and cross-spectral methods', *Econometrica*, **37**, 424–38.

GOVERNMENT OF PAKISTAN (1988), *Seventh Five Year Plan 1988–93 and Perspective Plan 1988–2003*, Islamabad, Planning Commission.

HSIAO, C. (1981), 'Autoregressive modelling

and money-income causality detection', *Journal of Monetary Economics*, **7**, 85–106.

KHAN, A. H. and IQBAL, Z. (1991), 'Fiscal deficit and private sector activities in Pakistan', *Economica Internazionale*, **44**, 182–90.

LACIVITA, C. J. and FREDERIKSEN, P. C. (1991), 'Defense spending and economic growth: an alternative approach to the causality issue', *Journal of Development Economics*, **35**, 117–26.

LEE, J. and IWASAKI, Y. (1989), *Promotion of Exports in Pakistan* (Economic Staff Paper 44), Manila, Asian Development Bank, 38.

LOONEY, R. and FREDERIKSEN, P. C. (1981), 'The regional impact of infrastructure in Mexico', *Regional Studies*, **15**, 285–96.

LOONEY, R. and FREDERIKSEN, P. C. (1987), 'Fiscal Policy in Mexico: the Fitzgerald thesis re-examined', *World Development*, **15**, 399–404.

NAQVI, S. N. H. and SARMAD, K. (1984), *Pakistan's Economy through the Seventies*, Islamabad, Pakistan Institute of Development Economics.

PASHA, H. A. and GELLERSON, M. (1988), 'Study of financial aid and economic impact of power interruption and load shedding', mimeo, Karachi, University of Karachi.

SARMAD, K. (1984), *A Review of Pakistan's Development Experience: 1949–50 to 1979–80*, Islamabad, Pakistan Institute of Development Economics.

THORNTON, D. L. and BATTEN, D. S. (1985), 'Lag-length selection and tests of granger causality between money and income', *Journal of Money, Credit and Banking*, **17**, 164–78.

UNITED NATIONS (1985), *Industrial Development Review Series: Pakistan*, Vienna, United Nations Industrial Development Office.

VOIGH, F. (1974), 'The tasks of modern transport science', *International Journal of Transport Economics*, **1**, 255–62.

WORLD BANK (1983), *Pakistan: Review of the Sixth Five-Year Plan*, Washington DC, World Bank.

WORLD BANK (1986), *Pakistan: Economic and Social Prospects* (Report No. 5962–PAK), Washington DC, World Bank.

WORLD BANK (1987), *Pakistan: Sixth Plan Progress and Future Prospects* (Report No. 6533-PAK), Washington DC, World Bank.

WORLD BANK (1988), *Pakistan: Growth Through Adjustment* (Report No. 7118-PAK), Washington DC, World Bank.

WORLD BANK (1989), *Pakistan: Medium Term Economic Policy Adjustments* (Report No. 7591–PAK), Washington DC, World Bank.

WORLD BANK (1991), *Pakistan: Current Economic Situation and Prospects* (Report No. 9283–PAK), Washington DC, World Bank.