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Causality between Public Investment in Transport and Communication and Economic Growth

by

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Abstract

This paper aims to provide an explanation for the robust and consistent relationship between public investment in transport and communication and economic growth that has frequently surfaced in recent empirical studies. Using both informal and formal causality tests, the paper finds that, for a set of developing countries, the strong association is the result of the effect running from growth to public investment rather than vice versa.

JEL Classification: O42; E62

Keywords: Public Investment, Transport and Communication, Economic Growth

Outline

Non-Technical Summary

Recent externality based growth models suggest that differences in public spending policies are able to explain, at least in part, the observed differences in growth rates across countries. This view has revived interest among economists in re-evaluating the relationship between the levels and the compositions of public spending and growth performances of countries. There does seem to be some pattern emerging from the studies, which have included disaggregated public investment variables within growth regressions. Where positive significant coefficients have been estimated these are usually confined to public investment expenditure in the transport and communication (T&C) sector. Yet, this association alone does not indicate the direction of causality. For example, one is able to come up with two equally plausible hypotheses to account for such an association: (1) public investments in T&C sector lead growth and the correlation between the two is the result of the effects running from public investment in T&C sector to growth; and (2) public investments in T&C sector follow growth, so that rapid growth leads to higher investments in this sector. Clearly, from the policy perspective, there is a need to examine which of the above two hypotheses is more plausible – an issue that has so far eluded the attention of most researchers. The objective of this paper is to examine this causality issue for a group of developing countries by using a formal method of studying the direction of causation.

Existing studies aiming at evaluating growth effects of public investment at a disaggregated level largely suffer from 'sparseness of data' problem. For us, however, this problem poses a greater challenge. A formal test for causality requires use of leads and lags of the variables in question. Accordingly, such analysis needs to be based on data sets containing relatively large number of observations per country. To overcome this problem, we collected 1970-89 data on central government investment expenditure in the T&C sector for 32 developing countries by consulting a large collection of World Bank Country Economic Reports and Public Expenditure Reviews.

Our analysis suggests that the widely reported association between the two variables are more due to growth causing investment in the transport and communication sector and not vice-versa.

1. Introduction:

Recent externality based growth models suggest that differences in public spending policies are able to explain, at least in part, the observed differences in growth rates across countries. This view has revived interest among economists in re-evaluating the relationship between the levels and the compositions of public spending and growth performances of countries. There does seem to be some pattern emerging from the studies, which have included disaggregated public investment variables within growth regressions. Where significant coefficients have been estimated these are usually confined to public investment expenditure in the transport and communication (T&C) sector. For example, Aschauer (1989) finds that public investment in the transport sector is highly correlated with private sector productivity in the United States for the period 1949-85. In a cross-country study, Easterly and Rebelo (1993) find that public investment in T&C sector is consistently positively correlated with growth with a very high coefficient (between 0.59 and 0.66). Yet, this association alone does not indicate the direction of causality. For example, one is able to come up with two equally plausible hypotheses to account for such an association: (1) public investments in T&C sector lead growth and the correlation between the two is the result of the effects running from public investment in T&C sector to growth; and (2) public investments in T&C sector follow growth, so that rapid growth leads to higher investments in this sector. Clearly, from the policy perspective, there is a need to examine which of the above two hypotheses is more plausible – an issue that has so far eluded the attention of most researchers[1]. The objective of this paper is to examine this causality issue for a group of developing countries by using a formal method of studying the direction of causation.

2. Data

Existing studies aiming at evaluating growth effects of public investment at a disaggregated level largely suffer from 'sparseness of data' problem[2]. For us, however, this problem poses a greater challenge. A formal test for causality requires use of leads and lags of the variables in question. Accordingly, such analysis needs to be based on data sets containing relatively large number of observations per country. To overcome this problem, we collected 1970-89 data on central government investment expenditure in the T&C sector for 32 developing countries[3] by consulting a large collection of World Bank Country Economic Reports and Public Expenditure Reviews.

3. The Causality

In conducting the analysis, we closely follow the footstep of Blomstrom, et al (1996) where Granger-Causality argument has been used as a formal way of studying the direction of causation between fixed investment and economic growth. More recently, Attanasio, et al (2000) adopted the same methodology in analysing the direction of causation between savings, investment, and growth rate.

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[1] To our knowledge, the only exception is the study by Easterly and Rebelo (1993) suggesting that effect of public investment in T&C sector on growth is robustly significant with instrumental variable, but the size of the coefficient is disturbingly high - a result which naturally casts doubt on the validity of the procedure and led authors to express the need for further work on this issue.

[2] Due to shortage of data, Easterly and Rebelo (1993) have based their analysis on the decade averages implying only two data points per country.

[3] Please refer to the data appendix for the country list.

We begin our preliminary investigation by running simple regressions (see Table 1) of growth rates in per capita GDP on government investment in the T&C sector in the preceding, current, and the succeeding periods.

Table 1: Regressions of Growth rates in Real GDP per capita on T&C Investment (as a proportion of GDP)

	Preceding period	Current period	Following period
Coefficient	0.29	0.39	0.47
t-statistic	1.54	2.05	2.59
adj R^2	0.005	0.01	0.02
No. of obs.	494	510	486

Note: t-statistics are White's (1981) heteroschedastic error corrected.

The results above indicate that the coefficients, t-statistics, and adjusted R^2's increase as one moves from the preceding to the current period and then from there to the succeeding period. Further, to avoid business cycle fluctuations and to acknowledge the possibility of a lagged relationship between public investments in the T&C sector and growth performances, we regress four-year average growth rates in per capita GDP on preceding, current, and succeeding four-year average government investment in the T&C sector (Table 2).

Table 2: Regressions of Average Growth rates in Real GDP per capita on Average T&C Investment (as a proportion of GDP)

	Preceding period	Current period	Following period
Coefficient	0.34	0.45	0.71
t-statistic	(1.29)	(2.12)	(3.06)
adj R^2	0.01	0.03	0.07
No. of obs.	113	140	115

Note: Growth in Real GDP per capita 1970-73, 1974-77, 1978-81, 1982-85 1986-89 (4-year average); Transport and Communication Investemnt (% of GDP) 1970-73, 1974-77, 1978-81, 1982-85 1986-89 (4-year average); t-statistics are White's (1981) heteroschedastic error corrected.

As in the previous case, results suggest that in the case of the T&C sector, the effects running from growth to subsequent public investment are stronger than the effects running from public investment to subsequent growth.

For the formal part of our analysis, we turn to the Granger-Sims causality framework (see Granger, 1969; Sims, 1972) and employ the block Granger non-causality tests on 20-years of panel data. Making use of the Akaike Information Criterion (AIC) to choose appropriate number of lags (two periods), we follow the above framework to find the direction of causality between the growth rates in per capita real GDP (GY) and public investment in T&C sector as a percentage of GDP (TCI). The results of the analysis are presented below (t-values are in parentheses):

(i) $$\underset{}{GY_t} = \underset{(2.17)}{0.01} + \underset{(6.06)}{0.29}\, GY_{t-1} + \underset{(0.78)}{0.03}\, GY_{t-2} + \underset{(0.65)}{0.19}\, TCI_{t-1} - \underset{(-0.14)}{0.04}\, TCI_{t-2}$$

adj. $R^2 = 0.09$, $n = 453$,
p-value for joint significance of the coefficients of lags of TCI = 0.62

(ii) $TCI_t = 0.002 + 0.79\ TCI_{t-1} + 0.08\ TCI_{t-2} + 0.01\ GY_{t-1} + 0.02\ GY_{t-2}$
(2.80) (14.80) (1.57) (0.67) (2.28)

adj. $R^2 = 0.69$, n =430,
p-value for joint significance of the coefficients of lags of GY = 0.03

The above results indicate that growth of GDP Granger causes public investment in T&C sector, but there is no evidence of any reverse causality. Robustness of our result is preserved when we repeat the same exercise with country dummies to account for cross-sectional differences among countries. The results with country dummy variables are presented below (t-values are in parentheses) [4]:

$(i)'$ $GY_t = \ldots + 0.17\ GY_{t-1} - 0.08\ GY_{t-2} - 0.001\ TCI_{t-1} - 0.33\ TCI_{t-2}$
(3.55) (-1.62) (-0.00) (-1.18)

adj. $R^2 = 0.14$, n = 453,
p-value for joint significance of the coefficients of lags of TCI = 0.34

$(ii)'$ $TCI_t = \ldots + 0.52\ TCI_{t-1} + 0.04\ TCI_{t-2} + 0.01\ GY_{t-1} + 0.02\ GY_{t-2}$
(9.75) (0.84) (0.76) (1.87)

adj. $R^2 = 0.74$, n = 430,
p-value for joint significance of the coefficients of lags of GY = 0.10

The above results indicate that growth of GDP Granger causes public investment in T&C sector, but there is no evidence of any reverse causality. To ensure the robustness further, we next consider an alternative specification recommended in the literature for testing causality. An alternative approach suggested by Sims (1972) considers a linear projection of y_t on past, present, and future $x's$ as

$$y_t = a + \sum_{j=0}^{\infty} b_j x_{t-j} + \sum_{j=1}^{\infty} d_j x_{t+j} + \eta_t \quad (1)$$

[4] For the equations with country dummies, "…" represents the results for country dummies that we have not reported.

Here y fails to Granger–cause x if and only if $d_j = 0$ for $j = 1,2,\ldots$. However, in implementing this procedure, it is important to take account of any serial correlation in the disturbance term, since otherwise the results of the *F*-test could be misleading. In order to eliminate the serial correlation in the disturbances term, Geweke *et al* (1983) have suggested incorporating the lagged values of the dependent variable in the regression[5]. To see the underlying logic, consider that η_t is in general autocorrelated and η_t has Wold representation: $\eta_t = \Psi(L)v_t$, where $\Psi(L)$ is a polynomial in lag operator and v_t is a white noise. Multiplying both sides of (1) by $h(L) = [\Psi(L)]^{-1}$ produces

$$y_t = a^* - \sum_{j=1}^{\infty} h_j y_{t-j} + \sum_{j=0}^{\infty} b_j^* x_{t-j} + \sum_{j=1}^{\infty} d_j^* x_{t+j} + v_t \ . \qquad (2)$$

Since, $d_j^* = 0$ for all j if and only if $d_j = 0$ for all j, it is possible to truncate the infinite sums in (2) at some finite value and one can test the null hypothesis that y does not Granger-cause x with an F test of $d_1^* = d_2^* = \ldots. = d_p^* = 0$. We repeat this procedure with our data and the regression results for without and for with country dummy variables are listed in (iii) and $(iii)'$, respectively (t-values are in parentheses).

$$(iii)\ \ GY_t = \underset{(0.71)}{0.00} + \underset{(4.80)}{0.25}\ GY_{t-1} + \underset{(0.10)}{0.005}\ GY_{t-2} - \underset{(-0.19)}{0.08}\ TCI_{t-1} - \underset{(-0.53)}{0.19}\ TCI_{t-2}$$

$$+ \underset{(0.40)}{0.16}\ TCI_t - \underset{(-0.05)}{0.02}\ TCI_{t+1} + \underset{(2.31)}{0.66}\ TCI_{t+2}$$

adj. $R^2 = 0.11$; n = 354;
p-value for joint significance of the coefficients of preceding lags of TCI = 0.72
p-value for joint significance of the coefficients of following lags of TCI = 0.02

[5] For further details please refer to See Hamilton (1994).

$$(iii)' \; GY_t = \; \ldots + \underset{(2.76)}{0.15\, GY_{t-1}} - \underset{(-1.73)}{0.09\, GY_{t-2}} - \underset{(-0.01)}{0.003\, TCI_{t-1}} - \underset{(-0.40)}{0.13\, TCI_{t-2}}$$

$$- \underset{(-0.23)}{0.08\, TCI_t} + \underset{(0.43)}{0.16\, TCI_{t+1}} + \underset{(2.06)}{0.63\, TCI_{t+2}}$$

adj. $R^2 = 0.14$; $n = 354$;
p-value for joint significance of the coefficients of preceding lags of TCI = 0.90
p-value for joint significance of the coefficients of following lags of TCI = 0.05

As before, the results suggest that the widely reported correlation between the investment in the T&C sector and growth more likely flows from the fact that T&C investments follow growth and not vice-versa.

The previous results suggest that, even though past history of public investments in T&C sector explains its current level well, past growth performances improve the prediction. However, high coefficient values of the lags of TCI do raise suspicion regarding the presence of unit roots in the T&C investment data. In Table 3, we present results of the Augmented Dickey-Fuller (ADF) test for levels and first differences for 20 countries (for which sufficient data points are available to carry out such test). Since the number of observations varies across the countries, we have chosen to report the corresponding critical value of the test statistic for each country.

Table 3: Augmented Dicky-Fuller Test for TCI

	Levels		First Difference	
Country	Test statistic	Critical value at 5% level	Test statistic	Critical value at 5% level
Bahamas	-1.38 (3)	-3.07	-4.64 ** (2)	-3.07
Bangladesh	-2.36 (2)	-3.93	-3.39 * (1)	-3.18
Congo	-3.13 * (3)	-3.12	-	-
Ethiopia	-2.02 (1)	-3.69	-4.37 * (2)	-3.93
Ghana	-0.77 (2)	-3.87	-3.97 * (2)	-3.93
Guatemala	-2.62 (2)	-3.05	-3.34 * (0)	-3.04
Indonesia	-3.76 * (4)	-3.08	-	-
Jamaica	-1.50 (1)	-3.05	-2.89 (0)	-3.05
Kenya	-3.89 * (0)	-3.67	-	-
Malawi	-2.17 (3)	-3.15	-6.01 ** (0)	-3.11
Malaysia	-2.03 (1)	-3.07	-3.59 * (1)	-3.08
Morocco	-1.82 (3)	-3.76	-4.79 ** (1)	-3.73
Nepal	-3.37 * (3)	-3.07	-	-
Pakistan	-3.79 * (3)	-3.79	-	-
Sierra Leone	-3.54 (4)	-3.76	-3.45 * (4)	-3.11
SriLanka	-8.87 ** (4)	-3.76	-	-
Sudan	-3.01 (3)	-3.87	-3.78 (0)	-3.79
Syria	-5.59 ** (4)	-3.83	-	-
Tanzania	-3.70 (4)	-3.76	-3.27 * (4)	-3.11
Thailand	-3.13 * (2)	-3.07	-	-

Note: Lags in parentheses are determined using the Akaike Information Criterion (AIC). We have not conducted ADF test for the first difference of TCI if we find its level having no unit root.

* significant at 5% level; ** significant at 1% level.

Table 3 indicates that the data for more than half of the countries contain a unit root. We take the first difference of T&C investment data (*DTCI*) in order to make the data stationary[6], and repeat the same exercise as in $(i)-(iii)$ and in $(i)'-(iii)'$. The corresponding regression results for without and for with country dummies are listed in $(iv)-(vi)$ and in $(iv)'-(vi)'$, respectively (t-values are in parentheses).

$$\text{(iv)}\quad \underset{(3.43)}{GY_t = 0.01} + \underset{(5.40)}{0.26\, GY_{t-1}} + \underset{(1.27)}{0.06\, GY_{t-2}} + \underset{(0.37)}{0.11\, DTCI_{t-1}} - \underset{(-0.29)}{0.09\, DTCI_{t-2}}$$

adj. $R^2 = 0.08$, n = 415,
p-value for joint significance of the coefficients of lags of TCI = 0.86

$$\text{(v)}\quad DTCI_t = \underset{(0.16)}{0.00} - \underset{(-2.89)}{0.16\, DTCI_{t-1}} - \underset{(-3.01)}{0.17\, DTCI_{t-2}} + \underset{(0.39)}{0.004\, GY_{t-1}} + \underset{(1.89)}{0.02\, GY_{t-2}}$$

adj. $R^2 = 0.032$, n = 393,
p-value for joint significance of the coefficients of lags of TCI = 0.10

$$\text{(vi)}\quad GY_t = \underset{(3.27)}{0.01} + \underset{(4.31)}{0.24\, GY_{t-1}} + \underset{(0.38)}{0.04\, GY_{t-2}} + \underset{(1.08)}{0.40\, DTCI_{t-1}} + \underset{(0.37)}{0.15\, DTCI_{t-2}}$$
$$+ \underset{(1.93)}{0.72\, DTCI_t} + \underset{(1.92)}{0.66\, DTCI_{t+1}} + \underset{(1.95)}{0.60\, DTCI_{t+2}}$$

adj. $R^2 = 0.08$; n = 321;
p-value for joint significance of the coefficients of preceding lags of DTCI = 0.55
p-value for joint significance of the coefficients of following lags of DTCI = 0.05

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[6] Our dependent variable, the growth rate of GDP per capita (*GY*), is generally accepted to be an I(0) variable. Accordingly, the need for any cointegration analysis does not arise when we use the first difference of the right hand side variable (*TCI*).

$$(iv)' \quad GY_t = \ldots \quad + \underset{(2.92)}{0.15}\, GY_{t-1} - \underset{(-1.17)}{0.06}\, GY_{t-2} + \underset{(0.65)}{0.18}\, DTCI_{t-1} + \underset{(0.25)}{0.07}\, DTCI_{t-2}$$

adj. $R^2 = 0.12$, n = 415,
p-value for joint significance of the coefficients of lags of TCI = 0.81

$$(v)' \quad DTCI_t = \ldots \; - \underset{(-4.82)}{0.27}\, DTCI_{t-1} - \underset{(-3.54)}{0.21}\, DTCI_{t-2} + \underset{(1.07)}{0.01}\, GY_{t-1} + \underset{(1.47)}{0.015}\, GY_{t-2}$$

adj. $R^2 = 0.03$; n = 393,
p-value for joint significance of the coefficients of lags of GY = 0.14

$$(vi)' \quad GY_t = \; \ldots \; + \underset{(2.04)}{0.12}\, GY_{t-1} - \underset{(-1.13)}{0.06}\, GY_{t-2} + \underset{(0.62)}{0.23}\, DTCI_{t-1} + \underset{(0.18)}{0.07}\, DTCI_{t-2}$$

$$+ \underset{(1.43)}{0.53}\, DTCI_t + \underset{(1.88)}{0.62}\, DTCI_{t+1} + \underset{(1.84)}{0.55}\, DTCI_{t+2}$$

adj. $R^2 = 0.13$; n = 321;
p-value for joint significance of the coefficients of preceding lags of DTCI = 0.82
p-value for joint significance of the coefficients of following lags of DTCI = 0.07

Although the inclusion of the country dummy variables makes the Granger-causality results relatively less robust, the Sims causality result holds and, in overall, results are supportive of the hypothesis that the direction of causality is from growth to public investments in the T&C sector and not vice versa. To obtain further insight, we extend our analysis to explore the causal relationship between growth and transport and communication investment per- capita (TCIPC). Operationally we run regressions $(i)' - (vi)'$ after substituting TCI by TCIPC. To economize on space, we abstain from reporting the whole regression results and report the p-values of the regressions in Table 4 below.

Table 4: Causality between Growth rates in Real GDP per capita on T&C investment per capita (TCIPC)

	Causality Test	p-value for joint significance of preceding lags of TCIPC on GY	p-value for joint significance of preceding lags of GY on TCIPC	p-value for joint significance of following lags of TCIPC on GY
Causation →		**TCIPC→GY**	**GY→TCIPC**	**GY→TCIPC**
Without country dummies				
Regression *(i)*	Granger	0.43	--	--
Regression *(ii)*	Granger	--	0.02	--
Regression *(iii)*	Sims-Geweke	0.50	--	0.00
Regression *(iv)*	Granger	0.73	--	--
Regression *(v)*	Granger	--	0.04	--
Regression *(vi)*	Sims-Geweke	0.24	--	0.00
With country dummies				
Regression *(i)′*	Granger	0.25	--	--
Regression *(ii)′*	Granger	--	0.03	--
Regression *(iii)′*	Sims-Geweke	0.64	--	0.00
Regression *(iv)′*	Granger	0.76	--	--
Regression *(v)′*	Granger	--	0.00	--
Regression *(vi)′*	Sims-Geweke	0.47	--	0.00

4. Concluding Remarks

The objective of this study has been to evaluate the direction of causality between the public investment in the transport and communication sector and economic growth for a set of developing countries. Our analysis suggests that the widely reported association between the two variables are more due to growth causing investment in the transport and communication sector and not vice-versa. While such conclusion has been on the basis of well-established procedures, there exists room for improvements in our analysis. The studies by Frankel (1962), Griliches (1979), Romer (1986) and Lucas(1988) have established a strong viewpoint that in evaluating the impact of investment on growth, one should pay attention to externality effects arising from both "learning by doing" and "technology spill-over" effects. This is particularly true in the case of transport and communication investments due to its non-rival characteristics, and we acknowledge the necessity for including a variable in the regression that captures the volume of non-rival ideas in the transport and communication sector. Aggregate capital stock in the transport and communication sector would be a natural choice for such variable. However, lack of data has prevented us to include this variable in the analysis. Finally, data used in this paper are hand-collected for the period 1970-89 to obtain an overlap of the period of analysis with other existing studies (e.g. Aschauer 1989; Easterly and Rebelo 1993), which report strong association between the two variables. We, however, acknowledge the need to extend the analysis with a more current data set – a task that remains as a part of our future research agenda.

References:

Aschauer, D. A. (1989): "Is Government Spending Productive?", *Journal of Monetary Economics*, 23: 177-200.

Attanasio, O. P., Picci, L. and Scorcu, A. E. (2000): "Saving, Growth, and Investment: A Macroeconomic Analysis Using a Panel of Countries", *The Review of Economics and Statistics*, Vol. 82, Number 2: 182 – 211.

Barro, R. J. (1990): "Government Spending in a Simple Model of Endogenous Growth", *Journal of Political Economy*, 98, 5, Part II (October): S103-S125.

Barro, R. J. (1991): "Economic Growth in Cross-section of Countries", Quarterly Journal of Economics, 106, 2 (May): 407-443.

Blomstrom, M., Lipsey, R. E., and Zejan, M. (1996): "Is Fixed Investment Key to Economic Growth", *Quarterly Journal of Economics,* Vol. 111, Issue 1 (February): 269 – 276.

Easterly, W. and Rebelo, S. (1993): "Fiscal Policy and Economic Growth: An Empirical Investigation", *Journal of Monetary Economics*, 32 (December): 417-458.

Frankel, M. (1962), "The production Function in Allocation and Growth: A synthesis." American Economic Review, 52, December, 995-1022.

Geweke, J., Meese, R., and Dent, W. (1983): "Comparing Alternative Tests of Causality in Temporal Systems", *Journal of Econometrics*, 21, p. 161 – 194.

Granger, C.W.J. (1969): "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods", *Econometrica*, 37 (July): 424-38.

Griliches , Z. (1979), "Issues in Assessing the Contribution of Research and Development to Productivity Growth.", Bell Journal of Economics, 10(1), 92-116.

Hamilton, J. D. (1994), "Time Series Analysis" Princeton University Press.

Lucas, R.E. (1988). "On the Mechanics of Economic Development." Journal of Monetary Economics, 22, July, 3-42.

Romer, P.M. (1986) "Increasing Returns and Long-Run Growth". Journal of Political Economy, 94, October, 1002-1037.

Sims, C, A. (1972) "Money, Income and Causality", *American Economic Review*, 62, 4 (September): 540-52.

Data Appendix

Table A1: Growth rate in GDP per capita

	Obs	Mean	Std. Dev.	Min	Max	1970	1989
BAHAMAS	19	.0112105	.0998736	-.189	.237	--	-.018
BANGLADESH	20	.00635	.0508209	-.139	.106	.034	.003
BHUTAN	20	.01585	.0505967	-.023	.171	-.013	.004
BOTSWANA	20	.0934	.0765557	-.05	.283	.006	.095
BURUNDI	20	.0437	.1130543	-.077	.439	.206	-.013
CHINA	17	.0624706	.0484692	-.069	.131	--	.027
CONGO	20	.0364	.082866	-.136	.231	.036	-.006
ETHIOPIA	20	-.0005	.0357189	-.095	.063	.039	-.019
GHANA	20	-.0093	.059405	-.156	.084	.066	.017
GUATEMALA	20	.0059	.0337544	-.063	.050	.029	.010
INDONESIA	20	.0434	.0211222	-.022	.070	.050	.056
JAMAICA	20	-.0025	.0518312	-.082	.105	.105	.060
KENYA	20	.0204	.0594894	-.082	.190	-.082	.013
MALAWI	20	.00805	.0446654	-.083	.135	-.025	-.029
MADAGASCAR	20	-.01745	.0401451	-.125	.072	.030	.009
MALAYSIA	20	.0433	.03421	-.037	.095	.035	.068
MOROCCO	20	.0224	.0383741	-.054	.084	.025	-.003
MAURTIOUS	20	.02975	.0521333	-.128	.109	-.030	.020
MOZAMBIQUE	20	-.0545	.0693424	-.188	.031	-.023	.015
NEPAL	20	.00375	.0340354	-.062	.066	-.002	.014
NIGERIA	20	.00615	.0727478	-.122	.161	.161	.036
PAKISTAN	20	.02675	.0281852	-.029	.079	.079	.018
RWANDA	20	.0147	.0535322	-.055	.166	.031	-.036
SRLANKA	20	.01535	.0252467	-.052	.066	.001	-.006
SIERRA LEONE	20	.00545	.0461958	-.071	.098	.098	.014
SUDAN	20	-.00225	.0804356	-.135	.152	.013	.041
SYRIA	20	.02805	.0966325	-.136	.205	-.053	-.136
THAILAND	20	.05005	.0305122	.023	.116	.080	.104
TANZANIA	20	.01195	.0282013	-.032	.066	.039	.066
TUNISIA	20	.02335	.0444963	-.047	.148	.017	-.015
ZAIRE	20	-.01905	.0385602	-.087	.058	.006	-.050
ZAMBIA	20	.0147	.0390844	-.047	.103	.027	-.009

Table A2: Public Investment in Transport and Communication as a proportion of GDP

	Obs	Mean	Std. Dev.	Min	Max	1970	1989
BAHAMAS	20	.0039500	.0027237	.001	.010	.004	.002
BANGLADESH	14	.0154286	.0041457	.008	.023	--	.014
BHUTAN	10	.0579000	.0386881	.020	.151	--	.151
BOTSWANA	9	.0307778	.0081052	.024	.050	--	--
BURUNDI	8	.0278750	.0132065	.018	.057	--	--
CHINA	6	.0091667	.0027142	.005	.012	--	.005
CONGO	17	.0467647	.0294714	0	.097	0	--
ETHIOPIA	20	.0163500	.0067922	.008	.038	.008	.038
GHANA	15	.0017333	.0016242	0	.005	--	.005
GUATEMALA	20	.0069500	.0030689	.003	.015	.007	.005
INDONESIA	20	.0114000	.0045468	.005	.020	.007	.010
JAMAICA	17	.0132941	.0080759	.003	.028	.008	--
KENYA	20	.0008500	.0003663	0	.001	.001	.001
MALAWI	16	.0368750	.0182204	.016	.072	.028	--
MADAGASCAR	14	.0165714	.0084098	.006	.034	.017	.029
MALAYSIA	18	.0222222	.0074720	.010	.038	.010	--
MOROCCO	19	.0251053	.0097576	.012	.043		.016
MAURTIOUS	14	.0065000	.0041091	.001	.015	.001	--
MOZAMBIQUE	7	.0060000	.0034641	.002	.013	--	--
NEPAL	20	.0239500	.0033003	.016	.029	.026	.029
NIGERIA	18	.0213889	.0166985	.001	.054	.001	.005
PAKISTAN	18	.0140556	.0040941	.008	.021	.008	--
RWANDA	17	.0094118	.0112364	.001	.032	.001	--
SRLANKA	20	.0203500	.0092297	.005	.042	.007	.026
SIERRA LEONE	20	.0086000	.0065083	0	.024	.020	.001
SUDAN	16	.0085625	.0060879	.001	.021	.004	--
SYRIA	18	.0367222	.0072664	.026	.051	.032	--
THAILAND	19	.0120526	.0030817	.008	.018	.017	--
TANZANIA	20	.0119000	.0075177	.004	.030	.019	.006
TUNISIA	12	.0107500	.0022613	.007	.014	.010	--
ZAIRE	11	.0020000	.0033466	0	.012	.001	--
ZAMBIA	18	.0282778	.0231715	.001	.082	.046	.013